A HISTORY OF INVENTIONS, DISCOVERIES, AND ORIGINS

Volume II

JOHN BECKMANN

1846

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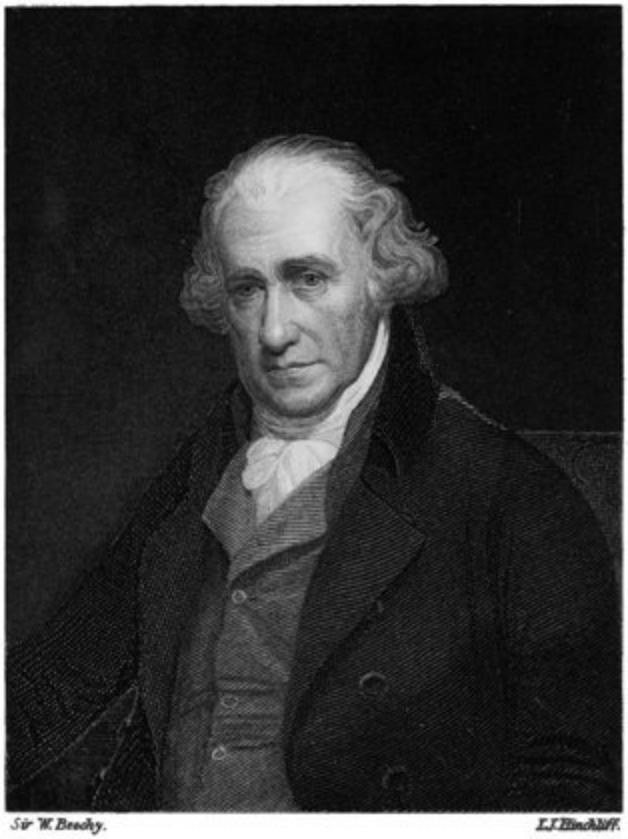

James Watt.

Sir W. Beechy. *I. J. Hinchliff.*

James Watt.

A

HISTORY

OF

INVENTIONS, DISCOVERIES,

AND ORIGINS.

By JOHN BECKMANN,

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TRANSLATED FROM THE GERMAN,

By WILLIAM JOHNSTON.

Fourth Edition,

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THE STEAM-ENGINE,

AND THE DISCOVERIES OF JAMES WATT.

Although the plan of this new edition of Beckmann's 'History of Inventions and Discoveries' was to confine it to the subjects treated of in the original work, yet we feel it imperative to make an exception in favour of the *Steam-Engine*, the most important of all modern inventions.

The power of steam was not entirely unknown to the ancients, but before the æra rendered memorable by the discoveries of JAMES WATT, the steam-engine, which has since become the object of such universal interest, was a machine of extremely limited power, inferior in importance and usefulness to most other mechanical agents used as prime movers. Hero of Alexandria, who lived about 120 years before the birth of Christ, has left us the description of a machine, in which a continued rotatory motion was imparted to an axis by a blast of steam issuing from lateral orifices in arms placed at right angles to it. About the beginning of the seventeenth century, a French engineer, De Caus, invented a machine by which a column of water might be raised by the pressure of steam confined in the vessel, above the water to be elevated; and in 1629, Branca, an Italian philosopher, contrived a plan of working several mills by a blast of steam against the vanes; from the descriptions, however, which have been left us of these contrivances, it does not appear that their projectors were acquainted with those physical properties of elasticity and condensation on which the power of steam as a mechanical agent depends.

In 1663, the celebrated Marquis of Worcester described in his Century of Inventions, an apparatus for raising water by the expansive force of steam only. From this work we extract the following short account of the first steam-engine. "68. An admirable and most forcible way to drive up water by fire; not by drawing or sucking it upwards, for that must be as the philosopher calleth it, *intra sphæram activitatis*, which is but at such a

distance. But this way hath no bounder, if the vessel be strong enough: for I have taken a piece of whole cannon, whereof the end was burst, and filled it three-quarters full of water, stopping and screwing up the broken end as also the touch-hole; and making a constant fire under it, within twenty-four hours it burst and made a great crack; so that having a way to make my vessels so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant stream, forty feet high: one vessel of water rarefied by fire, driveth up forty of cold water; and a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and refill with cold water, and so successively; the fire being tended and kept constant, which the self-same person may likewise abundantly perform in the interim, between the necessity of turning the said cocks."

The next name to be mentioned in connection with the progressive history of the invention of the steam-engine, is that of Denis Papin, a native of France, who, being banished from his country, was established Professor of Mathematics at the University of Marburg, by the Landgrave of Hesse. He first conceived the important idea of obtaining a moving power by means of a piston working in a cylinder (1688), and subsequently (1690) that of producing a vacuum in the cylinder by the sudden condensation of steam by cold. In accordance with these ideas he constructed a model consisting of a small cylinder, in which was inserted a solid piston, and beneath this a small quantity of water; on applying heat to the bottom of the cylinder, steam was generated, the elastic force of which raised the piston; the cylinder was then cooled by removing the fire, when the steam condensed and became again converted into water, thus creating a vacuum in the cylinder, into which the piston was forced by the pressure of the atmosphere; there is, however, no evidence of his having carried that or any other machine into practical use, before machines worked by steam had been constructed elsewhere.

The first actual working steam-engine of which there is any record, was invented by Captain Savery an Englishman, to whom a patent was granted in 1698 for a steam-engine to be applied to the raising of water, &c. This gentleman produced a working-model before the Royal Society, as appears from the following extract from their Transactions:—"June 14th, 1699. Mr. Savery entertained the Royal Society with showing a small model of his

engine for raising water by help of fire, which he set to work before them: the experiment succeeded according to expectation, and to their satisfaction." This engine, which was used for some time to a considerable extent for raising water from mines, consisted of a strong iron vessel shaped like an egg, with a tube or pipe at the bottom, which descended to the place from which the water was to be drawn, and another at the top, which ascended to the place to which it was to be elevated. This oval vessel was filled with steam supplied from a boiler, by which the atmospheric air was first blown out of it. When the air was thus expelled, and nothing but pure steam left in the vessel, the communication with the boiler was cut off, and cold water poured on the external surface. The steam within was thus condensed and a vacuum produced, and the water drawn up from below in the usual way by suction. The oval steam-vessel was thus filled with water; a cock placed at the bottom of the lower pipe was then closed, and steam was introduced from the boiler into the oval vessel above the surface of the water. This steam being of high pressure, forced the water up the ascending tube, from the top of which it was discharged; and the oval vessel being thus refilled with steam, the vacuum was again produced by condensation, and the same process was repeated by using two oval steam-vessels, which would act alternately; one drawing water from below, while the other was forcing it upwards, by which an uninterrupted discharge of water was produced. Owing to the danger of explosion, from the high pressure of the steam which was used, and from the enormous waste of heat by unnecessary condensation, these engines soon fell into disuse.

Several ingenious men now turned their attention to the improvement of the steam-engine, with a view to reduce the consumption of fuel, which was found to be so immense as to preclude its use except under very favourable circumstances; and in 1705, Thomas Newcomen, a blacksmith or ironmonger, and John Cawley, a plumber and glazier, patented their atmospheric engine, in which at first condensation was effected by the affusion of cold water upon the external surface of the cylinder, which was introduced into a hollow casing by which it was surrounded. Having accidentally observed that an engine worked several strokes with unusual rapidity without the supply of condensing water, Newcomen found, on examining the piston, a hole in it through which the water poured on to keep it air-tight issued in the form of a little jet, and instantly condensed the steam under it; this led him to abandon the casing and to introduce a pipe

furnished with a cock, into the bottom of the cylinder, by which water was supplied from a reservoir. Newcomen's engine required the constant attendance of some person to open and shut the regulating and condensing valves, a duty which was usually entrusted to boys, called *cock-boys*. It is said that one of these boys, named Humphrey Potter, wishing to join his comrades at play, without exposing himself to the consequences of suspending the performance of the engine, contrived by attaching strings of proper length to the levers which governed the two cocks, to connect them with the beam, so that it should open and close the cocks as it moved up and down, with the most perfect regularity. By this simple contrivance the steam-engine for the first time became an automaton.

It was in repairing a working model of a steam-engine on Newcomen's principle for the lectures of the professor of natural philosophy at the University of Glasgow, that James Watt directed his mind to the prosecution of those inventions and beautiful contrivances, by which he gave to senseless matter an almost instinctive power of self-adjustment, with precision of action more than belongs to any animated being, and which have rendered his name celebrated over the world.

At the time of which we speak, Newcomen's engine was of the last and most approved construction. The moving power was the weight of the air pressing on the upper surface of a piston working in a cylinder; steam being employed at the termination of each downward stroke to raise the piston with its load of air up again, and then to form a vacuum by its condensation when cooled by a jet of cold water, which was thrown into the cylinder when the admission of steam was stopped. Upon repairing the model, Watt was struck by the incapability of the boiler to produce a sufficient supply of steam, though it was larger in proportion to the cylinder than was usual in working engines. This arose from the nature of the cylinder, which being made of brass, a better conductor of heat than cast-iron, and presenting, in consequence of its small size, a much larger surface in proportion to its solid content than the cylinders of working engines, necessarily cooled faster between the strokes, and therefore at every fresh admission consumed a greater proportionate quantity of steam. But being made aware of a much greater consumption of steam than he had imagined, he was not satisfied without a thorough inquiry into the cause. With this view he made experiments upon the merits of boilers of different constructions; on the

effect of substituting a less perfect conductor, as wood, for the material of the cylinder; on the quantity of coal required to evaporate a given quantity of water; on the degree of expansion of water in the form of steam: and he constructed a boiler which showed the quantity of water evaporated in a given time, and thus enabled him to calculate the quantity of steam consumed at each stroke of the engine. This proved to be several times the content of the cylinder. He soon discovered that, whatever the size and construction of the cylinder, an admission of hot steam into it must necessarily be attended with very great waste, if in condensing the steam previously admitted, that vessel had been cooled down sufficiently to produce a vacuum at all approaching to a perfect one. If, on the other hand, to prevent this waste, he cooled it less thoroughly, a considerable quantity of steam remained uncondensed within, and by its resistance weakened the power of the descending stroke. These considerations pointed out a vital defect in Newcomen's engine; involving either a loss of steam, and consequent waste of fuel; or a loss of power from the piston's descending at every stroke through a very imperfect vacuum.

It soon occurred to Watt, that if the condensation were performed in a separate vessel, one great evil, the cooling of the cylinder, and the consequent waste of steam, would be avoided. The idea once started, he soon verified it by experiment. By means of an arrangement of cocks, a communication was opened between the cylinder, and a distinct vessel exhausted of its air, at the moment when the former was filled with steam. The vapour of course rushed to fill up the vacuum, and was there condensed by the application of external cold, or by a jet of water; so that fresh steam being continually drawn off from the cylinder to supply the vacuum continually created, the density of that which remained might be reduced within any assignable limits. This was the great and fundamental improvement.

Still, however, there was a radical defect in the atmospheric engine, inasmuch as the air being admitted into the cylinder at every stroke, a great deal of heat was abstracted, and a proportionate quantity of steam wasted. To remedy this, Watt excluded the air from the cylinder altogether; and recurred to the original plan of making steam the moving power of the engine, not a mere agent to produce a vacuum. In removing the difficulties of construction which beset this new plan, he displayed great ingenuity and

powers of resource. On the old plan, if the cylinder was not bored quite true, or the piston not accurately fitted, a little water poured upon the top rendered it perfectly air-tight, and the leakage into the cylinder was of little consequence, so long as the injection water was thrown into that vessel. But on the new plan, no water could possibly be admitted within the cylinder; and it was necessary, not merely that the piston should be air-tight, but that it should work through an air-tight collar, that no portion of the steam admitted above it might escape. This he accomplished by packing the piston and the stuffing-box, as it is called, through which the piston-rod works, with hemp. A further improvement consisted in equalising the motion of the engine by admitting the steam alternately above and below the piston, by which the power is doubled in the same space, and with the same strength of material. The vacuum of the condenser was perfected by adding a powerful pump, which at once drew off the condensed and injected water, and with it any portion of air which might find admission; as this would interfere with the action of the engine if allowed to accumulate. His last great change was to cut off the communication between the cylinder and the boiler, when a portion only, as one-third or one-half, of the stroke was performed; leaving it to the expansive power of the steam to complete it. By this, œconomy of steam was obtained, together with the power of varying the effort of the engine according to the work which it has to do, by admitting the steam through a greater or smaller portion of the stroke.

These are the chief improvements which Watt effected at different periods of his life. He was born June 19, 1736, at Greenock, where he received the rudiments of his education. Having at an early age manifested a partiality for the practical part of mechanics, he went in his eighteenth year to London to obtain instruction in the profession of a mathematical instrument-maker, but remained there little more than a year, being compelled to return home on account of his health. In 1757, shortly after his return home, he was appointed instrument-maker to the University of Glasgow, and accommodated with premises within the precincts of that learned body. In 1763 he removed into the town of Glasgow, intending to practise as a civil engineer. His first patent is dated June 5, 1769, which parliament extended in 1775 for twenty-five years in consideration of the national importance of the inventions, and the difficulty and expense of introducing them to public notice. He died at his house at Heathfield in the county of Stafford, on the 25th of August, 1819, at the advanced age of

eighty-four, after having realized an ample fortune, the well-earned reward of his industry and ability.

To enter into the history of the various applications of the steam-engine to the different branches of industry would carry us beyond the bounds of this work. “To enumerate its present effects,” says a well-known writer on the steam-engine[1], “would be to count almost every comfort and every luxury of life. It has increased the sum of human happiness, not only by calling new pleasures into existence, but by so cheapening former enjoyments as to render them attainable by those who before could never have hoped to share them: the surface of the land, and the face of the waters are traversed with equal facility by its power; and by thus stimulating and facilitating the intercourse of nation with nation, and the commerce of people with people, it has knit together remote countries by bonds of amity not likely to be broken. Streams of knowledge and information are kept flowing between distant centres of population, those more advanced diffusing civilization and improvement among those that are more backward. The press itself, to which mankind owes in so large a degree the rapidity of their improvement in modern times, has had its power and influence increased in a manifold ratio by its union with the steam-engine. It is thus that literature is cheapened, and by being cheapened, diffused; it is thus that reason has taken the place of force, and the pen has superseded the sword; it is thus that war has almost ceased upon the earth, and that the differences which inevitably arise between people and people are for the most part adjusted by peaceful negotiation.”

FOOTNOTES

[1] Dr. Lardner.

HISTORY OF INVENTIONS

AND

DISCOVERIES.

LENDING AND PAWNBROKING.

It appears singular to us at present that it should have been once considered unlawful to receive interest for lent money; but this circumstance will excite no wonder when the reason of it is fully explained. The different occupations by which one can maintain a family without robbery and without war, were at early periods neither so numerous nor so productive as in modern times; those who borrowed money required it only for immediate use, to relieve their necessities or to procure the conveniences of life; and those who advanced it to such indigent persons did so either through benevolence or friendship. The case now is widely different. With the assistance of borrowed money people enter into business, and carry on trades, from which by their abilities, diligence, or good fortune, so much profit arises that they soon acquire more than is requisite for their daily support; and under these circumstances the lender may undoubtedly receive for the beneficial use of his money a certain remuneration, especially as he himself might have employed it to advantage; and as by lending it he runs the risk of losing either the whole or a part of his capital, or at least of not receiving it again so soon as he may have occasion for it.

Lending on interest, therefore, must have become more usual in proportion as trade, manufactures, and the arts were extended; or as the art of acquiring money by money became more common: but it long continued to be detested, because the ancient abhorrence against it was by an improper construction of the Mosaic law converted into a religious prejudice[2], which, like many other prejudices more pernicious, was strengthened and confirmed by severe papal laws. The people, however, who often devise means to render the faults of their legislators less hurtful, concealed this practice by various inventions, so that neither the borrower nor lender could be punished, nor the giving and receiving of interest be prevented. As it was of more benefit than prejudice to trade, the impolicy of the prohibition

became always more apparent; it was known that the new-invented usurious arts under which it was privately followed would occasion greater evils than those which had been apprehended from lending on interest publicly; it was perceived also that the Jews, who were not affected by papal maledictions, foreigners, and a few natives who had neither religion nor conscience, and whom the church wished least of all to favour, were those principally enriched by it.

In no place was this inconvenience more felt than at the Romish court, even at a time when it boasted of divine infallibility; and nowhere was more care employed to remove it. A plan, therefore, was at length devised, by which the evil, as was supposed, would be banished. A capital was collected from which money was to be lent to the poor for a certain period on pledges without interest. This idea was indeed not new; for such establishments had long before been formed and supported by humane princes. The emperor Augustus, we are told, converted into a fund the surplus of the money which arose to the State from the confiscated property of criminals, and lent sums from it, without interest, to those who could pledge effects equal to double the amount[3]. Tiberius also advanced a large capital, from which those were supplied with money for three years, who could give security on lands equivalent to twice the value[4]. Alexander Severus reduced the interest of money by lending it at a low rate, and advancing sums to the poor without interest to purchase lands, and agreeing to receive payment from the produce of them[5].

These examples of the ancients were followed in modern Italy. In order to collect money, the popes conferred upon those who would contribute towards that object a great many fictitious advantages, which at any rate cost them nothing. By bulls and holy water they dispensed indulgences and eternal salvation; they permitted burthensome vows to be converted into donations to lending-houses; and authorised the rich who advanced them considerable sums to legitimate such of their children as were not born in wedlock. As an establishment of this kind required a great many servants, they endeavoured to procure these also on the same conditions; and they offered, besides the above-mentioned benefits, a great many others not worth notice, to those who would engage to discharge gratis the business of their new undertaking; but in cases of necessity they were to receive a

moderate salary from the funds. This money was lent without interest for a certain time to the poor only, provided they could deposit proper pledges of sufficient value.

It was, however, soon observed that an establishment of this kind could neither be of extensive use nor of long duration. In order to prevent the secret lending of money, by the usurious arts which had begun to be practised, it was necessary that it should advance sums not only to those who were poor in the strictest sense of the word, but to those also who, to secure themselves from poverty, wished to undertake and carry on useful employments, and who for that purpose had need of capitals. However powerful the attractions might be, which, on account of the religious folly that then prevailed, induced people to make large contributions, they gradually lost their force, and the latter were lessened in proportion, especially as a spirit of reformation began soon after to break out in Germany, and to spread more and more into other countries. Even if a lending-house should not be exhausted by the maintenance of its servants, and various accidents that could not be guarded against, it was still necessary, at any rate, to borrow as much money at interest as might be sufficient to support the establishment. As it was impossible that it could relieve all the poor, the only method to be pursued was to prevent their increase, by encouraging trade, and by supplying those with money who wanted only a little to enable them to gain more, and who were in a condition and willing to pay a moderate interest. The pontiffs, therefore, at length resolved to allow the lending-houses to receive interest, not for the whole capitals which they lent, but only for a part, merely that they might raise as much money as might be sufficient to defray their expenses; and they now, for the first time, adopted the long-established maxim, that those who enjoy the benefits should assist to bear the burthen—a maxim which very clearly proves the legality of interest. When this opening was once made, one step more only was necessary to place the lending-houses on that judicious footing on which they would in all probability have been put by the inventor himself, had he not been under the influence of prejudice. In order that they might have sufficient stock in hand, it was thought proper to give to those who should advance them money a moderate interest, which they prudently concealed by blending it with the unavoidable expenses of the establishment, to which it indeed belonged, and which their debtors, by the practice a little before introduced, were obliged to make good. The

lending-houses, therefore, gave and received interest. But that the odious name might be avoided, whatever interest was received, was said to be *pro indemnitate*; and this is the expression made use of in the papal bull.

All this, it must be confessed, was devised with much ingenuity: but persons of acuteness still discovered the concealed interest; and a violent contest soon arose respecting the legality of lending-houses, in which the greatest divines and jurists of the age took a part; and by which the old question, whether one might do anything wicked, or establish interest, in order to effect good, was again revived and examined. Fortunately for the pontifical court, the folly of mankind was still so great that a bull was sufficient to suppress, or at least to silence, the spirit of inquiry. The pope declared the holy mountains of piety, "sacri monti de pietà," to be legal; and threatened those with his vengeance who dared to entertain any further doubts on the subject. All the cities now hastened to establish lending-houses; and their example was at length followed in other countries. Such, in a general view, is the history of these establishments: I shall now confirm it by the necessary proofs.

When under the appellation of *lending-house* we understand a public establishment where any person can borrow money upon pledges, either for or without interest, we must not compare it to the *tabernæ argentariæ* or *mensæ nummulariæ* of the Romans. These were banking-houses, at which the state and rich people caused their revenues to be paid, and on which they gave their creditors orders either to receive their debts in money, or to have the sums transferred in their own name, and to receive security for them. To assign over money and to pay money by a bill were called *perscribere* and *rescribere*; and an assignment or draft was called *attributio*. These *argentarii*, *mensarii*, *nummularii*, *collybistæ* and *trapezitæ* followed the same employment, therefore, as our cashiers or bankers. The former, like the latter, dealt in exchanges and discount; and in the same manner also they lent from their capital on interest, and gave interest themselves, in order that they might receive a greater. Those who among the ancients were enemies to the lending of money on interest brought these people into some disrepute; and the contempt entertained for them was probably increased by prejudice, though those *nummarii* who were established by government as public cashiers held so exalted a rank that some of them became consuls. Such banking-houses existed in the Italian States in the middle ages, about

the year 1377. They were called *apothecæ seu casanæ feneris*[6], and in Germany *Wechselbanke*, banks of exchange; but they were not lending-houses in the sense in which I here understand them.

Equally distinct also from lending-houses were those banks established in the fourteenth century, in many cities of Italy, such, for example, as Florence, in order to raise public loans. Those who advanced money on that account received an obligation and monthly interest, which on no pretext could be refused, even if the creditor had been guilty of any crime. These obligations were soon sold with advantage, but oftener with loss; and the price of them rose and fell like that of the English stocks, but not so rapidly; and theologists disputed whether one could with a safe conscience purchase an obligation at less than the stated value, from a proprietor who was obliged to dispose of it for ready specie. If the State was desirous or under the necessity of repaying the money, it availed itself of that regale called by Leyser *regale falsæ monetæ*, and returned the capital in money of an inferior value. This establishment was confirmed, at least at Florence, by the pontiff, who subjected those who should commit any fraud in it to ecclesiastical punishment and a fine, which was to be carried to the papal treasury: but long before that period the republic of Genoa had raised a loan by mortgaging the public revenues. I have been more particular on this subject, because Le Bret[7] calls these banks, very improperly, lending-houses; and in order to show to what a degree of perfection the princely art of contracting and paying debts was brought so early as the fourteenth century.

Those who have as yet determined the origin of lending-houses with the greatest exactness, place it, as Dorotheus Ascanius, that is Matthias Zimmermann[8], does, in the time of Pope Pius II. or Paul II., who filled the papal chair from 1464 to 1471; and the reason for supposing it to have been under the pontificate of the latter is, because Leo X. in his bull, which I shall quote hereafter, mentions that pope as the first who confirmed an establishment of this kind. As the above account did not appear to me satisfactory, and as I knew before that the oldest lending-houses in Italy were under the inspection of the Franciscans, I consulted the Annals of the Seraphic Order, with full expectation that this service would not be omitted in that work; and I indeed found in it more materials towards the history of

lending-houses than has ever been collected, as far as I know, by any other person.

As complaints against usury, which was practised by many Christians, but particularly by the Jews, became louder and more public in Italy in the fifteenth century, Barnabas Interamnensis, probably of Terni, first conceived the idea of establishing a lending-house. This man was originally a physician; had been admitted to the degree of doctor; was held in great respect on account of his learning; became a Minorite, or Franciscan; acquired in that situation every rank of honour, and died, in the first monastery of this order at Assisi (*in monte Subasio*[9]), in the year 1474. While he was employed in preaching under Pope Pius II. at Perugia, in the territories of the Church, and observed how much the poor were oppressed by the usurious dealings of the Jews, he made a proposal for raising a capital by collections, in order to lend from it on pledges to the indigent, who should give monthly, for the use of the money borrowed, as much interest as might be necessary to pay the servants employed in this establishment, and to support it. Fortunatus de Copolis, an able jurist of Perugia, who after the death of his wife became also a Franciscan, approved of this plan, and offered to assist in putting it into execution. To be assured in regard to an undertaking which seemed to approach so near to the lending on interest, both these persons laid their plan before the university of that place, and requested to know whether such an establishment could be allowed; and an answer being given in the affirmative, a considerable sum was soon collected by preaching, so that there was a sufficiency to open a lending-house. Notwithstanding this sanction, many were displeased with the design, and considered the receiving of interest, however small it might be, as a species of usury. Those who exclaimed most against it were the Dominicans (*ex ordine Prædicatorum*): and they seem to have continued to preach in opposition to it, till they were compelled by Leo X. to be silent; while the Franciscans, on the other hand, defended it, and endeavoured to make it be generally adopted. The dispute became more violent when, at the end of a year, after all expenses were paid, a considerable surplus was found remaining; and as the managers did not know how to dispose of it, they at length thought proper to divide it amongst the servants, because no fixed salaries had been appointed for them. Such was the method first pursued at Perugia; but in other places the

annual overplus was employed in a different manner. The particular year when this establishment began to be formed I have nowhere found marked; but as it was in the time of Pius II., it must have been in 1464, or before that period[10]. It is very remarkable that this pontiff confirmed the lending-house at Orvieto (*Urbs Vetus*) so early as the above year; whereas that at Perugia was sanctioned, for the first time, by Pope Paul II. in 1467. It is singular also that Leo X., in his confirmation of this establishment, mentions Paul II., Sixtus IV., Innocent VIII., Alexander VI. and Julius II.; but not Pius II. Pope Sixtus IV., as Wadding says, confirmed in 1472 the lending-house at Viterbo, which had, however, been begun so early as 1469, by Franciscus de Viterbo, a Minorite[11].

In the year 1479 Sixtus IV. confirmed the lending-house which had been established at Savona, the place of his birth, upon the same plan as that at Perugia. The bull issued for this purpose is the first pontifical confirmation ever printed[12]; for that obtained for Perugia was not, as we are told by the editor, to be found in the archives there in 1618, the time when the other was printed. I have never found the confirmation of those at Orvieto and Viterbo. Ascianus sought for them, but without success, in Bullarium Magnum Cherubini, and they are not mentioned by Sixtus. This pontiff, in his bull, laments that the great expenses to which he was subjected did not permit him to relieve his countrymen with money, but that he would grant to the lending-house so many spiritual advantages, as should induce the faithful to contribute towards its support; and that it was his desire that money should be lent from it to those who would assist gratis during a year in the business which it required. If none could be found to serve on these conditions, a moderate salary was to be given. He added a clause also respecting pledges; but passed over in silence that the debtors were to contribute anything for the support of the institution by paying interest, which Barnabas, whose name does not occur in the bull, introduced however at Perugia, and which the pope tacitly approved.

The greater part of the lending-houses in Italy were established in the fifteenth and following centuries by the Minorites Marcus Bononiensis, Michael a Carcano[13], Cherubinus Spoletanus, Jacobus de Marchia, Antonius Vercellensis, Angelus a Clavasio, and above all, Bernardinus

Tomitano, named also *Feltrensis* and *Parvulus*. This man was born at Feltri, in the country of Treviso, in the year 1439. His father was called Donato Tomitano, and his mother Corona Rambaldoni; they were both of distinguished families, though some assert that he was of low extraction, and a native of Tomi, a small place near Feltri, on which account he got the name of Tomitano. The name of *Parvulus* arose from his diminutive stature, which he sometimes made a subject of pleasantry[14]. This much at any rate is certain, that he had received a good education. In 1456, when seventeen years of age, he suffered his instructors, contrary to the inclination of his father, to carry him to Padua, to be entered in the order of the Minorites; and on this occasion he changed his christian-name Martin into Bernardinus. As he was a good speaker, he was employed by his order in travelling through Italy and preaching. He was heard with applause, and in many parts the people almost paid him divine honours. The chief object of his sermons was to banish gaming, intemperance, and extravagance of dress; but he above all attacked the Jews, and excited such a hatred against them, that the governments in many places were obliged to entreat or to compel him either to quit their territories or not to preach in opposition to these unfortunate people, whom the crowds he collected threatened to massacre; and sometimes when he visited cities where there were rich Jews and persons who were connected with them in trade, he was in danger of losing even his own life. Taking advantage of this general antipathy to the Jews, he exerted himself, after the example of Barnabas, his brother Minorite, to get lending-houses established, and died at Pavia in the year 1494. The Minorites played a number of juggling tricks with his body, pretending that it performed miracles, by which means they procured him a place in the catalogue of the saints; and to render his name still more lasting, some of his sermons have been printed among the works of the writers of the Franciscan order[15].

The lending-houses in Italy, with the origin of which I am acquainted, are as follows:—The lending-house at Perugia was inspected in 1485 by Bernardinus, who enlarged its capital.

The same year he established one at Assisi, which was confirmed by Pope Innocent, and which was visited and improved by its founder in 1487[16].

In the year 1486, after much opposition, he established a lending-house at Mantua, and procured for it also the pope's sanction[17]. Four years after, however, it had declined so much, that he was obliged to preach in order to obtain new donations to support it.

At Florence he met with still more opposition; for the rich Jews bribed the members of the government, who wished in appearance to favour the establishment of the lending-house, to which they had consented eighteen years before, while they secretly thwarted it; and some boys having once proceeded, after hearing a sermon, to attack the houses of the Jews, the Minorites were ordered to abstain from preaching and to quit the city[18]. It was however completely established; but by the Dominican Hieronymus Savonarola[19].

In the year 1488 Bernardinus established a lending-house at Parma, and procured for it the pope's sanction, as well as for one at Cesena, where the interest was defined to be "pro salariis officialium et aliis montis oneribus perferendis." About the conclusion of this year he was at the other end of Italy, where he re-established the lending-house at Aquila in the kingdom of Naples[20].

In the year following he established one at Chieti (*Theate*) in the same kingdom, another at Rieti (*Reate*) in the territories of the Church, a third at Narni (*Narnia*)[21]; and a fourth at Lucca, which was confirmed by the bishop, notwithstanding the opposition of the Jews, who did every thing in their power to prevent it.

In the year 1490 a lending-house was established at Piacenza (*Placentia*) by Bernardinus, who at the same time found one at Genoa which had been established by the before-mentioned Angelus a Clavasio[22]. At this period also a lending-house was established at Verona[23], and another at Milan by the Minorite Michael de Aquis.

In 1491 a lending-house was established at Padua, which was confirmed by Pope Alexander VI. in 1493[24]; and another was established at Ravenna[25].

In 1492 Bernardinus reformed the lending-house at Vicenza, where, in order to avoid the reproach of usury, the artifice was employed of not demanding any interest, but admonishing the borrowers that they should give a remuneration according to their piety and ability. As people were by these means induced to pay more interest than what was legally required at other lending-houses, Bernardinus caused this method to be abolished[26]. He established a lending-house also the same year in the small town of Campo S. Pietro, not far from Padua, and expelled the Jews who had lent upon pledges. At this period there were lending-houses at Bassano, a village in the county of Trevisi, and also at Feltri, which he inspected and improved[27].

In the year 1493 Bernardinus caused a lending-house to be established at Crema, in the Venetian dominions; another at Pavia, where he requested the opinion of the jurists, whom he was happy to find favourable to his design; and likewise a third at Gubbio, in the territories of the Church. At the same time another Franciscan established at Cremona a *mons frumenti pietatis*, from which corn was lent out on interest to necessitous persons; and it appears that there had been an institution of the like kind before at Parma[28].

In the year 1494, Bernardinus, a short time before his death, assisted to establish a lending-house at Montagnana, in the Venetian territories[29], and to improve that at Brescia, which was likely to decay, because the servants had not fixed salaries[30]. The same year another Franciscan established the lending-house at Modena.

In the year 1506 Pope Julius II. confirmed the lending-house at Bologna. That of Trivigi was established in 1509; and in 1512, Elizabeth of the family of Gonzaga, as widow of duke Guido Ubaldus, established the first lending-house in the duchy of Urbino at Gubbio, and procured permission for it to coin money[31].

The historical account I have here given, displays in the strongest light the great force of prejudice, and particularly of the prejudice of ecclesiastics. Notwithstanding the manifest advantages with which lending-houses were attended, and though a great part of them had been already sanctioned by the infallible court of Rome, many, but chiefly Dominicans,

exclaimed against these institutions, which they did not call *montes pietatis*, but *impietatis*. No opposition gave the Minorites so much uneasiness as that of the Dominican Thomas de Vio, who afterwards became celebrated as a cardinal under the name of Cajetanus. This monk, while he taught at Pavia in 1498, wrote a treatise De Monte Pietatis[32], in which he inveighed bitterly against taking pledges and interest, even though the latter was destined for the maintenance of the servants. The popes, he said, had confirmed lending-houses in general, but not every regulation that might be introduced into them, and had only given their express approbation of them so far as they were consistent with the laws of the church. These words, he added, had been wickedly left out in the bulls which had been printed; but he had heard them, and read them, in the confirmation of the lending-house at Mantua. I indeed find that these words are not in the copy of that bull given in Wadding, which is said to have been taken from the original; nor in the still older confirmation of the lending-house at Savona. But even were they to be found there, this would not justify Cajetan's opposition, as the pope in both these bulls recommended the plan of the lending-house at Perugia to be adopted, of which receiving interest formed a part. Bernardinus de Bustis[33], a Minorite, took up the cause in opposition to Cajetan, and, according to Wadding's account, with rather too much vehemence. Among his antagonists were Barrianus and Franc. Papafava, a jurist of Padua[34]. As this dispute was revived with a great deal of warmth in the beginning of the sixteenth century, it was at length terminated by Pope Leo X., who in the tenth sitting of the council of the Lateran declared by a particular bull that lending-houses were legal and useful; that all doubts to the contrary were sinful, and that those who wrote against them should be placed in a state of excommunication[35]. The whole assembly, except one archbishop, voted in favour of this determination; and it appears from a decree of the council of Trent, that it also acknowledged their legality, and confirmed them[36]. Notwithstanding this decision, there were still writers who sometimes condemned them; and who did not consider all the decrees, at least the above one of the Lateran council, as agreeable to justice. Among these was Dominicus de Soto, a Dominican. All opposition, however, in the course of time subsided, and in the year 1565, Charles Borromeo, the pope's legate at

the council of Milan, ordered all governments and ecclesiastics to assist in establishing lending-houses[37].

Of the lending-houses established after this period in Italy, I shall mention those only of Rome and Naples. It is very remarkable that the pope's capital should have been without an institution of this kind till the year 1539, and that it should have been formed by the exertions of Giovanni Calvo, a Franciscan. Paul III., in his bull of confirmation, ordered that Calvo's successors in rank and employment should always have the inspection of it, because the Franciscans had taken the greatest pains to endeavour to root out usury[38].

The lending-house at Naples was first established in 1539 or 1540. Two rich citizens, Aurelio Paparo, and Leonardo or Nardo di Palma, redeemed all the pledges which were at that time in the hands of the Jews, and offered to deliver them to the owners without interest, provided they would return the money which had been advanced on them. More opulent persons soon followed their example; many bequeathed large sums for this benevolent purpose; and Toledo, the viceroy, who drove the Jews from the kingdom, supported it by every method possible. This lending-house, which has indeed undergone many variations, is the largest in Europe; and it contains such an immense number of different articles, many of them exceedingly valuable, that it may be considered as a repository of the most important part of the moveables of the whole nation. About the year 1563, another establishment of the like kind was formed under the title of *banco de' poveri*. At first this bank advanced money without interest, only to relieve confined debtors; afterwards, as its capital increased, it lent upon pledges, but not above the sum of five ducats without interest. For larger sums the usual interest was demanded[39].

At what time the first lending-house was established at Venice I have not been able to learn[40]. This State seems to have long tolerated the Jews; it endeavoured to moderate the hatred conceived against these people, and gave orders to Bernardinus to forbear preaching against them[41]. It appears to me in general, that the principal commercial cities of Italy were the latest to avail themselves of this invention; because they knew that to regulate

interest by law, where trade was flourishing, would be ineffectual or useless; or because the rich Jew merchants found means to prevent it.

The name *mons pietatis*, of which no satisfactory explanation has been as yet given, came with the invention from Italy, and is equally old, if not older. Funds of money formed by the contributions of different persons, for some end specified, were long before called *montes*. In the first centuries of the Christian æra, free gifts were collected and preserved in churches by ecclesiastics, partly for the purpose of defraying the expense of divine service, and partly to relieve the poor. Such capitals, which were considered as ecclesiastical funds, were by Prudentius, in the beginning of the fifth century, called *montes annonæ* and *arca numinis*[42]. Tertullian calls them *deposita pietatis*[43]; and hence has been formed *montes pietatis*. At any rate I am of opinion that the inventor chose and adopted this name in order to give his institution a sacred or religious appearance, and to procure it more approbation and support.

I find however that those banks employed in Italy, during the thirteenth and fourteenth centuries, to borrow money in the name of States, for which the public revenues were mortgaged and interest paid, were also called *montes*[44]. In this sense the word is used by Italian historians of much later times; and those are greatly mistaken, who, with Ascian and many others, consider all these *montes* as real lending-houses. These loan-banks or *montes* received various names, sometimes from the princes who established them, sometimes from the use to which the money borrowed was applied, and sometimes from the objects which were mortgaged. Of this kind were the *mons fidei*, or loan opened by Pope Clement VII. in the year 1526, for defending his capital[45]; the *mons aluminarius*, under Pope Pius IV., for which the pontifical alum-works were pledged; the *mons religionis*, under Pius V., for carrying on the war against the Turks; and the *montes farinæ*, *carnium*, *vini*, &c., when the duties upon these articles were pledged as a security. To facilitate these loans, every condition that could induce people to advance money was thought of. Sometimes high interest was given, if the subscribers agreed that it should cease, and the capital fall to the bank after their death; and sometimes low interest was given, but the security was heritable and could be transferred at pleasure. The former were

called *montes vacabiles*, and the latter *montes non vacabiles*. Sometimes the State engaged to pay back the capital at the end of a certain period, such for example as nine years, as was the case in regard to the *mons novennalis*, under Paul IV.; or it reserved to itself the option of returning the money at such a period as it might think proper, and sometimes the capital was sunk and the interest made perpetual. The first kind were called *montes redimibiles*, and the second *irredimibiles*[46]. One can here clearly discover the origin of life-rents, annuities, tontines, and government securities; but the further illustration of this subject I shall leave to those who may wish to employ their talents on a history of national debts. I have introduced these remarks, merely to rectify a mistake which has become almost general, and which occasioned some difficulties to me in this research; and I shall only observe further, that the popes gave to their loans, in order to raise their sinking credit, many of those spiritual advantages which they conferred on the *montes pietatis*. This error therefore was more easily propagated, as both were called *montes*; and hence it has happened that Ascianus and others assert that many lending-houses were misapplied by the popes in order to raise public loans.

From the instances here adduced, one may see that the first lending-houses were sanctioned by the pontiffs, because they only could determine to the Catholics in what cases it was lawful for them to receive interest. This circumstance seems to have rendered the establishment of them out of Italy difficult. At any rate the Protestants were at first averse to imitate an institution which originated at the court of Rome, and which, according to the prevailing prejudice of the times, it alone could approve; and from the same consideration they would not adopt the reformation which had been made in the calendar.

The first mention of a lending-house in Germany, which I have as yet met with, is to be found in the permission granted by the emperor Maximilian I. to the citizens of Nuremberg, in the year 1498, to drive the Jews from the city, and to establish an exchange-bank. The permission further stated, “That they should provide for their bank proper managers, clerks, and other persons to conduct it according to their pleasure, or as necessity might require; that such of their fellow-citizens as were not able to carry on their trades, callings, and occupations without borrowing and without pledging their effects, should, on demand, according to their trade

and circumstances, receive money, for which pledges, caution and security should be taken; that at the time of payment a certain sum should be exacted by way of interest; that the clerks and conductors of the bank should receive salaries for their service from the interest; and that if any surplus remained it should be employed for the common use of the city of Nuremberg, like any other public fund."

It here appears that the lending-houses in Germany were first known under the name of exchange-banks, by which was before understood any bank where money was lent and exchanged; but it does not thence follow, as Professor Fischer thinks[47], that they were an Italian invention. The citizens of Nuremberg had not then a lending-house, nor was one established there till the year 1618. At that period they procured from Italy copies of the regulations drawn up for various houses of this kind, in order to select the best. Those of the city of Augsburg however were the grounds on which they built, and they sent thither the persons chosen to manage their lending-house, that they might make themselves fully acquainted with the nature of the establishment at that place[48]. In the year 1591, the magistrates of Augsburg had prohibited the Jews to lend money, or to take pledges; at the same time they granted 30,000 florins as a fund to establish a lending-house, and the regulations of it were published in 1607[49].

In the Netherlands, France and England, lending-houses were first known under the name of *Lombards*, the origin of which is evident. It is well known that in the thirteenth and following centuries many opulent merchants of Italy, which at those periods was almost the only part of Europe that carried on an extensive trade, were invited to these countries, where there were few mercantile people able to engage deeply in commerce. For this reason they were favoured by governments in most of the large cities; but in the course of time they became objects of universal hatred, because they exercised the most oppressive usury, by lending at interest and on pledges. They were called *Longobardi* or *Lombardi*, as whole nations are often named after a part of their country, in the same manner as all the Helvetians are called Swiss, and the Russians sometimes Moscovites. They were, however, called frequently also Caorcini, Caturcini, Caursini, Cawarsini, Cawartini, Bardi, and Amanati; names, which in all probability arose from some of their greatest houses or banks. We know, at

any rate, that about those periods the family of the Corsini were in great consideration at Florence. They had banks in the principal towns for lending money; they demanded exorbitant interest; and they received pledges at a low value, and retained them as their own property if not redeemed at the stated time. They eluded the prohibition of the church against interest when they found it necessary, by causing the interest to be previously paid as a present or a premium; and it appears that some sovereigns borrowed money from them on these conditions. In this manner did Edward III. king of England, when travelling through France in the year 1329, receive 5000 marks from the bank of the Bardi, and give then in return, by way of acknowledgement, a bond for 7000[50]. When complaints against the usurious practices of these Christian Jews became too loud to be disregarded, they were threatened with expulsion from the country, and those who had rendered themselves most obnoxious on that account, were often banished, so that those who remained were obliged to conduct themselves in their business with more prudence and moderation. It is probable that the commerce of these countries was then in too infant a state to dispense altogether with the assistance of these foreigners. In this manner were they treated by Louis IX. in 1268, and likewise by Philip the Bold; and sometimes the popes, who would not authorise interest, lent their assistance by prohibitions, as was the case in regard to Henry III. of England in 1240.

In the fourteenth century, the Lombards in the Netherlands paid to government rent for the houses in which they carried on their money transactions, and something besides for a permission. Of this we have instances at Delft in 1313, and at Dordrecht in 1342[51]. As in the course of time the original Lombards became extinct, these houses were let, with the same permission, for the like employment[52]; but governments at length fixed the rate of interest which they ought to receive, and established regulations for them, by which usurious practices were restrained. Of leases granted on such conditions, an instance occurs at Delft in the year 1655. In 1578, William prince of Orange recommended to the magistrates of Amsterdam Francis Masasia, one of the Lombards, as they were then called, in order that he might obtain for him permission to establish a lending-house[53], as many obtained permission to keep billiard-tables, and

Jews letters of protection. In the year 1611, the proprietor of such a house at Amsterdam, who during the latter part of his lease had gained by his capital at least thirty-three and a half per cent., offered a very large sum for a renewal of his permission; but in 1614, the city resolved to take the lombard or lending-house into their own hands, or to establish one of the same kind. However odious this plan might be, a dispute arose respecting the legality of it, which Marets[54] and Claude Saumaise endeavoured to support. The public lending-house or lombard at Brussels was established in 1619; that at Antwerp in 1620, and that at Ghent in 1622. All these were established by the archduke Albert, when he entered on the governorship, with the advice of the archbishop of Mechlin; and on this occasion the architect Wenceslaus Coberger was employed, and appointed inspector-general of all the lending-houses in the Spanish Netherlands[55]. Some Italians assert that the Flemings were the first people who borrowed money on interest for their lending-houses; and they tell us that this practice began in the year 1619[56]. We are assured also, that after a long deliberation at Brussels, it was at length resolved to receive money on interest at the lending-houses. It however appears certain that in Italy this was never done, or at least not till a late period, and that the capitals of the lending-houses there were amassed without giving interest.

This beneficial institution was always opposed in France; chiefly because the doctors of the Sorbonne could not divest themselves of the prejudice against interest; and some in modern times who undertook there to accommodate people with money on the like terms, were punished by government[57]. A lending-house however was established at Paris under Louis XIII., in 1626; but the managers next year were obliged to abandon it[58]. In 1695, some persons formed a capital at Marseilles for the purpose of establishing one there according to the plan of those in Italy[59]. The present *mont de piété* at Paris, which has sometimes in its possession forty casks filled with gold watches that have been pledged, was, by royal command, first established in 1777[60].

[The following is the rate of profit or interest which pawnbrokers in this country are entitled to charge per calendar month. For 2*s.* 6*d.* one

halfpenny; 5*s.* one penny; 7*s.* 6*d.* three halfpence; 10*s.* twopence; 12*s.* 6*d.* twopence halfpenny; 15*s.* threepence; 17*s.* 6*d.* threepence halfpenny; £1 fourpence; and so on progressively and in proportion for any sum not exceeding 40*s.* For every sum exceeding 40*s.* and not exceeding 42*s.* eightpence; and for every sum exceeding 42*s.* and not exceeding £10, threepence to every pound, and so on in proportion for any fractional sum. Where any intermediate sum lent on a pledge exceeds 2*s.* 6*d.* and does not exceed 40*s.*, a sum of fourpence may be charged in proportion to each £1. Goods pawned are forfeited on the expiration of a year, exclusive of the date of pawning. But it has been held that the property is not transferred, but that the pawnbroker merely has a right to sell the article; and consequently that, on a claim after this period, with tender of principal and interest, the property must be restored if unsold (Walker *v.* Smith, 5 *Barn.* and *Ald.* 439). Pledges must not be taken from persons intoxicated or under twelve years of age. In Great Britain pawnbrokers must take out a license, which costs £15 within the limits of the old twopenny-post, and £7 10*s.* in other parts. No license is required in Ireland. A second license, which costs £5 15*s.*, is required to take in pledge articles of gold and silver.

From 1833 to 1838 the number of pawnbrokers in the metropolitan district increased from 368 to 386; in the rest of England and Wales, from 1083 to 1194; and in Scotland, from 52 to 88; making a total of 1668 establishments, paying £15,419 for their licenses, besides the licenses which many of them take out as dealers in gold and silver. The business of a pawnbroker was not known in Glasgow until August 1806, when an itinerant English pawnbroker commenced business in a single room, but decamped at the end of six months; and his place was not supplied until June 1813, when the first regular office was established in the west of Scotland for receiving goods in pawn. Other individuals soon entered the business, and the practice of pawning had become so common, that in 1820, in a season of distress, 2043 heads of families pawned 7380 articles, on which they raised £739 5*s.* 6*d.* Of these heads of families 1375 had never applied for or received charity of any description; 474 received occasional aid from the relief committee, and 194 were paupers. The capital invested in this business in 1840 was about £26,000. Nine-tenths of the articles pledged are redeemed within the legal period. There are no means of ascertaining the exact number of pawnbrokers' establishments in the large towns of England. In 1831, the number of males above the age of twenty employed

in those at Manchester was 107; at Liverpool, 91; Birmingham, 54; Bristol, 33; Sheffield, 31.

The following curious return was made by a large pawnbroking establishment at Glasgow to Dr. Cleland, who read it before the British Association in 1836. The list comprised the following articles:—539 men's coats, 355 vests, 288 pairs of trowsers, 84 pairs of stockings, 1980 women's gowns, 540 petticoats, 132 wrappers, 123 duffies, 90 pelisses, 240 silk handkerchiefs, 294 shirts and shifts, 60 hats, 84 bed-ticks, 108 pillows, 262 pairs of blankets, 300 pairs of sheets, 162 bed-covers, 36 tablecloths, 48 umbrellas, 102 *bibles*, 204 watches, 216 rings, and 48 *Waterloo medals*. There were about thirty pawnbrokers in Glasgow in 1840. In the manufacturing districts, during the prevalence of strikes, or in seasons of commercial embarrassment, many hundreds of families pawn the greater part of their wearing apparel and household furniture. The practice of having recourse to the pawnbrokers on such occasions is quite of a different character from the habits of dependence into which many of the working classes suffer themselves to fall, and who, "on being paid their wages on the Saturday, are in the habit of taking their holiday clothes out of the hands of the pawnbroker to enable them to appear respectably on the Sabbath, and on the Monday following they are again pawned and a fresh loan obtained to meet the exigencies of their families for the remainder of the week." It is on these transactions and on such as arise out of the desire of obtaining some momentary gratification that the pawnbrokers make their large profits. It is stated in one of the reports on the poor laws that a loan of threepence, if redeemed the same day, pays annual interest at the rate of 5200 per cent.; weekly, 866 per cent.;

4*d.*, annual interest 3900 per cent., or 650 p. c. weekly;
12*d.*, annual interest 1300 per cent., or 216 p. c. weekly.

It is stated that on a capital of sixpence thus employed (in weekly loans), pawnbrokers make in twelve months 2*s.* 2*d.*; on five shillings they gain 10*s.* 4*d.*; on ten shillings, 22*s.* 3¼*d.*; and on twenty shillings lent in weekly loans of sixpence, they more than double their capital in twenty-seven weeks, and should the goods pawned remain in their hands for the term of twelve months (which seldom occurs), they then frequently derive 100 per cent.[61]]

FOOTNOTES

[2] J. D. Michaelis, in Syntagma Commentationum, ii. p. 9; and his Mosaisches Recht. iii. p. 86.

[3] Sueton. Vita Augusti, cap. 41.

[4] Taciti Annal. vi. 17.—Sueton. Vita Tiberii, cap. 48.—Dio Cassius, lviii. 21.

[5] Ælius Lamprid. Vita Alex. Severi, cap. 21.

[6] M. Manni circa i sigilli antichi dei secoli bassi, vol. xxvii. p. 86. The author here quotes from an ancient city-book the following passage:—"Franciscus fenerator pro se et *apotheca seu casana fenoris*, quam tenebat in via Quattro Pagoni," &c.

[7] Algemeine Welthistorie, xlv. p. 10.

[8] This theologian, born at Eperies in Hungary in 1625, was driven from his native country on account of his religion, and died superintendant at Meisse in 1689. He wrote, besides other works, Dorothei Asciani Montes Pietatis Romanenses, historice, canonice, et theologice detecti. Lipsiæ, 1670, 4to. This book is at present very scarce. I shall take this opportunity of mentioning also the following, because many who have written on lending-houses have quoted it, though they never saw it:—Montes Pietatis Romanenses, das ist, die Berg der Fromheit oder Gottesforcht in der Stadt Rom. Durch Elychnium Gottlieb. Strasburg, 1608, 8vo. It contains nothing of importance that may not be found in Ascianus.

[9] Of this Barnabas I know nothing more than what I have here extracted from Waddingii Annales Minorum, tom. xiv. p. 93. Wadding refers to Marian. lib. v. c. 40. § 17; and Marc. 3. p. lib. 5. cap. 58. The former is Marianus Florentinus, whose Fasciculus Chronicoram Ordinis Minorum, which consists of five books, was

used in manuscript by Wadding, in composing his large work, and in my opinion has never been printed. Marc. is Marcus Ulyssoponensis, whose Chronica Ordinis Minorum I have not been able to procure, though it is translated into several languages. See Waddingii Scriptores Ordinis Minorum. Romæ 1650, fol. pp. 248, 249.

[10] This is confirmed by M. B. Salon, in t. 2. Contr. de Justit. et Jure, in ii. 2 Thom. Aquin. qu. 88. art. 2. controv. 27: "Hujus modi mons non erat in usu apud antiquos. Cœpit fere a 150 annis, tempore Pii II." In C. L. Richard's Analysis Conciliorum Generalium et Particularium, Venetiis, 1776, 4 vol. fol. iv. p. 98, I find that the first lending-house at Perugia was established in the year 1450; but Pius II., under whose pontificate it appears by various testimonies to have been founded, was not chosen pope till the year 1458.

[11] Bussi, Istoria della città di Viterbo. In Roma, 1742, fol. p. 271.

[12] It may be found in Bolle et Privilegi del Sacro Monte della Pietà di Roma. In Roma, 1618: ristampati l'anno 1658. This collection is commonly bound up with the following work, which was printed in the same year and again reprinted: Statuti del Sacro Monte della Pietà di Roma. This bull is inserted entire by Ascianus, p. 719, but in the Collection of the pontifical bulls it is omitted.

[13] This Michael travelled and preached much in company with Bernardinus, and died at Como in 1485.—Wadding, xiv. p. 396.

[14] The Piccolimini, nephews of the pope, having once paid their respects to him at Siena, he told them he was their namesake.—Wadding, xiv. p. 447.

[15] Waddingii Scriptores Ordinis Minorum, p. 58. Fabricii Biblioth. Mediæ et Infimæ Æt. i. p. 586.

[16] Wadding, xiv. pp. 398, 433.

[17] It may be found entire in Wadding, xiv. p. 411. It was ordered that the pledges should be worth double the sum lent, and that they should be sold if not redeemed within a year.

[18] Wadding, xiv. p. 446.

[19] D. Manni circa i Sigilli Antichi, tom. xxvii. p. 92, where much information respecting this subject may be found.

[20] Wadding, xiv. p. 451.

[21] Ibid. pp. 462, 465.

[22] Ibid. xiv. pp. 480, 481.

[23] Ibid. p. 517.

[24] Ibid. xiv. pp. 93, 482.

[25] Ibid. p. 514.

[26] Ibid. xv. pp. 6, 65.

[27] Wadding, xv. pp. 7, 9, 12.

[28] Ibid. xv. pp. 37, 45, 46.

[29] Ibid. xv. 67.

[30] Ibid. xv. p. 68. Bernardinus considered the giving of wages as a necessary evil.

[31] Della Zecca di Gubbio, e delle Geste de' Conti e Duchi di Urbino; opera di Rinaldo Reposati. Bologna, 1772, 4to.

[32] It is to be found in the well-known large collection of juridical writings quoted commonly under the title Tractatus Tractatuum.

Venetiis, 1584, fol. p. 419, vol. vi. part 1. It has also been printed separately.

[33] His works were printed together, in folio, at Brescia in 1588.

[34] The work of the former appeared in 1496. The writings of both are printed in the work of Ascianus, or Zimmermann, which has been often quoted already.

[35] This bull, which forms an epoch in the history of lending-houses, may be found in S. Lateranen. Concilium Novissimum. Romæ, 1521, fol. This scarce work, which I have now before me, is inserted entire in Harduini Acta Conciliorum, tom. ix. Parisiis, 1714, fol. The bull may be found p. 1773. It may be found also in Bullarium Magnum Cherubini, i. p. 560; Waddingii Annal. Minor. xv. p. 470; Ascianus, p. 738; and Beyerlinck's Theatrum Vitæ Hum. v. p. 603.

[36] This is the conclusion formed by Richard, in Analysis Conciliorum, because in sess. 22, cap. 8, lending-houses are reckoned among the *pia loca*, and the inspection of them assigned to the bishops.

[37] Waddingii Annal. Minor. xv. p. 471.

[38] Ibid. xvi. p. 444; Ascianus, p. 766.

[39] (Summonte) Historia de Napoli, 1749, 4to, vol. iv. p. 179.—Giannone, vol. iv.—De' Banchi di Napoli, da Michele Rocco. Neap. 1785, 3 vols. 8vo, i. p. 151.

[40] Vettor Sandi, in Principi di Storia civile della Republica di Venezia. In Venezia 1771, 4to, vol. ii. p. 436. The author treats expressly of the institution of this bank, but the year when it commenced is not mentioned.

[41] Waddingii Annal. Minor. xv. p. 67.

[42] Hymnus ii. honorem Laurentii. The poet relates, that in the third century the pagan governor of the city demanded the church treasure from Laurentius the deacon.

[43] This passage, with which Senkenberg was not acquainted, may be found in Tertullian's Apolog. cap. 39, edition of De la Cerda, p. 187.

[44] This word however is not to be found in the Glossarium Manuale.

[45] See the bull in Bullarium Magnum, n. 17.

[46] See Petr. Gregorius Tholosanus de Republica. Francof. 1609, 4to, lib. xiii. c. 16, p. 566; and Ascianus, p. 753.

[47] Geschichte des Teutschen Handels, ii. p. 454.

[48] Gokink's Journal für Teutschland, 1784, i. p. 504, where may be found the first and the newest regulations respecting the lending-house at Nuremberg.

[49] Stettens Geschichte der Stadt Augsburg. Frankf. 1742, 2 vols. 4to, i. p. 720, 789, 833.

[50] Fœdera, vol. iv. p. 387.

[51] Beschryving der Stadt Delft. 1729, fol. p. 553.

[52] Salmasius de Fœnore trapezitico. Lugd. 1640, 8vo, p. 744.

[53] De Koophandel van Amsterdam. Rott. 1780, 8vo, i. p. 221.

[54] S. de Marets Diss. de trapezitis.

[55] Beyerlinck, Magnum Theatrum Vitæ, tom. v. p. 602.

[56] Richard, Analysis Concilior. iv. p. 98.

[57] Turgot, Mem. sur le prêt à intérest, &c. Par. 1789, 8vo.

[58] Sauval, Hist. de la Ville de Paris.

[59] Rufel, Hist. de la Ville de Marseille; 1696. fol. ii. p. 99.

[60] Tableau de Paris. Hamb. 1781. 8vo, i. p. 78.

[61] Waterston’s Cyclopædia of Commerce.

CHEMICAL NAMES OF METALS.

As those metals earliest known, viz. copper, iron, gold, silver, lead, quicksilver and tin, received the same names as the nearest heavenly bodies, which appear to us largest, and have been distinguished by the like characters, two questions arise: Whether these names and characters were given first to the planets or to the metals? When, where, and on what account were they made choice of; and why were the metals named after the planets, or the planets after the metals? The latter of these questions, in my opinion, cannot be answered with any degree of certainty; but something may be said on the subject, which will not, perhaps, be disagreeable to those fond of such researches, and who have not had an opportunity of examining it.

That the present usual names were first given to the heavenly bodies, and at a later period to the metals, is beyond all doubt; and it is equally certain that they came from the Greeks to the Romans, and from the Romans to us. It can be proved also that older nations gave other names to these heavenly bodies at much earlier periods. The oldest appellations, if we may judge from some examples still preserved, seem to have originated from certain emotions which these bodies excited in the minds of men; and it is not improbable that the planets were by the ancient Egyptians and Persians named after their gods, and that the Greeks only adopted or translated into their own language the names which those nations had given them[62]. The idea that each planet was the residence of a god, or that they were gods themselves, has arisen, according to the most probable conjecture, from rude nations worshiping the sun, which, on account of his beneficent and necessary influence over all terrestrial bodies, they considered either as the deity himself, or his abode, or, at any rate, as a symbol of him. In the course of time, when heroes and persons who by extraordinary services had rendered their names respected and immortal, received divine honours, particular heavenly bodies, of which the sun,

moon and planets seemed the fittest, were also assigned to these divinities[63]. By what laws this distribution was made, and why one planet was dedicated to Saturn and not to another, Pluche did not venture to determine: and on this point the ancients themselves are not all agreed[64]. When the planets were once dedicated to the gods, folly, which never stops where it begins, proceeded still further, and ascribed to them the attributes and powers for which the deities, after whom they were named, had been celebrated in the fictions of their mythologists. This in time laid the foundation of astrology; and hence the planet Mars, like the deity of that name, was said to cause and to be fond of war; and Venus to preside over love and its pleasures.

The next question is, Why were the metals divided in the like manner among the gods, and named after them? Of all the conjectures that can be formed in answer to this question, the following appears to me the most probable. The number of the deified planets made the number seven so sacred to the Egyptians, Persians and other nations, that all those things which amounted to the same number, or which could be divided by it without a remainder, were supposed to have an affinity or a likeness to and connexion with each other[65]. The seven metals, therefore, were considered as having some relationship to the planets, and with them to the gods, and were accordingly named after them. To each god was assigned a metal, the origin and use of which was under his particular providence and government; and to each metal were ascribed the powers and properties of the planet and divinity of the like name; from which arose, in the course of time, many of the ridiculous conceits of the alchemists.

The oldest trace of the division of the metals among the gods is to be found, as far as I know, in the religious worship of the Persians. Origen, in his Refutation of Celsus, who asserted that the seven heavens of the Christians, as well as the ladder which Jacob saw in his dream, had been borrowed from the mysteries of Mithras, says, “Among the Persians the revolutions of the heavenly bodies were represented by seven stairs, which conducted to the same number of gates. The first gate was of lead; the second of tin; the third of copper; the fourth of iron; the fifth of a mixed metal; the sixth of silver, and the seventh of gold. The leaden gate had the slow tedious motion of Saturn; the tin gate the lustre and gentleness of

Venus; the third was dedicated to Jupiter; the fourth to Mercury, on account of his strength and fitness for trade; the fifth to Mars; the sixth to the Moon, and the last to the Sun[66].” Here then is an evident trace of metallurgic astronomy, as Borrichius calls it, or of the astronomical or mythological nomination of metals, though it differs from that used at present. According to this arrangement, tin belonged to Jupiter, copper to Venus, iron to Mars, and the mixed metal to Mercury. The conjecture of Borrichius, that the transcribers of Origen have, either through ignorance or design, transposed the names of the gods, is highly probable: for if we reflect that in this nomination men at first differed as much as in the nomination of the planets, and that the names given them were only confirmed in the course of time, of which I shall soon produce proofs, it must be allowed that the causes assigned by Origen for his nomination do not well agree with the present reading, and that they appear much juster when the names are disposed in the same manner as that in which we now use them[67].

This astrological nomination of metals appears to have been conveyed to the Brahmans in India; for we are informed that a Brahman sent to Apollonius seven rings, distinguished by the names of the seven stars or planets, one of which he was to wear daily on his finger, according to the day of the week[68]. This can be no otherwise explained than by supposing that he was to wear the gold ring on Sunday; the silver one on Monday; the iron one on Tuesday, and so of the rest. Allusion to this nomination of the metals after the gods occurs here and there in the ancients. Didymus, in his Explanation of the Iliad, calls the planet Mars the iron star. Those who dream of having had anything to do with Mars are by Artemidorus threatened with a chirurgical operation, for this reason, he adds, because Mars signifies iron[69]. Heraclides says also in his allegories, that Mars was very properly considered as iron; and we are told by Pindar that gold is dedicated to the sun[70].

Plato likewise, who studied in Egypt, seems to have admitted this nomination and meaning of the metals. We are at least assured so by Marsilius Ficinus[71]; but I have been able to find no proof of it, except where he says of the island Atlantis, that the exterior walls were covered

with copper and the interior with tin, and that the walls of the citadel were of gold. It is not improbable that Plato adopted this Persian or Egyptian representation, as he assigned the planets to the demons; but perhaps it was first introduced into his system only by his disciples[72]. They seem, however, to have varied from the nomination used at present; as they dedicated to Venus copper, or brass, the principal component part of which is indeed copper; to Mercury tin; and to Jupiter electrum. The last-mentioned metal was a mixture of gold and silver; and on this account was probably considered to be a distinct metal, because in early periods mankind were unacquainted with the art of separating these noble metals[73].

The characters by which the planets and metals are generally expressed when one does not choose to write their names, afford a striking example how readily the mind may be induced to suppose a connexion between things which in reality have no affinity or relation to each other. Antiquaries and astrologers, according to whose opinion the planets were first distinguished by these characters, consider them as the attributes of the deities of the same name. The circle in the earliest periods among the Egyptians was the symbol of divinity and perfection; and seems with great propriety to have been chosen by them as the character of the sun, especially as, when surrounded by small strokes projecting from its circumference, it may form some representation of the emission of rays. The semicircle is in like manner the image of the moon, the only one of the heavenly bodies that appears under that form to the naked eye. The character ♄ is supposed to represent the sythe of Saturn; ♃ the thunderbolts of Jupiter; ♂ the lance of Mars, together with his shield; ♀ the looking-glass of Venus; and ☿ the caduceus or wand of Mercury.

The expression by characters adopted among the older chemists agrees with this mythological signification only in the character assigned to gold. Gold, according to the chemists, was the most perfect of metals, to which all others seemed to be inferior in different degrees. Silver approached nearest to it; but was distinguished only by a semicircle, which, for the more perspicuity, was drawn double, and thence had a greater resemblance to the most remarkable appearance of the moon; the name of which this metal had already obtained. All the other metals, as they seemed to have a greater or less affinity to gold or silver, were distinguished by marks

composed of the characters assigned to these precious metals. In the character ☿ the adepts discover gold with a silver colour. The cross placed at the bottom, which among the Egyptian hieroglyphics had a mysterious signification[74], expresses, in their opinion, something I know not what, without which quicksilver would be silver or gold. This something is combined also with copper, the possible change of which into gold is expressed by the character ♀. The character ♂ declares the like honourable affinity also; though the half-cross is applied in a more concealed manner; for, according to the most proper mode of writing, the point is wanting at the top, or the upright line ought only to touch the horizontal, and not to intersect it. Philosophical gold is concealed in steel; and on this account it produces such valuable medicines. Of tin one-half is silver, and the other consists of the something unknown: for this reason the cross with the half moon appears in ♃. In lead this something is predominant, and a similitude is observed in it to silver. Hence in its character ♄ the cross stands at the top, and the silver character is only suspended on the right-hand behind it.

The mythological signification of these characters cannot be older than the Grecian mythology; but the chemical may be traced to a much earlier period. Some, who consider them as remains of the Egyptian hieroglyphics[75], pretend that they may be discovered on the table of Isis, and employ them as a proof of the high antiquity, if not of the art of making gold, at least of chemistry. We are told also that they correspond with many other characters which the adepts have left us as emblems of their wisdom.

If we are desirous of deciding without prejudice respecting both these explanations, it will be found necessary to make ourselves acquainted with the oldest form of the characters, which in all probability, like those used in writing, were subjected to many changes before they acquired that form which they have at present. I can, however, mention only three learned men, Salmasius[76], Du Cange[77], and Huet[78], who took the trouble to collect these characters. As I am afraid that my readers might be disgusted were I here to insert them, I shall give a short abstract of the conclusion which they form from them; but I must first observe that the oldest manuscripts differ very much in their representation of these characters, either because they were not fully established at the periods when they were written, or because

many supposed adepts endeavoured to render their information more enigmatical by wilfully confounding the characters; and it is probable also that many mistakes may have been committed by transcribers.

The character of Mars, according to the oldest mode of representing it, is evidently an abbreviation of the word Θοῦρος, under which the Greek mathematicians understood that deity; or, in other words, the first letter Θ, with the last letter ς placed above it. The character of Jupiter was originally the initial letter of Ζεύς; and in the oldest manuscripts of the mathematical and astrological works of Julius Firmicus the capital Z only is used, to which the last letter ς was afterwards added at the bottom, to render the abbreviation more distinct. The supposed looking-glass of Venus is nothing else than the initial letter, a little distorted, of the word Φωσφόρος, which was the name of that goddess. The imaginary sythe of Saturn has been gradually formed from the first two letters of his name Κρόνος, which transcribers, for the sake of dispatch, made always more convenient for use, but at the same time less perceptible. To discover in the pretended caduceus of Mercury the initial letter of his Greek name Στίλβων, one needs only look at the abbreviations in the oldest manuscripts, where they will find that the Σ was once written as C; they will remark also that transcribers, to distinguish this abbreviation still more from the rest, placed the C thus, ∪; and added under it the next letter τ. If those to whom this deduction appears improbable will only take the trouble to look at other Greek abbreviations, they will find many that differ still further from the original letters they express than the present character ☿ from the C and τ united. It is possible that later transcribers, to whom the origin of this abbreviation was not known, may have endeavoured to give it a greater resemblance to the caduceus of Mercury. In short, it cannot be denied that many other astronomical characters are real symbols, or a kind of proper hieroglyphics, that represent certain attributes or circumstances, like the characters of Aries, Leo, and others quoted by Salmasius.

But how old is the present form of these characters? According to Scaliger[79], they are of great antiquity, because they are to be found on very old gems and rings. If the ring No. 104 in Goræus be old and accurately delineated, this must indeed be true; for some of these characters may be very plainly distinguished on the beazel[80]. We are told by Wallerius that

they were certainly used by the ancient Egyptians, because Democritus, who resided five years in Egypt, speaks of them in the plainest terms. I do not know whence Wallerius derived this information, but it proves nothing. He undoubtedly alludes to the laughing philosopher of Abdera, who lived about 450 years before our æra, but no authentic writings of his are now extant. Fabricius says that we have a Latin translation of a work of his, De Arte Sacra, Patavii, 1572, which, however, is certainly a production of much later times. I have it now before me from the library of our university; and I find that it is not the whole book, but only an abstract, and written in so extravagant a manner that the deception is not easily discovered. It contains chemical processes, but nothing of the characters of metals; which is the case also with the letters of Democritus, published by Lubbinus[81].

[By way of contrast to the seven metals with which the ancients were acquainted, we may enumerate those known at the present day. They are as follows:—

1.	Gold		☉
2.	Silver		☽
3.	Iron		♂
4.	Copper		♀
5.	Mercury		☿
6.	Lead		♄
7.	Tin		♃
8.	Antimony	Basil Valentine	1490.
9.	Bismuth	Agricola	1530.
10.	Zinc	(Paracelsus?)	1530.
11.	Arsenic	Brandt	1733.
12.	Cobalt		
13.	Platinum	Wood	1741.
14.	Nickel	Cronstedt	1751.
15.	Manganese	Gahn	1774.
16.	Tungsten	D’Elhujart	1781.
17.	Tellurium	Müller	1782.

18. Molybdenum	Hjelm	1782.
19. Uranium	Klaproth	1789.
20. Titanium	Gregor	1791.
21. Chromium	Vauquelin	1797.
22. Columbium	Hatchett	1802.
23. Palladium 24. Rhodium	Wollaston	1803.
25. Iridium 26. Osmium	Tennant	1803.
27. Cerium	Hisinger	1804.
28. Potassium 29. Sodium 30. Barium 31. Strontium 32. Calcium	Davy	1807.
33. Cadmium	Stromeyer	1818.
34. Lithium	Arfwedson	1818.
35. Silicium 36. Zirconium	Berzelius	1824.
37. Aluminum 38. Glucinum 39. Yttrium	Wöhler	1828.
40. Thorium	Berzelius	1829.
41. Magnesium	Bussy	1829.
42. Vanadium	Sefström	1830.
43. Didymium 44. Lanthanium	Mosander	1842.
45. Erbium 46. Terbium	Mosander	1843.
47. Pelopium 48. Niobium	H. Rose	1845.
49. Ruthenium	Claus	1845.

FOOTNOTES

[62] See Goguet, Origines. Bailly, Hist. de l'Astron. Ancienne.

[63] Jablonski, Pantheon Ægypt. 1750, p. 49.

[64] These contradictions are pointed out by Goguet, in a note, p. 370. A better view of them may be found in Hygini Astronom. (ed. Van Staveren), xlii. p. 496.

[65] Jablonski, Panth. p. 55. Vossius de Idololatria, ii. 34, p. 489. Bruckeri Histor. Philosoph. i. p. 1055.

[66] Origenes Contra Celsum, lib. vi. 22. I expected to have received some explanation of this passage from the editors of Origen, and in those authors who have treated expressly on the religious worship of the Persians; but I find that they are quoted neither by Hyde; Philip a Turre, whose Monumenta Veteris Antii is printed in Thesaurus Antiquitat. et Histor. Italiæ; nor by Banier in his Mythology.

[67] Borrichius arranges the words in the following manner: "Secundam portam faciunt Jovis, comparantes ei stanni splendorem et mollitiem; tertiam Veneris æratam et solidam; quartam Martis, est enim laborum patiens, æque ac ferrum, celebratus hominibus; quintam Mercurii propter misturam inæqualem ac variam, et quia negotiator est; sextam Lunæ argenteam; septimam Solis auream."—Ol. Borrichius De Ortu et Progressu Chemiæ." Hafniæ, 1668, 4to, p. 29. Professor Eichhorn reminded me, as allusive to this subject, of the seven walls of Ecbatana, the capital of Media, the outermost of which was the lowest, and each of the rest progressively higher, so that they overtopped each other. Each was of a particular colour. The

outermost was white; the second black; the third purple; the fourth blue; the fifth red, or rather of an orange colour; and the summit of the sixth was covered with silver, and that of the seventh, or innermost, with gold. Such is the account given by Herodotus, i. 98; and it appears to me not improbable that they may have had a relation to the seven planets, though nothing is hinted on that subject by the historian.

[68] Philostrat. Vita Apollonii, iii. 41, p. 130. How was the ring for Wednesday made? Perhaps it was hollow, and filled with quicksilver. Gesner, in Commentaria Societat. Scien. Gotting. 1753, iii. p. 78, thinks that these rings might have been made or cast under certain constellations.

[69] Oneirocritica, v. 37.

[70] Isthm. Od. ver. 1. Of the like kind are many passages in Eustathius on Homer's Iliad, b. xi., and also the following passages of Constantinus Manasses, where he describes the creation of the stars, in his Annales (edit. Meursii, Lugd. 1616), p. 7, and p. 263: "Saturnus nigricabat, colore plumbeo; Jupiter ut argentum splendebat; Mars flammeus conspiciebatur; Sol instar auri puri lucebat; (Venus uti stannum;) Mercurius instar æris rubebat; Luna in morem glaciei pellucida suam et ipsa lucem emittebat," &c.

[71] In his Preface to Critias. Platonis Opera; Francof. 1602, fol. p. 1097.

[72] It is probable that Ficinus had in view a passage in Olympiodori Commentar. in Meteora Arist. Ven. 1551, fol. lib. iii. p. 59.

[73] This distribution, which is ascribed to the Platonists, may be found also in the scholiasts on Pindar, at the beginning of the fifth Isthmian Ode, p. 459.

[74] Jablonski, Pantheon Ægypt. i. p. 282, 283, 287; and ii. p. 131. This author makes it the representation of something which cannot be

well named. Kircheri Œdipus Ægypt. t. ii. pars ii. p. 399. Romæ, 1653, fol.

[75] Goguet, ii. pp. 370, 371, considers them as remains of the original hieroglyphics; but he is of opinion that we received them in their present form from the Arabians.

[76] Plinianæ Exercitat. in Solinum, p. 874.

[77] Gloss. ad Script. Med. et Infimæ Græcitatis.

[78] In his Annotations on Manilii Astronomicon (in usum Delphini). Par. 1679, 4to, p. 80.

[79] In his Annotations on Manilii Astron. Strasb. 1665, 4to, p. 460.

[80] In Gorii Thesaurus Gemmarum antiquarum astriferarum, Florent. 1750, 3 vols. fol., I found nothing on this subject. Characters of the moon and of the signs in the zodiac often occur; but no others are to be seen, except in tab. 33, where there is a ring, which has on it the present characters of Mars and Venus. In general the planets are represented by seven small asterisks, or by six and the character of the moon. Besides, the antiquity of this gem cannot be ascertained.

[81] See the collection of Greek letters of Eilh. Lubbinus. Commelin. 1601, 8vo.

ZINC.

Zinc is one of those metals which were not known to the Greeks[82], Romans, or Arabians. This we have reason to conjecture, because it has not been distinguished by a chemical character like the rest; but it is fully proved, by our not finding in the works of the ancients any information that appears even to allude to it. I know but of one instance where it is supposed to have been found among remains of antiquity. Grignon pretends that something like it was discovered in the ruins of the ancient Roman city in Champagne[83]. Such an unexpected discovery deserved to have been investigated with the utmost minuteness; but it seems to have been examined only in a very superficial manner; and as that was the case, it is impossible to guess what kind of a metal or metallic mixture this author considered as zinc.

It is not surprising that this metal should have remained so long unknown, for it has never yet been found in the metallic state. Its ores are often and in a great degree mixed with foreign ingredients; and when they are melted, it sublimes in a metallic form, and is found adhering above to the cool sides of the furnace; but a particular apparatus is necessary, else the reduced metal partly evaporates, and is partly oxidized, by which means it appears like an earth, and exhibits to the eye no traces of metal.

That mixture of zinc and copper called at present brass, tomback, pinchbeck, princes-metal, &c., and which was first discovered by ores, abundant in zinc, yielding when melted not pure copper, but brass, was certainly known to the ancients. Mines that contained ores, from which this gold-coloured metal was produced, were held in the highest estimation; when exhausted, the loss of them was regretted; and it was supposed that the metal would never be again found. In the course of time it was remarked, no one knows by what accident, that an ore, which must have been calamine, when added to copper while melting, gave it a yellow

colour. This ore was therefore used, though it was not known what metal it contained, in the same manner as oxide of cobalt was employed in colouring glass before mineralogists were acquainted with that metal itself. Aristotle and Strabo speak of an earth of that kind, the use of which in making brass has been retained through every century. Ambrosius, bishop of Milan, in the fourth century; Primasius, bishop of Adrumetum in Africa, in the sixth; and Isidore, bishop of Seville, in the seventh, mention an addition by which copper acquired a gold colour, and which undoubtedly must have been calamine. When in course of time more calamine was discovered, the ancient method of procuring brass from copper-ore that contained zinc was abandoned; and it was found more convenient first to extract from it pure copper, and then to convert it into brass by the addition of calamine.

Those desirous of inquiring further into the knowledge which the ancients had of this metal must examine the meaning of the word *cadmia*, which seems to have had various significations. This task I have ventured to undertake; and though I cannot clear up everything that occurs respecting it, I shall lay before my readers what information I have been able to obtain on the subject, because perhaps it may amount to somewhat more than is to be found in the works of old commentators. *Cadmia* signified, then, in the first place, a mineral abounding in zinc, as well as any ore combined with it, and also that zinc-earth which we call calamine. Those who should understand under it only the latter, would not be able to explain the greater part of the passages in the ancients where it is mentioned. It is probable that ore containing zinc acquired this name, because it first produced brass[84]. When it was afterwards remarked that calamine gave to copper a yellow colour, the same name was conferred on it also. It appears, however, that it was seldom found by the ancients[85]; and we must consider *cadmia* in general as signifying ore that contained zinc. Gold-coloured copper or brass was long preferred to pure or common copper, and thought to be more beautiful the nearer it approached to the best *aurichalcum*. Brass therefore was supposed to be a more valuable kind of copper; and on this account Pliny says that *cadmia* was necessary for procuring copper, that is brass. Copper, as well as brass, was for a great length of time called *æs*, and it was not till a late period that mineralogists, in order to distinguish them, gave the name of

cuprum to the former[86]. Pliny says that it was good when a large quantity of *cadmia* had been added to it, because it not only rendered the colour more beautiful, but increased the weight. In the like manner a quintal of copper in Hungary produces a hundred and fifty pounds of brass. The same author remarks also that the *cadmia* (*fossilis*) was not used in medicine: this however is to be understood only of the raw ore, for some physicians prepared oxide of zinc from ore that contained zinc, as he afterwards tells us; and Galen extols the calamine found in Cyprus on account of its superior effects, because, perhaps, the oxide could be obtained from it much purer.

In the second place, *cadmia*, among the ancients, was what we call (*ofenbruch*) furnace-calamine, or what in melting ore that contains zinc, or in making brass, falls to the bottom of the furnace, and which consists of more or less calcined zinc. As this furnace-calamine assumes various appearances, according to the manner of melting, and according to many other circumstances that in part cannot be defined, and as the ancients comprehend all its varieties under the general name of *cadmia*, and give to each variety, according to its form, consistence and colour, a particular name also, a confusion of names has hence arisen which cannot now be cleared up, especially as it is not thought worth while to distinguish all its incidental variations. Our physicians esteem only the pure oxide of zinc; and as they know how to obtain it, they are not under the necessity of using impure furnace-calamine. In our melting-houses it is employed, without much nicety in the choice, for making zinc or brass[87].

What here appears to me most singular is, that the ancients should have given the same names to furnace-calamine as they gave to ores that contained zinc. The affinity of these substances they could conjecture only from their effects, or perhaps they were induced to do so from observing that furnace-calamine was not produced but when the different kinds of *cadmia*, as they were called, were melted; that is, when yellow and not red copper was obtained. *Ofenbruch* got the name of furnace-calamine at Rammelsberg, when it was observed that it could be employed instead of native calamine for making brass[88]. Were the ancients then in any measure acquainted with this use of it? Galen and Dioscorides speak only of its use in medicine, and say nothing of its being employed in the preparation of

brass. The Arabian writers, particularly the translators of the Greek physicians, speak in a much clearer manner of the preparation of brass; but the appellations which they employ are so indeterminate in their signification, that an answer to the above question cannot be deduced from them. *Climia*, which some pronounce *calimia* and from which the modern Greeks made *kelimia*, and the Latins *lapis calaminaris*, seems to have entirely the same meaning as *cadmia*. *Tutia*, which occurs first in the eleventh century, in Avicenna, and which the Greeks write *toutia*, or perhaps more properly *thouthia*, signifies sometimes *pompholyx*; but in common it seems to express also minerals that contain zinc, and likewise furnace-calamine[89]. Could it be proved that the *tutia* of the Arabs and later Greeks was furnace-calamine, or the *tutia* of our druggists, the oldest account with which I am acquainted of furnace-calamine, employed in making brass, would occur in Zosimus, who, according to every appearance, lived in the fifth century[90]. This author tells us, that in order to make brass, Cyprus copper must be melted, and pounded *tutia* must be strewed over it. Salmasius suspects that Zosimus here means only calamine: but however this may be, his receipt has been retained till the present time in books on the arts; for these recommend not calamine, but *tutia*[91].

We can with more certainty affirm that this use of furnace-calamine, in making brass, was known to Albertus Magnus in the thirteenth century; for he says, first, that yellow copper was made by the addition of calamine, which he calls *lapis calaminaris*. He tells us afterwards, that Hermes taught how to give a gold colour to copper by throwing pounded *tutia* into the melted metal. *Tutia*, says he, which is used in the transmutation of metals, is not a native mineral, but an artificial mixture, produced in the furnace when copper-ore is melted; and he advises glass-gall to be strewed over the ore, otherwise calamine and *tutia* will lose their force in the fire[92]. It would appear that the last-mentioned name, in the thirteenth century, signified only furnace-calamine, and that its use for making brass was at that period known.

For many centuries, however, the *ofenbruch* (furnace-calamine), with which, as we are told, the furnaces at Rammelsberg overflowed, was thrown aside as useless, till at length, in the middle of the sixteenth century,

Erasmus Ebener first showed that it might be used instead of native calamine for making brass. This Ebener, descended from the noble family of that name at Nuremberg, was a man of great learning, and an able statesman. He was employed by his native city, and by foreign princes, on occasions of the highest importance. In 1569 he was privy-counsellor to Julius duke of Brunswick, and died in 1577, at Helmstadt, where he was buried. I regret much that I can give no further account of this important discovery; the time even when it was made is not known with certainty. Lœhneyss says that it was sixty years before the period when he wrote. But at what period did he write? The oldest edition, with which I am acquainted, of his treatise on mines, is of the year 1617, so that this discovery would fall about the year 1557[93]. Calvör caused to be printed an old account of the Rammelsberg mines, which was said to have been published in 1565. According to that work, Ebener made the above-mentioned observation at Nuremberg, about seventeen years before, that is, about the year 1548. Schluter assigns as the period about 1550, and Honemann about 1559. We may therefore very safely place it in the middle of the sixteenth century, and probably the discovery happened in 1553, at which time Ebener was sent to duke Henry, with whom he continued a long time, as we are expressly told by Doppelmayer. This use of calamine refuse induced the managers of the profitable brass-works in the Harz forest to pick up carefully that which before had been thrown aside. Duke Julius, who endeavoured to improve every branch of manufacture, and particularly what related to metallurgy, and who, agreeably to the then prevailing mode of princes, suffered himself to be duped with the hopes of making gold, improved the brass-works at Buntheim, below Harzburg, and by these means brought a great revenue to the electoral treasury.

Another production of zinc, artificial white vitriol, was also long prepared, used and employed in commerce before it was known that it was procured from this metal. That it was not known before the middle of the sixteenth century, and that it was first made at Rammelsberg, may with confidence be affirmed. Schluter ascribes the invention of it to duke Julius, and places it in the year 1570: but it must be somewhat older than the above-quoted account of Rammelsberg; for the author, who wrote about 1565[94], relates, that in his time one citizen only, whom he calls Henni Balder, boiled white vitriol; and it appears that this person kept the process

a secret. That the invention was not then new, is evident from his adding, that what its effects might be in medicine had not been examined; but that its use in making eye-water had been known almost as early as the time when it was discovered. This agrees with another account, according to which the method of boiling white vitriol was found out at the time when Christopher Sander, whose service to the Harz is well-known, was tithe-gatherer. Honemann says that Sander was tithe-gatherer at the mines of the Upper Harz before the year 1564, but that in this year he was principal tithe-gatherer and director of the mines and melting-houses at Goslar. Sander himself, in a paper dated August 3, 1575, seems to ascribe the invention of white vitriol to duke Julius[95].

At first this salt was called *Erzalaun*, a name occasioned by its likeness to alum, but afterwards it was more frequently known by those of *Gallitzenstein*, *Golitzenstein*, and *Calitzenstein*. The latter names however appear to be older than white vitriol itself; as we find that green vitriol, even before the year 1565, was called green *Gallitzenstein*. May not the word be derived from *gallæ*; because it is probable that vitriol and galls were for a long time the principal articles used for making ink and in dyeing? I am of opinion that the white vitriol, which is produced in the mines of Rammelsberg in the form of icicles, gave rise to the discovery and manufacture of this salt. The former, so early as the year 1565, was called white native vitriol, or white *Gogkelgut*, and was packed up in casks, and in that manner transported for sale[96]. I shall not here enter into the old conjectures respecting the origin and component parts of this vitriol; but it deserves to be remarked, that Henkel and Neumann[97] observed in it a mixture of zinc, by which Brandt, a member of the Swedish council of mines, was led to prove, that, when pure, it consists of vitriolic acid and oxide of zinc; and this was afterwards confirmed by Hellot[98].

I come now, in the last place, to the history of this metal, which, when furnace-calamine was used, could not remain long unobserved, as it is sometimes found amongst it uncalcined in metallic drops. It is worthy of remark, that Albertus Magnus, who first described the use of furnace-calamine in making brass, is the oldest author in whose works mention is made of zinc. He calls it *marchasita aurea*. This was properly a stone, the

metallic particles of which were so entirely sublimated by fire, that nothing but useless ashes remained behind. It contained fixed quicksilver, communicated a colour to metals, on which account it was well known to the alchemists, burned in the fire, and was at length entirely consumed. It was found in various parts, but that at Goslar was the best, because the copper it contained seemed to have in it a mixture of gold. To give this copper however a still greater resemblance to gold, some tin was added to it, by which means it became more brittle. This marchasita also rendered copper white as silver. Thus far Albertus. It obtained without doubt the name of *marchasita aurea*, because zinc communicates a yellow colour to copper; and for the same reason the Greeks and the Arabians called *cadmia* golden or *aurea*. But how could Albertus say that marchasite made copper white? Did he commit a mistake, and mean tin? To me this appears not probable, as at one time he seems to call it *argentea*. I imagine that he knew that copper, when mixed with as much zinc as possible, that is, according to Scheffer, eighty-nine pounds to a hundred, became white; and it appears that by this he wished to establish its affinity with quicksilver.

The next author who gives an intelligible account of this metal is Theophrastus Paracelsus, who died in 1541. I do not however imagine that it was forgotten in this long interval, at least by those who were called alchemists. I am rather of opinion, that on account of the great hopes which it gave them by the colouring of copper, they described it purposely in an obscure manner, and concealed it under other names, so that it was not discovered in their works. There are few who would have patience to wade through these, and the few who could do so, turn their attention to objects of greater importance than those which occupy mine. Gold and silver excepted, there is no metal which has had formerly so many and so wonderful names as zinc[99]. For this reason, chemists long believed that zinc was not a distinct metal, but only a variety of tin or bismuth; and with these perhaps it may hence have been often confounded.

The name zinc occurs first in Paracelsus. He expressly calls it a distinct metal, the nature of which was not sufficiently known; which could be cast, but was not malleable, and which was produced only in Carinthia. Was he then unacquainted with the zinc of Goslar, which was known at an earlier period to Albertus Magnus[100]? George Agricola, who wrote about the year

1550, speaks however of the Goslar zinc, but he calls it *liquor candidus*, and in German *conterfey*[101]. Mathesius, who published his sermons in 1562, says, "at Freyberg there is red and white zinc." Perhaps he did not mean the metal, but minerals that contained zinc. George Fabricius, who died in 1571, conjectures that *stibium* is what the miners call *cincum*, which can be melted, but not hammered.

It is seen by these imperfect accounts that this metal must have been scarce, even in the middle of the sixteenth century, and that it was not in the collection of Agricola, which was considerable for that period. Libavius, who died in 1616, mentions it several times, but he regrets, in one of his letters, that he had not been able to procure any of it[102]. Was this owing to the prohibition of duke Julius, by which it was forbidden to be sold? This prohibition is quoted by Pott from Jungii Mineralogia, with which I am unacquainted; but as Pott has already, by his unintelligible quotations, made me spend many hours to no purpose, I shall not waste more in searching for it. The prohibition alluded to is mentioned neither by Rehtmeier nor by any other author. The foolish taste for alchemy, which prevailed then at the duke's court, makes it not altogether improbable that one was issued[103]; and if that was really the case, it was occasioned not so much by any dread of this metal being misused, as Pott thinks, but by the high hopes which were entertained of its utility in making gold. The first accurate and certain account of the method of procuring zinc at Goslar, is, as far as I know, given by Lœhneyss, in 1617, though he considers it to be the same as bismuth[104]. Joh. Schrœder of Westphalia, who died in 1664, calls it *marcasita pallida*.

The first person who purposely procured this metal from calamine, by the addition of some inflammable substance, was undoubtedly Henkel, who gave an account of his success in the year 1741, though he concealed the whole process[105]. After him, Dr. Isaac Lawson, a Scotsman, seems to have made experiments which proved the possibility of obtaining zinc in this manner on a large scale; and in 1737 Henkel heard that it was then manufactured in England with great advantage. Of this Lawson I know nothing more than what is related by Dr. Watson[106]. Anthony von Swab,

member of the Swedish council of mines, procured this metal afterwards from calamine by distillation, in 1742; as did Marggraf in 1746, who appears however not to have been acquainted with the Swedish experiment. In the year 1743, one Champion established zinc works at Bristol, which were continued by his successor James Emerson, who established works of the like kind at Henham, in the neighbourhood. The manner in which the metal was procured, has been described by Dr. Watson in his Chemical Essays.

The greater part of this metal, used in Europe, was undoubtedly brought from the East Indies. The Commercial Company in the Netherlands, between the years 1775 and 1779, caused to be sold, on their account, above 943,081 pounds of it[107]. In the year 1780, the chamber of Rotterdam alone sold 28,000 pounds; and I find, by printed catalogues, that the other chambers, at that period, had not any of it in their possession. If the account given by Raynal be true, the Dutch East India Company purchased annually, at Palimbang, a million and a half of pounds[108]. In 1781, the Danish Company at Copenhagen purchased 153,953 pounds of tutenage, which had been carried thither in two vessels, at the rate of from four and one-eighth to four and a quarter schillings Lubec per pound. It is probable that the English and Swedes import this article also. It would be of some consequence if one could learn in what part of India, when, and in what manner this metal was first procured, and in what year it was first carried thence to Europe. According to the scanty information which we have on the subject, it comes from China, Bengal, Malacca[109], and the Malabar coast, from which copper and tin are also imported. In the oldest bills of lading of ships belonging to the Netherlands I find no mention of zinc; but it is possible that it may be comprehended under the name of Indian tin; for so it was at first called. Savot, who died about the year 1640, relates, on the authority of a contemporary writer[110], that some years before the Dutch had taken from the Portuguese a ship laden with this metal, which was sold under the name of *speautre*. It is probable therefore that it was brought to Europe so early as the beginning of the seventeenth century. Indian tin is mentioned by Boyle.

It is probable that this metal was discovered in India before anything of the European zinc had been known in that country; but we are still less acquainted with the cause of the discovery than with the method of procuring the metal. We are told that an Englishman, who, in the above century, went to India, in order to discover the process used there, returned with an account that it was obtained by distillation *ver descensum*.

Respecting the origin of the different names of this metal, I can offer very little. *Conterfey* signified formerly every kind of metal made in imitation of gold[111]. Frisch says it was called *zink*, from which was formed first *zinetum*, and afterwards *zincum*, because the furnace-calamine assumes the figure of (*zinken* or *zacken*) nails or spikes; but it is to be remarked that these names do not occur before the discovery of this metal, though *ofenbruch* was known long before. Fulda speaks of the Anglo-Saxon *sin*, *zink*, which he translates *obryzum*. *Spiauter*, *speauter*, and *spialter*, from which Boyle made *speltrum*, and also *tutaneg* or *tuttanego*, came to us from India with the commodity. Under the last-mentioned name is sometimes comprehended a mixture of tin and bismuth. *Calaem* is also an Indian appellation given to this metal, and has a considerable likeness to calamine; but I am of opinion with Salmasius that the latter is not derived from the former, as *lapis calaminaris* occurs in the thirteenth century, and *calaem* was first brought to us by the Portuguese from India.

[Most of the zinc works in this country are situated in the neighbourhood of Birmingham and Bristol; a few furnaces also exist in the neighbourhood of Sheffield, among the coal-pits surrounding that town; there is also one at Maestag in Glamorganshire. The ores worked at Bristol and Birmingham are principally obtained from the Mendip-hills and Flintshire; those at Sheffield from Alston Moor. The greater part however of the zinc used in this country is imported in ingots and plates from Silesia, by way of Hamburg, Antwerp, Dantzic, &c. We receive annually from 100,000 to 170,000 cwts. from Germany; of this quantity, about 80,000 cwt. are entered for home consumption, and the rest is exported for India.

From its moderate price and the ease with which it can be worked, zinc is now extensively used for making water-cisterns, baths, pipes, covering of roofs, and a great many architectural purposes. It has also of late been employed in the curious art of transferring printing, known under the name

of *Zincography*, but owing to the ease with which this metal becomes coated with a film of oxide or carbonate, by exposure to the air, the plates cannot be preserved for any great length of time.]

FOOTNOTES

82 [It has been observed by an anonymous reviewer (British and Foreign Medical Review, vol. viii. p. 361) that a passage in Strabo authorises the belief that the ancients were acquainted with this metal in its separate state, and that it is the *false silver*, ψευδάργυρον, of that ancient geographer.]

83 Bulletin des fouilles d'une ville Romaine, p. 11.

84 Plin. lib. xxxiv. sect. 22.

85 Zinc-ore, besides being mentioned by Aristotle and Strabo, is mentioned by Galen, De Simplic. Medicam. Facultatibus, lib. ix. p. 142. As he found no furnace-calamine when he resided in Cyprus, he procured from the overseer of the mines some raw *cadmia*, which had been found in the mountains and rivulets, and which certainly must have been calamine.

86 At first it was called *æs cyprium*, but in the course of time only *cyprium*; from which was at length formed *cuprum*. It cannot however be ascertained at what periods these appellations were common. The epithet *cupreus* occurs in manuscripts of Pliny and Palladius; but one cannot say whether later transcribers may not have changed *cyprius* into *cupreus*, with which they were perhaps better acquainted. The oldest writer who uses the word *cuprum* is Spartian; who says, in the Life of Caracalla, "cancelli ex ære vel cupro." But may not the last word have been added to the text as a gloss? Pliny, book xxxvi. 26, says, "Addito cyprio et nitro;" which Isidore, xvi. 15, p. 393, expresses by the words *adjecto cupro et nitro*. The superiority of the Cyprian copper gave occasion to this

appellation; as the best iron or steel was called *chalybs*, from the *Chalybes* (a people of Galatia) who prepared the finest, and carried on the greatest trade with it. But in what did the superiority of this Cyprian copper consist? In its purity, or in its colour, which approached near to that of gold? That island produced a great deal of ore which contained zinc, and abounded also with calamine. Pliny says, "in Cypro prima fuit æris inventio." Red copper however had been known there from the earliest periods, so that the honour of its invention must be allowed to that island without any contradiction; and Pliny must undoubtedly allude in the above passage to some particular kind.

87 Dioscorides, book v. c. 84, first mentions some sorts of *cadmia*, βοτρυίτις, πλακωτὴ and ὀστρακῖτις. These, according to Galen and Pliny, are undoubtedly certain kinds of (*ofenbruch*) furnace-calamine; but Salmasius in his book De Homonymis, p. 230, and Sarracen in his Annotations, p. 113, are of opinion that Dioscorides considered them as native kinds of *cadmia*, or minerals abundant in zinc. I cannot however allow myself to believe that Dioscorides, who was so careful, and who immediately after describes the artificial preparation of *cadmia* clearly and properly, should have thus erred. Besides, every kind of *ofenbruch* (furnace-calamine) must have discovered its origin from fire to such a good judge of minerals as Dioscorides. I am convinced that he, as well as Galen and Pliny, considered the above kinds as furnace-calamine.

Pompholyx was the name of the white flowers of zinc which Dioscorides, v. 85, p. 352, compares to wool, and which by chemists were formerly called *lana philosophica*. The ancients collected these flowers when produced by the melting of zinc-ore; but they obtained them also by an apparatus which is fully described by Dioscorides and Galen, and which approaches near to that used for collecting arsenic in the poison melting-houses, as they are usually called.

88 This however I will not with certainty affirm. As *calmey* and *galmey* have probably taken their rise from *cadmia* or *calimia*, and as both these words signified proper calamine, as well as

ofenbruch, the latter, perhaps, may at an earlier period have signified furnace-calamine.

89 Proofs respecting this subject may be found in Salmasius De Homonymis.

90 It is not certainly known when this Zosimus Panopolitanus lived. His works, which must contain abundance of information respecting the history of chemistry, have never yet been printed. The greater part of them were preserved in the king's library at Paris. The receipt to which I allude has been inserted by Salmasius, p. 237.

91 We read in Observations sur la Physique, vi. p. 255, that for many years *tutia* has been collected and sold in the bishopric of Liege. Lehmann endeavours to show that it was made by the Jews in Poland. Novi Comment. Acad. Petrop. xii. p. 381. As the use of tutia [which is an impure oxide of zinc found in the chimneys of the furnaces in which zinc-ores are roasted, or in which zinciferous lead-ores are smelted] has been almost abandoned, because physicians prefer pure flowers of zinc, and because those who make pinchbeck employ purified zinc, it is probable that this substance will soon be entirely neglected.

92 De Mineralibus. Coloniæ, 1569, 12mo, p. 350, lib. iv. cap. 5; and lib. v. cap. 7, p. 388.

93 The other edition was printed at Stockholm and Hamburg, by Liebezeit, and is the same as that mentioned by H. Gatterer, in Anleitung den Harz zu bereisen, i. p. 313, and ii. p. 13.

94 "White vitriol also is made at Goslar, but by one citizen only, named Henni Balder. It is not procured by the evaporation of copper like other vitriol; but when large quantities of ore are roasted in the furnaces, a red substance is from time to time collected on the refuse of the ore, and found in some places half an ell thick. This substance, which is saltish, is formed into a lye, and boiled in small leaden pans. The rest of the process I do not know,

but I observed that it crystallizes like saltpetre, but is stronger and whiter. It is also cast into small cakes about the thickness of one's hand. This vitriol is employed by the leather-dressers, and may be used for many things instead of alum; but it cannot be used in dressing white skins, because it makes them yellowish."

95 Bruckmann, ii. p. 446. [Schwartze, in his Pharm. Tabell. 2nd edit. p. 779, states that white vitriol was known towards the end of the thirteenth or at the commencement of the fourteenth century.]

96 Calvor, Historische Nachricht, p. 199 and 200. Properly it is written and pronounced *jöckel*. It is very remarkable that in Iceland this word at present signifies icicles.

97 Chemie, von Kessel, iv. 2, p. 832, where may be found the old opinions on this subject.

98 Brandt, in Acta Upsaliens. 1735. Hellot, in Mémoires de l'Acad. des Sciences, Paris, 1735, p. 29. [Sulphate of zinc or white vitriol is at present manufactured in considerable quantity for pharmaceutical purposes, and for the calico-printer.]

99 A great many may be found collected in Fuchs, Geschichte des Zinks. Erfurt, 1778, 8vo.

100 Paracelsi Opera. Strasb. 1616, fol. I shall here transcribe the principal passage. Of zinc:—There is another metal, zinc, which is in general unknown. It is a distinct metal of a different origin, though adulterated with many other metals. It can be melted, for it consists of three fluid principles, but it is not malleable. In its colour it is unlike all others, and does not grow in the same manner; but with its *ultima materia* I am as yet unacquainted, for it is almost as strange in its properties as *argentum vivum*. It admits of no mixture, will not bear the *fabricationes* of other metals, but keeps itself entirely to itself.

101 De Re Metallica, lib. ix. p. 329.

[102] In J. Hornung's Cista Medica. Lipsiæ.

[103] How much duke Julius, who in other respects did great service to his country, suffered himself to be duped by the art of making gold, appears from an anecdote given by Rehtmeier, p. 1016. Of this anecdote I received from M. Ribbentrop an old account in manuscript, which one cannot read without astonishment. There is still shown, at the castle of Wolfenbuttle, an iron stool, on which the impostor, Anna Maria Zieglerinn, named Schluter Ilsche, was burnt, February 5, 1575.

[104] Page 83:—"When the people at the melting-houses are employed in melting, there is formed under the furnace, in the crevices of the wall, among the stones where it is not well plastered, a metal which is called zinc or *conterfeht*; and when the wall is scraped, the metal falls down into a trough placed to receive it. This metal has a great resemblance to tin, but it is harder and less malleable, and rings like a small bell. It could be made also, if people would give themselves the trouble; but it is not much valued, and the servants and workmen only collect it when they are promised drink-money. They however scrape off more of it at one time than at another; for sometimes they collect two pounds, but at others not above two ounces. This metal, by itself, is of no use, as, like bismuth, it is not malleable; but when mixed with tin, it renders it harder and more beautiful, like the English tin. This zinc or bismuth is in great request among the alchemists."

[105] Kieshistorie, p. 571, and particularly p. 721.

[106] Pott refers to Lawson's Dissert. de Nihilo, and quotes some words from it; but I cannot find it; nor am I surprised at this, as it was not known to Dr. Watson.—See Chemical Essays, iv. p. 34. Pryce, in Mineral. Cornub., p. 49, says, "The late Dr. J. Lawson, observing that the flowers of *lapis calaminaris* were the same as those of zinc, and that its effects on copper were also the same with that semi-metal, never remitted his endeavours till he found the method of separating pure zinc from that ore." The same account is given

in the supplement to Chambers's Dictionary, 1753, art. *calm.* and *zinc*; and in Campbell's Political Survey of Britain, ii. p. 35. The latter however adds, that Lawson died too early to derive any benefit from his discovery.

107 Ricards Handbuch der Kaufleute, i. p. 57.

108 Raynal says that the company purchase it at the rate of twenty-eight florins three-quarters per hundred weight, and that this price is moderate. At Amsterdam, however, the price was commonly from seventeen to eighteen florins banco. According to a catalogue which I have in my possession, the price, on the 9th of May, 1788, was seventeen florins, and on the 22nd of January, 1781, it was only sixteen.

109 Linschoten, b. ii. c. 17. The author calls it *calaem*, the name used in the country. It is a kind of tin.

110 De Nummis Antiquis; in Grævii Thes. Antiq. Rom. xi. p. 1195.

111 Matthesius, Pred. v. p. 250.—"*Conterfeil* is a metal of little value, formed by additions and colouring substances, so that it resembles gold or silver, as an image, or anything counterfeited, does its archetype. Thus copper is coloured by calamine and other mixtures, in such a manner that it appears to be pure gold." In the police ordinance issued at Strasburg in 1628, young women are forbidden to wear gold or silver, or any *conterfaite*, and everything that might have the appearance of gold or silver.

CARP.

So obscure is the ichthyology of the ancients, or so little care has been taken to explain it, that the question whether our carp were known to Aristotle, Pliny, and their contemporaries, cannot with any great degree of probability be determined. Besides, that subject is attended with much greater difficulties than the natural history of quadrupeds. Among four-footed animals there is a greater variety in their bodily conformation, which at any rate strikes the eye more, and can be more easily described than that of fishes, which in general are so like in shape, that an experienced systematic naturalist finds it sometimes difficult to determine the characters of the genera and species. It is not surprising therefore that the simple descriptions of the ancients, or rather the short accounts which they give us of fish, do not afford information sufficient to enable us to distinguish with accuracy the different kinds. Quadrupeds may terrify us by their ferocity, or endeavour to avoid us by shyness and craft; but it is still possible to observe their sexes, their age, and their habits, and to remark many things that are common to one or only a few species. Fishes, on the other hand, live in an element in which we cannot approach them, and which for the most part conceals them from our observation. The chase, since the earliest periods, and in modern times more than formerly, has been the employment of idle persons, who bestow upon it greater attention the fewer those objects are which can attract their curiosity or employ their minds: but fishing has almost always been the laborious occupation of poor people, who have no time to make observations, as they are obliged to follow it in order to find a subsistence; and mankind in general seldom see fish except on their tables or in collections of natural history. On this account those properties of fish by which their species could be determined, were less known. The descriptions of four-footed animals which have been handed down to us from the time of the Greek and Roman writers, give us, at any rate, some information; but from those of fishes, which are more uncommon, we can scarcely derive any; unless one were as acute or easy of belief as many

collectors of petrefactions, who imagine that they can distinguish each species of fish in the impressions which they see in stones. More however might be done towards elucidating the ichthyology of the ancients than has hitherto been attempted. It would be necessary only to make a beginning by collecting the species and names which can with certainty be determined, together with the authorities, and separating them from the rest; and an abstract should be formed of what is said in the ancients respecting the unknown species, or whatever may in any measure serve to make us acquainted with them; but mere conjectures ought never to be given as proofs, nor ought the opinions of commentators, or the explanations of dictionaries to be adopted without sufficient grounds. If these are to be believed without further examination, the names *cyprini* and *lepidoti* must be considered as those of carp; and the proposed question would be soon answered: but that opinion has scarcely probability in its favour when one searches after proofs.

I shall not here lay before the reader everything completely that the ancients have said respecting the *cyprini*, and which is in part so corrupted by transcribers, that no certain meaning can be drawn from it. Were I to treat of the ichthyology of the ancients, it might be necessary; but as that is not the case, I shall only quote such parts of it as have been employed by Rondelet and others to prove that they were our carp. Their principal grounds seem to be, that among all the fish of the ancients no others occur which can with any probability be considered as carp. If the *cyprini* therefore were not carp, these must not have been named by the ancients; and that undoubtedly will not readily be admitted. It is well known what a high value the ancients, particularly the Orientals, set upon fish, of which they had a great variety; and it appears that they preferred them to all dishes prepared from four-footed animals or fowls. Fish seem to have been the choicest delicacies of voluptuaries, and in that respect they are oftener mentioned by historians than fowls. Physicians also, to whom the most sumptuous tables have in all ages been of the greatest benefit, speak of fish oftener in their writings than of dishes made of the flesh of other animals. In the ancient cookery, the number of dishes prepared from fish is indeed great in comparison of those dressed from fowls. *Turdi* and *attagines* are much praised; but had pheasants, snipes, partridges, and others, been as much esteemed then as they are now, these would not have been forgotten, or would have occurred oftener. Fish at present form the principal food in

Greece, as well as at Constantinople, and a great abundance and variety of them may be found there in the markets; but fowls which have been caught or shot are seldom exposed for sale. When the Egyptian and Greek monks wished to distinguish themselves by abstinence and temperance, they denied themselves all kinds of fish, as the richest delicacies, in the same manner as pretended devotees among the Europeans deny themselves flesh. But though all this may be true, it does not prove that our carp must occur in the writings of the ancients. The Roman voluptuaries, indeed, left very little untried that was likely to gratify their appetite; but it was impossible for them to make a trial of everything. There may have been particular reasons which prevented them from meeting with carp; and who will venture to affirm that all the knowledge of the ancients must be contained in those few of their writings which have been preserved to us by accidents?

If one, freed from these prejudices, should now ask why the *cyprinus* must be our carp, the answer will be, because what we read of the tongue and scales of the *cyprini* cannot be applied with so much propriety to any species of fish as to the *Cyprinus carpio* of Linnæus. Aristotle informs us that the *cyprini* had properly no tongue, but that their soft fleshy palate might very readily be taken for one[112]. Athenæus affirms that they had a tongue, but that it lay in the upper part of the mouth or palate; and in confirmation of this he refers to Aristotle[113]. This assertion of Athenæus however is very dubious; for these words are not to be found in the works of Aristotle which have been preserved, though the same meaning might be indeed forced, in case of necessity, from the passage first quoted. It is possible that Athenæus, as Casaubon[114] has already conjectured, may here, as well as in other parts, allude to some book of Aristotle not now extant. Besides, he calls the fish of which he speaks, not *cyprinus*, but *cyprianus*; and a question therefore arises, whether he may not have meant some other kind. This much at any rate appears certain from the passage of Aristotle, that the *cyprinus* had a thick fleshy palate; and that indeed is the case with our carp, so that the head, on account of the delicacy and agreeable taste of the palate, is reckoned the most relishing part. By that circumstance however nothing is proved; as it is not peculiar to carp alone, but common to every species of the same family, such as the bream, tench, &c. Fish of this kind, says Bloch, have properly no tongue; that which appears to be one

is merely a cartilaginous substance which projects through those band-like parts that enclose it on each side. This proof would have more weight, did we find it related, that in the time of Aristotle, the tongue was considered as an exquisite morsel: but that is not mentioned; and H. Krunitz is mistaken, when he says that Heliogabalus, to satisfy his luxurious appetite, was induced to try a fricassee of the tongues of carp: it consisted only of the tongues of peacocks and nightingales[115]. Had the ancients really used carp on their tables, we must have ascribed to them the discovery of these delicious fish.

The other proof which is brought from the scales consists in what is said by Dorion, in Athenæus[116], that the *cyprianus* was called also by some *lepidotus*, or scaly. As nearly all fish have scales, the scales of this species must have been extremely large, as they got that name by way of eminence; and it must be indeed allowed, that the above epithet would suit our carp exceedingly well, as their scales are very large. But this circumstance alone proves nothing, as the *Mullus* and *Mugil* have still larger scales; and to the first genus belonged one of the fish most esteemed by the ancients[117]. Strabo mentions the *lepidotus* among the sacred fish of the Nile; but whether it be the same as that of which Dorion speaks, cannot be determined. It is certain that the Nile contains carp still; for Norden saw them caught at the waterfall near Essuane, which is the ancient Syene. Did we know that the modern Greeks at present call carp *cyprini*, this would prove more; for it is an undoubted fact that the ancient names have for the most part been retained in Greece. We are assured by Massarius[118], that the Greeks still use the name *cyprinus*; but Gyllius says that it is employed only by a few: and this is confirmed by Bellon, who mentions all the names of carp which he heard in Greece, and which are entirely different from the ancient[119]; but he adds, that carp in Ætolia are still called *cyprini*. Both the before-mentioned circumstances respecting the *cyprini* agree extremely well with our carp; but as they will suit other kinds equally well, they afford no complete proof, but only a probability which amounts to this, that among the large-scaled fish, carp in particular have a fleshy palate; and it is readily admitted that the ancients were acquainted with all kinds, and chose names for them with more foundation than is done at present.

In opposition to this probability it may be said that Oppian and Pliny reckon the *cyprini* among the sea-fish, to which kind our carp do not belong. This reply however, which some have indeed made, is not of great weight. In the first place, both these writers seem to have been in an error; for what Pliny says of the *cyprini* is evidently taken from Aristotle, and the latter does not tell us that these fish live in the sea, but rather the contrary. The Roman author, as Dalechamp remarks, added the words *in mari*, if they were not added by some transcriber. Oppian as a poet does not always adhere strictly to truth; and he makes more of the freshwater fish of Aristotle to be inhabitants of the sea. In the second place, I consider the distinction made between sea-fish, freshwater fish and those kept in ponds, to be not always very certain or well founded. Who knows whether the greater part of the last may not have been originally sea-fish? This is the more probable in regard to carp, as Professor Foster says that carp are sometimes caught in the harbour at Dantzic[120].

In order to answer the question here proposed, another point may be considered. As all nations at present give these fish the same name, it is probable that it was brought with them from that country where they were first found, and from which they were procured. Cassiodorus, who lived in the sixth century, is the oldest author as yet known in whom that name has been observed[121]. In a passage where he speaks of the most delicate and costly fish, which at that time were sent to the tables of princes, he says, "Among these is the *carpa*, which is produced in the Danube." In the earliest Latin translation of Aristotle, the word *cyprinus*, as Camus says, is expressed by *carpra*. In the thirteenth century this fish was called by Vincentius de Beauvais[122] *carpera*, and by Cæsarius *carpo*; and it is highly probable that both these names allude to our carp. By the above passage of Cassiodorus, the opinion that these fish were the *cyprini* of the ancients obtains a new, but at the same time a very feeble proof; for the *cyprinus* was found also in the Danube, as we learn from Ælian[123], who among the fish of the Ister, mentions black *cyprini*; and these, according to the conjecture of Professor Schneider, were the black fish of the Danube which Pliny considers as unhealthful or poisonous, and like which there were some in Armenia. Our carp indeed are not poisonous, but Pliny alludes to a particular variety, and what he says was only report, to which something

must have given rise, as also to the idea of carp with a death's head, and the head of a pug-dog, as some have been represented by writers of the sixteenth century. The *carpo* of Cæsarius appears to have been our carp, because its scales had a very great resemblance to those of the latter; for we are told in the work already quoted, that the devil, once indulging in a frolic, appeared in a coat of mail, and had scales like the fish *carpo*. The *carpera* of Vincent de Beauvais is still less doubtful, as the same craft in avoiding rakes and nets is ascribed to that fish as is known to be employed by our carp. Sometimes they thrust their heads into the mud and suffer the net to pass over them; and sometimes they join the head and tail together, and separating them suddenly, throw themselves towards the surface of the water, and springing often four or five feet above the net, make their escape.

But whence did this name arise? The origin assigned by Vincentius, or the anonymous author of the lost books De Natura Rerum, like another mentioned in ridicule by Gesner, is too silly to be repeated. More learned at any rate is the derivation of Menage, who traces it from *cyprinus*, which was afterwards transformed into *cuprinus*, *cuprius*, *cuprus*, *cupra*, *curpa*, and lastly into *carpa*. For my part, I am more inclined to derive it from a dialect which was spoken on the banks of the Danube, and to believe that it was brought with the fish from the southern part of Europe; but I am too little acquainted with that dialect to be able to render my conjecture very probable; and the etymologists I consulted, such as Wachter, Ihre, Johnson, &c., afforded me no assistance. Fulda gave me some hopes, as he allows the word to be of German extraction; but I must confess that his derivation is too far-fetched, and like the chemistry of the adepts, to me not perfectly intelligible.

It may perhaps not be superfluous here to observe that one must not confound *carpa* and *carpo*, or our carp, with *carpio*. The latter belongs to the genus of the salmon and trout; and in the Linnæan system is called *Salmo carpio*. It is found chiefly in the Lago di Garda, the ancient Lacus Benacus, on the confines of Tyrol. The oldest account of this fish is to be found in works of the sixteenth century, such as the poems of Pierius Valerianus, and in Jovius de Piscibus. According to Linnæus, it is found in the rivers of England; but that is false. This celebrated naturalist suffered himself to be misled by Artedi, who gives the char or chare, mentioned by Camden in his description of Lancashire, as the *Salmo carpio*. Pennant

however, by whom it is not mentioned among the English fish, says expressly that the char is not the *carpio* of the Lago di Garda, but rather a variety of the *Salmo alpinus*[124].

That our carp were first found in the southern parts of Europe, and conveyed thence to other countries, is undoubtedly certain. Even at present they do not thrive in the northern regions, and the further north they are carried the smaller they become[125]. Some accounts of their transportation are still to be found. If it be true that the Latin poem on the expedition of Attila is as old as the fifth or sixth century, and if the fish which Walther gave to the boatman who ferried him over the Rhine, and which the latter carried to the kitchen of Gunther king of the Franks, were carp, this circumstance is a proof that these fish had not been before known in that part of France which bordered on the Rhine[126]. The examination of this conjecture I shall however leave to others. D'Aussy quotes a book never printed, of the thirteenth century, entitled Proverbes, and in which is given an account of the best articles produced at that time by the different parts of the kingdom, and assures us that a great many kinds of fish were mentioned in it, but no carp, though at present they are common all over France.

It appears also that there were no carp in England in the eleventh century, at least they do not occur in the Anglo-Saxon Dictionary of Ælfric, who in 1051 died archbishop of York[127]. We are assured likewise that they were first brought into the kingdom in the fifth year of the reign of Henry VIII., or in 1514, by Leonard Mascal of Plumsted in Sussex[128]. What we read in the Linnæan System, that these fish were first brought to England about the year 1600, is certainly erroneous. Where that celebrated naturalist, under whom I had the pleasure of studying, acquired this information, I do not know.

Denmark is indebted for these fish to that celebrated statesman Peter Oxe, who introduced them into the kingdom as well as cray-fish, and other objects for the table. He died in the year 1575.

We are told that these fish were brought from Italy to Prussia, where they are at present very abundant, by a nobleman whose name is not mentioned. This service however may be ascribed with more probability to

the upper burg-grave, Caspar von Nostiz, who died in 1588, and who in the middle of the sixteenth century first sent carp to Prussia from his estate in Silesia, and caused them to be put into the large pond at Arensberg not far from Creuzburg. As a memorial of this circumstance, the figure of a carp, cut in stone, was shown formerly over a door at the castle of Arensberg. This colony must have been very numerous in the year 1535, for at that period carp were sent from Königsberg to Wilda, where the archduke Albert then resided. At present (1798) a great many carp are transported from Dantzic and Königsberg to Russia, Sweden, and Denmark. It appears to me probable that these fish after that period became everywhere known and esteemed, as eating fish in Lent and on fast-days was among Christians considered to be a religious duty, and that on this account they endeavoured to have ponds stocked with them in every country, because no species can be so easily bred in these reservoirs.

I shall observe in the last place, that the *Spiegel-carpen*, mirror-carp, distinguished by yellow scales, which are much larger, though fewer in number, and which do not cover the whole body, are not mentioned but by modern writers. Bloch says that they were first described by Johnston under the name of royal carp. The passage where he does so I cannot find; but in plate xxix. there is a bad engraving, with the title *Spiegel-karpen*, which however have scales all over their bodies, and cannot be the kind alluded to. On the other hand, the *Spiegel-karpen* are mentioned by Gesner, who, as it appears, never saw them. In my opinion, Balbinus, who wrote in the middle of the sixteenth century, was the first person who gave a true and complete description of them; and according to his account, they seem to have come originally from Bohemia. The first correct figure of them is to be found in Marsigli.

FOOTNOTES

[112] Histor. Animal. lib. iv. cap. 8.

[113] Lib. vii. p. 309.

[114] Animadvers. vii. 17, p. 540.

[115] Lampridii Vita Heliogab. c. 20.

[116] Lib. vii. p. 309.

[117] This fish was a first-rate article of luxury among the Romans, and was purchased at a dear rate. Juvenal says, “Mullum sex millibus emit, æquantem sane paribus sestertia libris.” See Plin. lib. ix. c. 17. The Italians have a proverb, “La triglia non mangia chi la piglia,” which implies, that he who catches a mullet is a fool if he eats it and does not sell it. When this fish is dying, it changes its colours in a very singular manner till it is entirely lifeless. This spectacle was so gratifying to the Romans, that they used to show the fish dying in a glass vessel to their guests before dinner.

[118] Fr. Massarii in ix. Plinii. libr. Castigat. Bas. 1537, 4to.

[119] A great service would be rendered to the natural history of the ancients, if some able systematic naturalist would collect all the Greek names used at present. Tournefort and others made a beginning.

[120] Philosophical Transact. vol. lxi. 1771, part i. 310.

[121] Variorum, p. 380.

[122] Speculum Naturale.

[123] De Nat. Anim. xiv.—Plin. xxxi. sect. 19.—Antig. Car. c. 181.

[124] British Zoology, vol. iii. p. 259.

[125] Pontoppidan, Natürliche Historie von Norwegen, ii. p. 236.

[126] De Prima Expedit. Attilæ, ed. Fischer. Lips. 1780, 4to.

[127] Printed at the end of Somneri Dict. Saxonicum.

128 See Anderson's Hist. of Commerce, and Pennant's Zoology, p. 300. Both these authors refer to Fuller's British Worthies. [The carp existed in England before the year 1486: for in Dame Juliana Berners' work on Angling, which was published at St. Albans (hence called the Book of St. Albans) in 1486, we find the following passage: speaking of the carp, she says "That it is a deyntous fysshe, but there ben but few in Englonde. And therefore I wryte the lesse of hym. He is an euyll fysshe to take. For he is so stronge enarmyd in the mouthe, that there maye noo weke harnays hold him."]

CAMP-MILLS.

Under this appellation are understood portable or moveable mills, which can be used, particularly in the time of war, when there are neither wind- nor water-mills in the neighbourhood, and which on that account formerly accompanied armies in the same manner as camp-ovens and camp-forges. Some of these mills have stones for grinding the corn, and others are constructed with a notched roller like those of our coffee-mills. Some of them also are so contrived that the machinery is put in motion by the revolution of the wheels of the carriage on which they are placed; and others, and perhaps the greater part of those used, are driven by horses or men, after the wheels of the carriage are sunk in the ground, or fastened in some other manner.

To the latter kind belongs that mill of which Zonca[129] has given a coarse engraving, but without any description. He says it was invented by Pompeo Targone, engineer to the well-known marquis Ambrose Spinola; and he seems to place the time of the invention about the end of the sixteenth century. This mill is the same as that described by Beyer in his Theatrum Machinarum Molarium, and represented in the twenty-seventh plate of that work[130]. Beyer remarks that it was employed by Spinola.

The inventor, as his name shows, was an Italian, who made himself known, in particular, at the celebrated siege of Rochelle, under Louis XIII., at which he was chosen to assist, because in the year 1603, when with Spinola, who was consulted respecting the operations at Rochelle, he had helped by means of a mole to shut the harbour of Ostend during the tedious siege of that place. He was likewise in the French service, as *intendant des machines du roi*; but his numerous and expensive undertakings did not succeed according to his expectations[131]. He invented also a particular kind of gun-carriages, and a variety of warlike machines[132].

Another old figure of such a mill was shown to me by Professor Meister, in Recueil de Plusieurs Machines Militaires, printed in 1620. This machine was driven by the wheels of the carriage; but whether it was ever used the author does not inform us.

Lancellotti[133] ascribes this invention to the Germans, about the year 1633.

Carriages for transporting camp-forges and mill-machinery are mentioned by Leonard Fronsperger[134], but he does not say whether complete mills were affixed to them.

FOOTNOTES

[129] Novo Teatro di Machine ed Edificii, di Vittorio Zonca. Padoua, 1621, and reprinted in 1656, fol. The greater part of the machines delineated in this scarce book are engines for raising heavy bodies; but many of them are used in various trades and manufactures, and may serve in some measure to illustrate the history of them.

[130] J. M. Beyer's Schauplatz der Mühlen-Bau-kunst. Leipzig, 1735, fol. Reprinted at Dresden, 1767.

[131] All those authors who have written expressly on the fate of the Huguenots, the History of Richelieu, Louis XIII., and the siege of Rochelle, make mention of Targone.

[132] Histoire de la Milice Françoise, par Daniel. Amst. 1724, i. p. 332.

[133] L'Hoggidi, overo gl'Ingegni non inferiori a' passati. Ven. 1636, 8vo.

[134] Kriegsbuch, Frankf. 1596, fol. p. 9.

MIRRORS[135].

It is highly probable that a limpid brook was the first mirror[136], but we have reason to think that artificial mirrors were made as mankind began to exercise their art and ingenuity on metals and stones. Every solid body, capable of receiving a fine polish, would be sufficient for this purpose; and indeed the oldest mirrors mentioned in history were of metal. Those which occur in Job[137] are praised on account of their hardness and solidity; and Moses relates[138], that the brazen laver, or washing-basin, was made from the mirrors of the women who had assembled at the door of the tabernacle to present them, and which he caused them to deliver up. As the women appeared in full dress at divine worship, it was necessary for them to have looking-glasses after the Egyptian manner. With these the washing-basins, according to the conjecture of most interpretators, were only ornamented, covered, or perhaps hung round; and Michaelis[139] himself was once of this opinion. But why should we not rather believe that the mirrors were melted and formed into washing-basins? As soon as mankind began to endeavour to make good mirrors of metal, they must have remarked that every kind of metal was not equally proper for that use, and that the best could be obtained only from a mixture of different metals. In the mirrors however which were collected by Moses, the artists had a sufficient stock of speculum metal, and were not under the necessity of making it themselves; and for this reason they could much more easily give to the whole basin a polished surface, in which the priests, when they washed, might survey themselves at full length. At any rate such a basin would not be the only one employed instead of a mirror. Artemidorus[140] says that he who dreams of viewing himself in a basin, will have a son born to him by his maid. Dreams indeed are generally as groundless as this interpretation; but one can hardly conjecture that Artemidorus would have thought of such a dream, had it not been very common for people to contemplate themselves in a basin. There

were formerly a kind of fortune-tellers, who pretended to show in polished basins to the simple and ignorant, what they wished to know[141]. The ancients also had drinking-vessels, the inside of which was cut into mirrors, so disposed that the image of the person who drank from them was seen multiplied[142]. Vopiscus mentions, among the valuable presents of Valerian to the emperor Probus, when a tribune, a silver cup of great weight, which was covered on the inside with mirrors of this sort[143].

Menard and others conjecture that mirrors in the time of Homer were not much used, because he mentions them on no occasion, not even where he describes in so circumstantial a manner the toilet of Juno[144]. In answer to this, however, I have two things to observe. In the first place, it is not to be expected that Homer should have mentioned every article with which he was acquainted; and secondly, we are assured by Callimachus, where he evidently has imitated the passage of Homer before-quoted[145], that neither Juno nor Pallas employed a mirror when they dressed. Mythology therefore did not allow the poet to introduce a mirror upon the toilet of that deity. Polydore Vergilius, Boccace, Menard, and others have all fallen into the error of making Æsculapius the inventor of mirrors, though Cicero[146] seems to say the same thing; but the best commentators have long since observed very justly, that the Roman philosopher alludes not to a mirror but to a probe, the invention of which we may allow to the father of medicine, who was at first only a surgeon.

When one reflects upon the use made of metal mirrors, particularly at Rome, to add to magnificence and for other purposes, and how many artists, during many successive centuries, were employed in constructing them, and vied to excel each other in their art, one cannot help conjecturing that this branch of business must at those periods have been carried to a high degree of perfection. It is therefore to be regretted that they have not been particularly described by any writer, and that on this account the art was entirely lost after the invention of glass mirrors, which are much more convenient. No one at that time entertained the least suspicion that circumstances would afterwards occur which would render these metal mirrors again necessary, as has been the case in our days by the invention of

the telescope. Our artists then were obliged to make new experiments in order to discover the best mixture for mirrors of metal; and this should be a warning to mankind, never to suffer arts which have been once invented and useful to become again unknown. A circumstantial description of them should at any rate be preserved for the use of posterity, in libraries, the archives of human knowledge.

When we compare metals in regard to their fitness for mirrors, we shall soon perceive that the hardest of a white colour possess in the highest degree the necessary lustre. For this reason platina is preferable to all others, as is proved from the experiments made by the Count von Sickengen. Steel approaches nearest to this new metal, and silver follows steel; but gold, copper, tin and lead, are much less endowed with the requisite property. I have however observed among the ancients no traces of steel mirrors; and it is probable they did not make any of that metal, as it is so liable to become tarnished, or to contract rust. An ancient steel-mirror is indeed said to have been once found, but as some marks of silvering were perceived on it, a question arises whether the silvered side was not properly the face of the mirror[147]. Besides, every person knows that a steel mirror would not retain its lustre many centuries amidst ruins and rubbish.

The greater part of the ancient mirrors were made of silver, not on account of costliness and magnificence, as many think, but because silver, as has been said, was the fittest and the most durable of all the then known unmixed metals for that use. In the Roman code of laws, when silver plate is mentioned, under the heads of heirship and succession by propinquity, silver mirrors are rarely omitted; and Pliny[148], Seneca[149], and other writers, who inveigh against luxury, tell us, ridiculing the extravagance of the age, that every young woman in their time must have a silver mirror. These polished silver plates may however have been very slight, for all the ancient mirrors, preserved in collections, which I have ever seen, are only covered with a thin coat of that expensive metal; and in the like manner our artists have at length learned a method of making the cases of gold and silver watches so thin and light, that every footman and soldier can wear one. At first the finest silver only was employed for these mirrors, because it was imagined that they could not be made of that which was standard; but afterwards metal was used of an inferior quality. Pliny tells us so expressly,

and I form the same conclusion from a passage of Plautus[150]. Philematium having taken up a mirror, the prudent Scapha gives her a towel, and desires her to wipe her fingers, lest her lover should suspect by the smell that she had been receiving money. Fine silver however communicates as little smell to the fingers as gold; but it is to be remembered that the ancients understood much better than the moderns how to discover the fineness of the noble metals by the smell, as many modes of proof which we use to find out the alloy, were to them unknown. Money-changers therefore employed their smell when they were desirous of trying the purity of coin[151]. The witty thought of Vespasian, who, when reproached on account of his tax upon urine, desired those who did so to smell the money it produced, and to tell him whether it had any smell of the article which was the object of it, alludes to this circumstance. In the like manner many savage nations at present can by their smell determine the purity of gold[152].

We are informed by Pliny, that Praxiteles, in the time of Pompey the Great, made the first silver mirror, and that mirrors of that metal were preferred to all others. Silver mirrors however were known long before that period, as is proved by the passage of Plautus above-quoted. To reconcile this contradiction, Meursius remarks that Pliny speaks only of his countrymen, and not of the Greeks, who had such articles much earlier, and the scene in Plautus is at Athens. This therefore seems to justify the account of Pliny, but of what he says afterwards I can find no explanation. Hardouin is of opinion, that mirrors, according to the newest invention, at that period, were covered behind with a plate of gold, as our mirrors are with an amalgam. But as the ancient plates of silver were not transparent, how could the gold at the back part of them produce any effect in regard to the image? May not the meaning be, that a thin plate of gold was placed at some distance before the mirror in order to throw more light upon its surface? But whatever may have been the case, Pliny himself seems not to have had much confidence in the invention.

Mirrors of copper, brass and gold, I have found mentioned only by the poets, who perhaps employed the names of these metals because they best suited their measure, or because they wished to use uncommon expressions, and thought a golden mirror the noblest. By the brass ones perhaps are to be understood only such as were made of mixed copper. Did golden mirrors

occur oftener, I should be inclined to refer the epithet rather to the frame or ornaments than to the mirror itself; for at present we say a gold watch, though the cases only may be of that metal.

Mirrors seem for a long time to have been made of a mixture of copper and tin, as is expressly said by Pliny[153], who adds, that the best were constructed at Brundisium. This mixture, which was known to Aristotle, produces a white metal, which, on account of its colour, may have been extremely proper for the purpose, and even at present the same mixture, according to the careful experiments made by Mr. Mudge, an Englishman[154], produces the best metal for specula. It appears that the ancients had not determined the proportion very accurately; for Pliny assures us twice that in his time mirrors of silver were preferred. It is indeed not easy to ascertain the quantity of each metal that ought to be taken, and the most advantageous degree of heat; upon which a great deal depends. One of the principal difficulties is to cast the metal without blisters or air-holes, and without causing any part of the tin to oxidize, which occasions knots and cracks, and prevents it from receiving a fine polish. A passage of Lucian[155], which no one as yet has been able to clear up, alludes certainly, in my opinion, to these faults. A mixture of copper and tin is so brittle, that it is very liable to crack; and a mirror formed of it, if not preserved with great care, soon becomes so dim, that it cannot be used till it has been previously cleaned and polished. For this reason a sponge with pounded pumice-stone was generally suspended, from the ancient mirrors, and they were kept likewise in a case or box, as may be seen by the greater part of those still extant. Mirrors of silver were less subject to this inconvenience, and I am inclined to think that the latter on this account made the former be disused, as we are informed by Pliny.

As ancient mirrors of metal are still to be found in collections of antiquities, it might be of some importance to the arts if chemical experiments were made on their composition. Those who have hitherto given us any account of them have contented themselves with describing their external figure and shape. Count Caylus[156] is the only person, as far as I know, who caused any chemical experiments to be undertaken on this subject. They were made on a mirror found near Naples, by M. Roux, who

asserts that the composition was a mixture of copper and regulus of antimony, with a little lead. Antimony however was not known to the ancients. If that metal was really a component part, the mirror must have been the work of more modern times, or it must be allowed that the artist had metal combined with antimony without knowing it; but the latter is not probable. The experiments made by Roux do not seem to me to have proved in a satisfactory manner the presence of regulus of antimony; moreover, no certain information can be derived from them, for the antiquity of the mirror was not ascertained; nor was it known whether it ought to be reckoned amongst the best or the worst of the period when it was made.

Those mirrors, which were so large that one could see one's self in them at full length, must, in all probability, have consisted of polished plates of silver; for to cast plates of such a size of copper and tin would have required more art than we can allow to those periods; and I do not know whether our artists even now would succeed in them[157].

We read in various authors, that, besides metals, the ancients formed stones into mirrors, which were likewise in use. It is undoubtedly certain that many stones, particularly of the vitreous kind, which are opake and of a dark colour, would answer exceedingly well for that purpose; but let the choice have been ever so good, they would not, in this respect, have been nearly equal to metals. These of all mineral bodies have the most perfect opacity; and for that reason the greatest lustre: both these properties are produced by their solidity; and hence they reflect more perfectly, and with more regularity, the rays of light that proceed from other bodies. Our glass mirrors, indeed, are properly metallic. Stones, on the other hand, have at any rate some, though often hardly perceptible, transparency; so that many of the rays of light are absorbed, or at least not reflected. Mention of stone mirrors occurs also so seldom in the ancients, that we may conclude they were made rather for ornament than real utility. In general, we find accounts only of polished plates or panels of stone, fixed in the walls of wainscoted apartments, which were celebrated on account of their property of reflection.

Pliny[158] praises in this respect the obsidian stone, or, as it is now called, the Icelandic agate. Everything that he says of it will be perfectly intelligible to those who are acquainted with this species of stone or

vitrified lava. The image reflected from a box made of it, which I have in my possession, is like a shadow or silhouette; but with this difference, that one sees not only the contour, but also the whole figure distinctly, though the colours are darkened. To form it into images and utensils, which Pliny speaks of, must have been exceedingly difficult, on account of its brittleness. I saw at Copenhagen, among other things made of it, a drinking-cup and cover, on which the artist had been employed four years.

Domitian, when he suspected that plots were formed against him, caused a gallery, in which he used to walk, to be lined with *phengites*, which by its reflection showed everything that was done behind his back[159]. Under that appellation we are undoubtedly to understand a calcareous or gypseous spar, or selenite, which is indeed capable of reflecting an image; but we cannot therefore pretend to say that the ancients formed mirrors of it; nor do I explain what Pliny says, where he speaks of the *phengites*, as if whole buildings had been once constructed of it[160]. That kind of stone, for various reasons, and particularly on account of its brittleness, is altogether unfit for such a purpose. At those periods, the windows of houses were open, and not filled up with any transparent substance, but only covered, sometimes by lattices or curtains. It is probable, therefore, that those openings of the walls of the building mentioned by Pliny, where the windows used to be, were filled up with *phengites*, which, by admitting a faint light, prevented the place from being dark even when the doors were shut; so that Pliny might say, "It appeared as if the light did not fall into the building, but as if it were inclosed in it."

I might be accused of omission did I not here mention also a passage of Pliny[161], where he seems to speak of a mirror made of an emerald, which Nero used to assist him to see the combats of the gladiators. Cary asserts that Nero was short-sighted, and that his emerald was formed like a concave lens. The former is expressly said by Pliny[162], but the latter, though by Abat considered not improbable[163], I can scarcely allow myself to believe, because such an interpretation of Pliny's words is too forced, and because they can be explained much better in another manner. As no mention of such an excellent help to short-sighted people is to be found in any other ancient author, we must allow, if Cary's opinion be adopted, that this

property of the concave emerald was casually remarked, and that no experiments were made to cut any other natural or artificial glass in the same form for the like use, because people imagined that this property was peculiar to the emerald alone, which was then commonly supposed to be endowed with the power of greatly strengthening the eye-sight. Much more probable to me is the explanation of an Italian, which Abat also does not entirely reject, that the emerald had a smooth polished surface, and served Nero as a mirror[164]; and the passage of Pliny alluded to seems to have been thus understood by Isidore[165] and Marbodæus. It may here be objected, that real emeralds are too small to admit of being used as mirrors; but the ancients speak of some sufficiently large for that purpose, and also of artificial ones[166]; so that we may with certainty conclude, that they classed among the emeralds fluor-spar green vitrified lava, or the green Icelandic agate as it is called, green jasper, and also green glass. The piece of green glass in the monastery of Reichenau, which is seven inches in length, three inches in thickness, and weighs twenty-eight pounds three-quarters; and the large cup at Genoa, which is however full of flaws[167], have been given out to be emeralds even to the present time.

Mirrors were made also of rubies, as we are assured by Pliny[168], who refers to Theophrastus for his authority; but this precious stone is never found now of such a size as to render this use possible; and Gary and the anonymous Italian before-mentioned have proved very properly that Pliny has committed a gross mistake, which has not been observed by Hardouin. Theophrastus, in the passage alluded to[169], does not speak of a ruby, but of the well-known black marble of Chio, though he calls both *carbunculus*, a name given to the ruby on account of its likeness to a burning coal, and to the black marble on account of its likeness to a quenched coal or cinder; and the latter, as well as the obsidian stone, was used sometimes for mirrors.

The account how mirrors were formed by the native Americans, before they had the misfortune to become acquainted with the Europeans, is of considerable importance in the history of this art. These people had indeed mirrors which the Europeans could not help admiring. Some of them were

made of black, somewhat transparent, vitrified lava, called by the Spaniards *gallinazo*, and which is of the same kind as the obsidian stone employed by the Romans for the like purpose. Of this substance the Americans had plane, concave, and convex mirrors. They had others also made of a mineral called the Inca's stone[170], which, as has been already said by Bomare, Sage, Wallerius, and other mineralogists, was a compact pyrites or marcasite, susceptible of a fine polish; and on that account often brought to Europe, and worn formerly in rings under the name of the stone of health. Ulloa says the Inca's stone is brittle, opake, and of a somewhat bluish colour; it has often veins which cannot be polished, and where these veins are it frequently breaks. The mirrors formed of it, which he saw, were from two to three inches in diameter; but he saw one which was a foot and a half. The opinion which some have entertained, that these mirrors were cast, has no other foundation than the likeness of polished marcasite to cast brass. This mineral is very proper for reflecting images; and I am inclined to think that the Peruvians had better mirrors than the Greeks or the Romans, among whom we find no traces of marcasite being employed in that manner. It appears, however, that the Indians had mirrors also of silver, copper, and brass[171].

I come now to the question in what century were invented our glass mirrors, which consist of a glass plate covered at the back with a thin leaf of metal. This question has been answered by some with so much confidence, that one might almost consider the point to be determined; but instead of real proofs, we find only conjectures or probabilities; and I must here remark, that I cannot help thinking that they are older than has hitherto been supposed, however desirous I may be to separate historical truth from conjecture. When I have brought together everything which I know on the subject, I would say, that attempts were even made at Sidon to form mirrors of glass; but that they must have been inferior to those of metal, because they did not banish the use of the latter. The first glass mirrors appear to me to have been of black-coloured glass, or an imitation of the obsidian stone; and to have been formed afterwards of a glass plate with some black foil placed behind it[172]. At a much later period, blown glass, while hot, was covered in the inside with lead or some metallic mixture; and still later, and, as appears, first at Murano, artists began to cover plates of glass with an

amalgam of tin and quicksilver. The newest improvements are, the casting of glass-plates, and the art of making plates equally large by blowing and stretching, without the expensive and uncertain process which is required for casting.

That glass mirrors were made at the celebrated glass-houses of Sidon, is mentioned so clearly by Pliny that it cannot be doubted[173]. When I read the passage, however, without prejudice, without taking into consideration what others have said on it, and compare it with what certain information the ancients, in my opinion, give on the same subject, I can understand it no otherwise than as if the author said, that the art of manufacturing glass various ways was invented, principally, at Sidon, where attempts had been made to form mirrors of it. He appears therefore to allude to experiments which had not completely succeeded; and to say that such attempts, at the time when he wrote, had been entirely abandoned and were almost forgotten. Had this circumstance formed an epoch in the art, Pliny, in another place, where he describes the various improvements of it so fully, would not have omitted it; but of those experiments he makes no further mention[174]. All the inventions which he speaks of, evidently relate to metal mirrors only, of which the silver, at that time, were the newest. Had the Sidonian mirrors consisted of glass plates covered at the back, those of metal, the making of which was, at any rate, attended with no less trouble, which were more inconvenient for use on account of their aptness to break, their requiring to be frequently cleaned and preserved in a case, and which were more unpleasant on account of the faint, dull image which they reflected, could not possibly have continued so long in use as they really did; and circumstances and expressions relative to glass mirrors must certainly have occurred. Though glass continued long to be held in high estimation, particularly at Rome; and though many kinds of glass-ware are mentioned in ancient authors, among costly pieces of furniture, mirrors are mentioned only among articles of silver plate. I am acquainted with no certain trace of glass mirrors from the time of Pliny to the thirteenth century; but after that period, at which they are spoken of in the clearest manner, we find them often mentioned in every century; and mirrors of metal at length entirely disappear.

How the Sidonian mirrors were made, is not known; but if I may be allowed a conjecture, I am of opinion that they consisted of dark-coloured glass, which had a resemblance to the obsidian stone. Such is the usual progress of inventions. At those periods one had no other representation of glass mirrors than that afforded by natural glass or vitreous stones. When artists wished to make mirrors of glass, they would try to imitate the latter. After the invention of printing, people endeavoured to render printed books as like as possible to manuscripts; because they imagined that this invention was to be approved only so far as it enabled them to imitate these, without observing that it could far excel the art of writing. But the Sidonian glass mirrors were so much surpassed by the silver or brass ones, which perhaps were invented about the same time, that on this account they were never brought into use. Glass mirrors, perhaps, would have been invented sooner, had mankind employed at an earlier period glass-windows, which often, when they are shut on the outside so that no light can pass through them, reflect images in a much better manner than the best mirrors of metal. This observation, which may be made daily, would then, in all probability, have been sooner turned to advantage.

No one has employed a greater profusion of words to maintain an opinion opposite to mine, than Abat; but when his proofs are divested of their ornaments, they appear so weak that one has very little inclination to agree with him. “The observation,” says he, “that a plate of glass is the best mirror, when all other rays of light, except those reflected back from the glass, are prevented, by a metallic covering placed behind it, from falling on the eye, is so easy, that it must have been made immediately after the invention of glass.” Who does not think here of Columbus and his egg? Instances occur in history of many having approached so near an invention, that we are astonished how they could have missed it; so that we may exclaim with a certain emperor, “Taurum toties non ferire difficile est[175].” “The Sidonian invention,” continues he, “would not have been worth mentioning, had it not produced better mirrors than those which the ancients had before of the obsidian stone. But these even are mentioned only once, in so short and abrupt a manner, and as it were out of ridicule, that one may easily perceive they were not much esteemed.” “If the Sidonians,” adds he, “were not the inventors, let some other inventor be mentioned;” and he assures us that he had sought information on this

subject, in Neri, Kunkel, and Merret, but without success. That I believe; but Abat does not remark that by the same manner of reasoning we may ascribe to the Sidonians the invention of watches, and many other articles, the inventors of which are not to be found in books where they ought as much to be expected as the inventor of glass in Neri. The grounds on which many old commentators of the Bible, Nicholas de Lyra and others, have supposed that glass mirrors were known so early as the time of Moses, are still weaker. If quoting the names of writers who entertain a like opinion be of any weight, I could produce a much greater number of learned men, who, after an express examination of the question, deny altogether that glass mirrors were used by the ancients.

Dr. Watson[176] also has endeavoured to support the opinion of Abat, but with less confidence and with more critical acumen. His grounds, I think, I have weakened already; but one observation here deserves not to be overlooked, because it suggests an idea that may serve to illustrate a passage of Pliny, which, as I before remarked, has never yet been explained. "If we admit," says he, "that Pliny was acquainted with glass mirrors, we may thus understand what he says respecting an invention, which was then new, of applying gold behind a mirror." Instead of an amalgam of tin, some one had proposed to cover the back of the mirror with an amalgam of gold, with which the ancients were certainly acquainted, and which they employed in gilding[177]. He mentions, also, on this occasion, that a thought had once occurred to Buffon, that an amalgam of gold might be much better for mirrors than that used at present[178]. This conjecture appears, at any rate, to be ingenious; but when I read the passage again, without prejudice, I can hardly believe that Pliny alludes to a plate of glass in a place where he speaks only of metallic mirrors; and the overlaying with amalgam requires too much art to allow me to ascribe it to such a period without sufficient proof. I consider it more probable that some person had tried, by means of a polished plate of gold, to collect the rays of light, and to throw them either on the mirror or the object, in order to render the image brighter.

Professor Heeren showed me a passage in the Ecloga of Stobæus, which, on the first view, seems to allude to a glass mirror[179]. It is there said, Philolaus the Pythagorean believed that the sun was a vitreous body, which

only received the rays of the æthereal fire and reflected them to us like a mirror. When we compare, however, the words of Stobæus with those by which Plutarch[180], Achilles Tatius[181], Eusebius[182], and others, express the same thing, that meaning cannot be drawn from them. It appears, at first, as if Philolaus had considered the sun to be transparent, and supposed that the rays passed through it, and came condensed to our earth, in the same manner as they are brought to a focus by a glass globe. Some commentators have explained the passage in this manner; and on account of the affinity of the Greek words have thought also of a funnel. In that case, however, the comparison of the sun with a mirror would not have been just; and if it be admitted that Philolaus considered the sun as a bright body endowed with the property of reflection, what he says of rays passing or transmitted through it, and of the pores of the sun's body, will become unintelligible. But even if we adopt the last explanation, that Philolaus imagined the sun to be a mirror, it does not follow that he had any idea of a glass one[183]; and besides, he only speaks of a body capable of reflecting a strong light; and that glass, under certain circumstances, is fit for that purpose, may have been remarked as soon as it was invented, though men might not find out the art of forming it into proper mirrors by placing some opake substance behind it[184]. Empedocles also said, that the sun was a mirror, and that the light received by our earth was the reflection of the æthereal fire, which Eusebius compares to the reflection made by water[185].

In the problems ascribed to Alexander of Aphrodisias, glass mirrors, covered on the back with tin, are clearly mentioned; but this information does not lead us one step further in the history of the art; as it is proved that the above Alexander, who lived in the beginning of the third century, could not have written that work. The author, who must have been a physician, maintains the immortality of the soul, which Alexander of Aphrodisias, with Aristotle, denies. Some therefore have ascribed these problems to Alexander Trallianus, who practised physic in the middle of the sixth century; but this is only a conjecture which no one has as yet rendered probable, especially as there have been many physicians of the name of Alexander. The problem to which I allude is not to be found in every manuscript and edition; so that it is doubtful whether it may not be the production of a later author than that of the rest of the book, particularly as

it is certain that many who had it in their possession added problems of various kinds according to their pleasure. However this may be, it is evident that the author of this problem was acquainted with mirrors covered at the back; and the expression which he uses does not merely imply that a leaf of tin was placed behind the glass plate, but that the tin in a liquid state was rubbed over it. The old French translator thinks that the author speaks of windows; but that opinion is undoubtedly false[186].

Of as little importance as the above passage of Alexander, is another of Isidore, often quoted in support of the antiquity of glass mirrors. On the first view it appears to be a testimony of great weight; but when closely examined it becomes reduced to very little. "Nothing," says he, "is so fit for mirrors as glass[187]." Abat and others, who have considered these words as decisive, make less hesitation to ascribe to the sixth century, in which Isidore lived, a knowledge of mirrors covered on the back with tin and quicksilver, as the same writer, in another place, observes, that quicksilver can be kept in no vessel but one of glass[188]. It is very true that a glass filled with that metal will form a very good mirror; but I am of opinion that this may have been long known, before people thought of making an amalgam of tin and quicksilver in order to cover the backs of mirrors. The first passage, which is properly the one of any consequence, loses its force when we see that it is taken from Pliny and copied incorrectly. The latter says, that one can give to glass every kind of shape and colour, and that no substance is more ductile, or fitter to be moulded into any form[189]. Isidore, as is usual, says the same thing, and in the same words, except, that instead of *sequacior* he substitutes *speculis aptior*; so that the mention of a mirror is altogether unexpected, and so little suited to what goes before and what follows, that one must believe that this alteration, occasioned perhaps by the similitude of the words, or by an abbreviation, was not made by Isidore, but by some transcriber. But even if we believe that Isidore himself spoke of glass being used at that period for mirrors, we are not able to comprehend, from what he says, how glass mirrors were made in the sixth century.

I have met with no information respecting this subject in the whole period between the age of Isidore and the eleventh century. About the year 1100, at least as is supposed not without probability, Alhazen the Arabian

wrote his well-known treatise on Optics, in which I conjectured that I should find mention made of glass mirrors; but I searched that work in vain, though I must confess I did not read it through entirely. Where he begins his catoptrical lessons, he however often speaks of iron mirrors, by which we may understand mirrors of the best steel. In explaining a certain phænomenon, he says, that the cause of it cannot be in the darkness of the iron mirror, because if a mirror of silver be used, the same effects will be produced. Would he not on this occasion have introduced glass mirrors, had he been as well-acquainted with them as with those already mentioned? At first, he never speaks of mirrors without adding of iron, of silver; but he mentions them afterwards without any epithet of the kind.

All these mirrors I find also in the Optics of Vitello, who wrote in the middle of the thirteenth century, in Italy, a country which was at that time almost the only one where the arts flourished[190]. That author has, indeed, borrowed a great deal from Alhazen, though there are many things of his own, and he gives an account of some experiments on the refracting power of glass; but he never, as far as I have observed, mentions glass mirrors. Whether Jordanus Nemorarius, or Nemoratius, who also wrote, in the thirteenth century, a book *De Speculorum Natura*, makes mention of them, I do not know, because I have never had an opportunity of seeing that work. I am of opinion it was never printed.

It is in the thirteenth century, that I find the first undoubted mention of glass mirrors covered at the back with tin or lead. Johannes Peckham, or Peccam, an English Franciscan monk, who taught at Oxford, Paris, and Rome, and who died in 1292, wrote about the year 1279 a treatise of optics, which was once printed, with the title of Johannis Pisani Perspectiva Communis[191]. In this work, besides mirrors made of iron, steel, and polished marble, the author not only speaks often of glass mirrors, but says also that they were covered on the back with lead, and that no image was reflected when the lead was scraped off. Vincentius Bellovacensis[192] speaks in a manner still clearer, for he tells us that lead was poured over the glass plate while hot. To the same century also belong the concurrent testimonies of Raimundus Lullius[193], Roger Bacon[194], Antonius di Padua[195], and Nicephorus Gregoras[196], who died after the year 1360[197].

That this invention cannot be much older we have reason to conclude, because glass mirrors were extremely scarce in France even in the fourteenth century, while mirrors of metal were in common use; and we are told that the mirror of Anne de Bretagne, consort of Louis XII., was of the latter kind[198]. Metal mirrors also were made and employed in Persia and the East, where indeed ancient usages continued longest, and glass mirrors were not known there till the commencement of the European trade with these remote regions. The former are still preferred in those countries, because they are not so liable to break, and can be preserved better in a dry hot climate than the amalgam of the latter.

Respecting the progress of this art, I know nothing more than what follows:—At first, melted lead, or perhaps tin, was poured over the glass plate while yet hot as it came from the furnace. This process agrees with that which, since very early periods, has been employed in or around Nuremberg for making convex mirrors by blowing with the pipe into the glass-bubble whilst still hot a metallic mixture, with a little resin or salt of tartar, which prevents oxidation and assists the fusion. When the bubble is covered all over in the inside, and after it has cooled, it is cut into small round mirrors. This art is an old German invention, for it is described by Porta and Garzoni, who both lived in the beginning of the sixteenth century, and who both expressly say, that it was then common in Germany. Curious foreigners often attempted to learn it, and imagined that the Germans kept it a secret. Boyle made various experiments in order to discover the process; and the secretary of the Royal Society endeavoured, by means of the ambassador from Charles II., who, perhaps about 1670, resided at Frankfort, to obtain a knowledge of it; but did not succeed, as we are told by Leibnitz[199]. It was called the art of preparing mirrors without foil; and it was highly esteemed, because it was supposed that it might be useful to those fond of catoptrics, by enabling them to form convex and concave mirrors themselves. This account of Leibnitz seems to have led Von Murr into a slight error, and induced him to believe that the art of making convex mirrors without foil was first found out at Nuremberg in 1670. I introduce this remark because I flatter myself he will not be displeased that I make the above service, rendered by his native city, to be a century and a half older. These small convex mirrors, which reflect a diminished, but a clearer image than our usual mirrors, are perhaps made still, though they are not now

carried round so frequently for sale in Germany as they were thirty years ago, at which time, if I remember right, they were called (*Ochsen-augen*) ox-eyes. They were set in a round painted board, and had a very broad border or margin. One of them, in my possession, is two inches and a half in diameter. It is probable that the low price of plane mirrors, when glass-houses began to be more numerous, occasioned these convex ones to be little sought after. The mixture employed in making them was, according to Porta, antimony, lead, and colophonium; but according to Garzoni, it was *una mistura di piombo, stagno, marchesita d'argento, e tartaro*, which in the German edition is translated very badly, "lead, tin, flint, silver, and tartar." The following observation perhaps is not altogether useless: Colophonium, which is employed on many other occasions for soldering, was formerly called mirror-resin, and was sold under that name even in the beginning of the present century. Frisch assigns no reason for this appellation, and Jacobson gives a wrong one, viz. its having a bright shining surface when broken. The true reason was the above-mentioned use; and as that is now very little known, it is called from that to which it is principally applied, violin-resin.

It appears that, instead of pouring melted metal over plates of glass, artists for some time applied to them the before-mentioned amalgam of tin, or covered them in some other manner, perhaps in the same way as Boyle covered concave glasses in the inside. Porta however saw almost the same process employed at Murano as that which is still followed at present. The tin, hammered to thin leaves, was spread out very smoothly; and quicksilver was poured over it, and rubbed into it, either with the hand or a hare's foot; and when the tin was saturated it was covered with paper. The glass, wiped exceedingly clean, was then laid above it; and while the workman pressed it down with his left hand, he drew out very carefully with his right the paper that lay between the tin and the glass, over which weights were afterwards placed. This much at any rate is certain, that the method of covering with tin foil was known at Murano so early as the sixteenth century[200], and therefore it is much older than J. M. Hoffmann supposes. To conclude, whether this ingenious invention belongs to the Venetians, as several later, and particularly Italian, writers assert, I can neither prove nor contradict; but it is well known that till about the end of the seventeenth century their mirrors were sold all over Europe and in both the Indies. After that period the glass-

houses in other countries were improved, and new ones established; and the discovery made in France, that glass, like metal, could be cast into much larger plates than had been before prepared by blowing and rolling, was in more than one respect prejudicial to the sale of those made at Venice.

So early as the year 1634, attempts were made in France to establish glass-houses for manufacturing mirrors, and Eustache Grandmont obtained a patent for that purpose; but his undertaking was not attended with success. As Colbert exerted himself very much to promote manufactures of every kind, Nicholas de Noyer proposed to make mirrors according to the Venetian method. This plan was adopted by Charles Rivière, sieur du Freni, valet-de-chambre to the king; and having procured the royal permission, he sold it afterwards for a large sum to De Noyer, who, in 1665, received a confirmation of the patent, and an advance of 12,000 livres for four years, on condition of his procuring workmen from Venice, who, after serving eight years in the kingdom, were to be naturalized. De Noyer was joined by several more, who entered into partnership with him, and particularly by one Poquelin, who had hitherto carried on the greatest trade in Venetian mirrors, and who engaged workmen from Murano. The glass-houses were erected at the village of Tourlaville, near Cherbourg, in Lower Normandy. After the death of Colbert, who was succeeded by Louvois, the charter of the company was in 1684 renewed for thirty years longer, and at that period Pierre de Bagneux was at the head of it.

Scarcely had five years of this period elapsed, when, in 1688, Abraham Thevart made a proposal to the court for casting glass mirrors of a much larger size than any ever before made. This plan, after an accurate investigation, was approved; and in the same year he received the royal permission to use his invention for thirty years, but it was not registered till 1693 or 1694. The first plates were cast at Paris, and astonished every artist who saw them. They were eighty-four inches in height, and fifty in breadth. In order to lessen the excessive expense, the glass-houses were erected at St. Gobin, in Picardy; and to prevent all dispute with the old privileged company, Thevart was expressly bound to make plates at least sixty inches in length and forty in breadth, whereas the largest of those made before had never exceeded forty-five or fifty inches in length. On the other hand, the old company were allowed to make plates of a smaller size, and were prohibited from employing any of the instruments or apparatus invented by

Thevart. These however had not been so accurately defined as to remove all cause of litigation between the companies, and for that reason permission was at length granted, in 1695, for both to be united into one, under the inspection of François Plastrier, to whom the king, in 1699, sold the palace of St. Gobin. After this they declined so rapidly, that in 1701 they were not able to pay their debts, and were obliged to abandon several of the furnaces. To add to their misfortune, some of the workmen whom they had discharged retired to other countries, which were already jealous of the French invention, and wished to turn it to their advantage. The French writers assert that their attempts never succeeded, and that most of the workmen returned again to France, when a new company was formed in 1702, under the management of Antoine d'Agincourt, who by prudent œconomy improved the establishment, so as to render the profit very considerable. At present mirrors are cast as well as blown, both at St. Gobin and at Cherbourg; and in 1758 the price of them was greatly reduced, in order probably to weaken the competition of the foreign glass-houses, among which there are many not inferior to the French.

This short history of the glass manufactories in France is collected from Savary[201] and Expilly[202]. A more particular account perhaps may be expected of the inventor, of his first experiments, and of their success; but notwithstanding a strict search, I have not been able to find any further information on the subject. We are told only that his name was sieur Abraham Thevart, though the historians who record that circumstance have filled their pages with uninteresting anecdotes, and even with the vices of many of the courtiers of the same period.

The principal benefit which has arisen to the art from this invention, properly is, that much larger mirrors can be obtained than formerly; for when attempts were made to blow very large plates, they were always too thin. Casting, however, besides great expense in apparatus[203], requires so many expert workmen, and so tedious and severe labour, and is accompanied with so much danger, that it is only seldom that plates of an extraordinary size succeed, and the greater part of them must be cut into smaller plates which might have been blown. Those cast are never so even and smooth as those that have been blown; they require therefore a great deal of polishing, and on that account must be very thick. The monstrous

mass requisite for a mirror of the largest size, stands ready melted in a very frail red-hot earthen pot, which is taken from the furnace and placed upon an iron plate, strongly heated, that the mass may be cast upon it into a glass plate. The latter must then be speedily conveyed to the cooling-furnace, and if it be found free from faults, it is ground, polished and silvered; but the last part of the process is generally done at the place where a purchaser can be found for so expensive an article, in order that less loss may be sustained in case it should happen to break by the way.

These great difficulties, which have excited the astonishment of every one who has seen the process, and that of finding sale for so expensive and magnificent wares, have obliged artists to return to the old method of blowing; and many have been so fortunate in improving this branch of manufacture, that plates are formed now by blowing, sixty-four Flemish inches in height and twenty-three in breadth, which it was impossible to make before but by casting.

The mass of matter necessary for this purpose, weighing more than a hundred pounds, is by the workman blown into the shape of a large bag; it is then reduced to the form of a cylinder, and being cut up, is, by stretching, rolling it with a smooth iron, and other means, transformed into an even plane.

[All but the very commonest mirrors are now made of plate-glass; which is also used to a great extent for window-panes, and is manufactured by casting, rolling and polishing. The enormous plates of glass which are seen in many of the large shops of this city are well-calculated to excite the astonishment of those who are not yet aware of the late improvements in this branch of manufacture. An idea of what may be accomplished by blowing was given in 1845, at the Exhibition at Vienna, where a blown glass 7 feet in length and 3½ in breadth was exhibited; and which was of sufficient thickness to admit of polishing. Nevertheless, the casting of plate-glass is now managed with such comparative ease, that there appears to be no limit to the size to which the plates can be brought, so that the blowing of large panes of glass is given up in this country. Private houses may now be seen decorated with single sheets of glass upwards of 20 feet in height and 10 in width.

A patent for a very ingenious process for silvering glass was taken out in November 1843 by Mr. Drayton. It consists in depositing silver, from a solution, upon glass, by deoxidizing the oxide of silver in solution, so that the precipitate will adhere to the glass, without the latter having been coated with metallic or other substances. This is effected by mixing 1 oz. of coarsely powdered nitrate of silver with ½ oz. of spirits of hartshorn and 2 oz. of water; after standing for 24 hours, the mixture is filtered (the deposit on the filter, which contains silver, being preserved), and an addition is made thereto of 3 oz. of spirit (by preference, spirit of wine) at 60° above proof, or naphtha; from 20 to 30 drops of oil of cassia are then added, and after remaining for about 6 hours longer, the solution is ready for use. The glass to be silvered must have a clean and polished surface; it is to be placed in a horizontal position, and a wall of putty formed around it, so that the solution may cover the surface of the glass to the depth of from ⅛th to ¼th of an inch. After the solution has been poured on the glass, from 6 to 12 drops of a mixture of oil of cloves and spirit of wine (in the proportion of 1 part by measure of the oil to 3 of spirit of wine) are dropped into it at different places; or the diluted oil of cloves may be mixed with the solution before it is poured upon the glass; the more oil of cloves used, the more rapid will be the deposition of the silver, but the patentee prefers that it should occupy about two hours. When the required deposit has been obtained, the solution is poured off; and as soon as the silver on the glass is perfectly dry, it is varnished with a composition, formed by melting together equal quantities of bees' wax and tallow. The patentee states that, by experiment, he has ascertained that about 18 grs. of nitrate of silver are used for each square foot of glass.

It has been urged as an objection to this process, that in the course of a few weeks the surfaces of the mirrors formed by it become dotted over with small brownish-red spots, which greatly injures their appearance. Dr. Stenhouse states that these spots are caused by the metallic silver, whilst being deposited on the surface of the glass, carrying down with it mechanically small quantities of a resinous matter, resulting most probably from the oxidation of the oil. This subsequently acts upon the metallic surface with which it is in contact, and produces the small brown spots already mentioned. Mr. Drayton, however, states that the brown spots only occur when the oil employed is old and unfit for use.]

FOOTNOTES

135 The works in which this subject has been already treated are the following:—Eberhartus de Weihe, de Speculi origine, usu et abusu. A compilation formed without taste, of which I gave some account in the Article on Chimneys.—Spanhemii Obs. in Callimachi hymn. lavacr. Palladis, p. 615.—Académie des Inscriptions, t. xxiii. p. 140.—Recherches sur les Miroirs des Anciens, par Menard. A short paper, barren of information.—Saggi di Dissertazioni Accad. dell' Accad. Etrusca dell' città di Cortona, vii. p. 19: Sopra gli Specchi degli Antichi, del Sig. Cari. A translation from the French, with the figures of some ancient mirrors. It contains an explanation of some passages in Pliny, where he seems to speak of a mirror formed of a ruby, and some conjectures respecting the mirror of Nero. An anonymous member of the Academy, in an appendix, confirms the former, and considers the latter, very properly, as improbable.—Caylus, Recueil d'Antiquités, iii. p. 331, and v. p. 173. A description and figures of ancient mirrors, with some chemical experiments on their composition.—Amusemens Philosophiques. Par le père Bonaventure Abat. Amst. 1763, 8vo, p. 433: Sur l'Antiquité des Mirroirs de Verre. A dissertation worthy of being read on account of the author's acquaintance with the ancient writers, and his knowledge of technology; but he roves beyond all proof, and employs too much verbosity to decorate his conjectures.

136 Passages of the poets, where female deities and shepherdesses are represented as contemplating themselves in water instead of a mirror, may be found in the notes to Phædri Fab. i. 4, in the edition of Burmann.

137 Chap. xxxvii. ver. 18.

138 Exodus, chap. xxxviii. ver. 8.

139 Historia Vitri apud Judæos, in Comment. Societat. Scient. Gotting. iv. p. 330. Having requested Professor Tychsen's opinion on this subject, I received the following answer:—"You have conjectured very properly that the mirrors of the Israelitish women, mentioned Exod. xxxviii. 8, were not employed for ornamenting or covering the washing-basins, in order that the priests might behold themselves in them; but that they were melted and basins cast of them. The former was a conceit first advanced, if I am not mistaken, by Nicol. de Lyra, in the fourteenth century, and which Michaelis himself adopted in the year 1754; but he afterwards retracted his opinion when he made his translation of the Old Testament at a riper age. In the Hebrew expression there is no ground for it; and mirrors could hardly be placed very conveniently in a basin employed for washing the feet. I must at the same time confess that the word (מראת) which is here supposed to signify a mirror, occurs nowhere else in that sense. Another explanation therefore has been given, by which both the women and mirrors disappear from the passage. It is by a learned Fleming, Hermann Gid. Clement, and may be found in his Dissertatio de Labro Æneo, Groning. 1732, and also in Ugolini Thesaurus, tom. xix. p. 1505. He translates the passage thus: Fecit labrum æneum et operculum ejus æneum cum *figuris ornantibus*, quæ ornabant ostium tabernaculi. This explanation however is attended with very great difficulties; and as all the old translators and Jewish commentators have here understood mirrors; and as the common translation is perfectly agreeable to the language and circumstances, we ought to believe that Moses, not having copper, melted down the mirrors of his countrywomen and converted them into washing-basins for the priests."

140 Oneirocrit. lib. iii. cap. 30. p. 176.

141 Joh. Sarisberiensis, i. cap. 12.

142 Plin. lib. xxxiii. cap. 9. Seneca, Quæst. Nat. i. cap. 5.

143 Vita Probi, cap. iv. p. 926: “Patinam argenteam librarum decem specillatam.” Salmasius chooses rather to read *specellatam*. I am inclined to think that this word ought to be read in Suetonius instead of *speculatum*, where he speaks of an apartment which Horace seems to have been fond of. That historian, in his Life of Horace, says, “Ad res venereas intemperantior traditur: nam *speculato* cubiculo scorta dicitur habuisse disposita, ut quocunque respexisset, ibi ei imago coitus referretur.” Lessing, who in his Miscellanies (Vermischten Schriften, Berlin 1784, 12mo, iii. p. 205) endeavours to vindicate the poet from this aspersion, considers the expression *speculatum cubiculum*, if translated *an apartment lined with mirrors*, as contrary to the Latin idiom, and thinks therefore that the whole passage is a forgery. Baxter also before said that this anecdote had been inserted by some malicious impostor. This I will not venture to contradict, but I am of opinion that *specillatum* or *specellatum cubiculum* is at any rate as much agreeable to the Roman idiom as *patina specillata*. This expression Salmasius and Casaubon have justified by similar phrases, such as *opera filicata*, *tesselata*, *hederata*, &c. The chamber in which Claudian makes Venus ornament herself, and be overcome by the persuasion of Cupid, was also covered over with mirrors, so that whichever way her eyes turned, she could see her own image. Did Claudian imagine that this goddess knew how to employ such an apartment, not only for dressing, but even after she was undressed, as well as Horace? I have seen at a certain court, a bed entirely covered in the inside with mirrors.

144 Iliad. lib. xiv. ver. 166.

145 Hymnus in Lavacrum Palladis, v. 15, 21. It was however customary to ascribe a mirror to Juno, as Spanheim on this passage proves; and Athanasius, in Orat. contra Gentes, cap. xviii. p. 18, says that she was considered as the inventress of dress and all ornaments. Should not therefore the mirror, the principal instrument of dress, belong to her? May it not have been denied to her by Callimachus, because he did not find it mentioned in the description which Homer has given of her dressing-room?

[146] De Natur. Deorum, iii. 22.

[147] Licetus de Lucernis Antiq. lib. vi. cap. 92.

[148] Lib. xxxiv. cap. 17, p. 669.

[149] Quæst. Nat. at the end of the first book.

[150] Mostell. act i. sc. 3. v. 101.

[151] Arrianus in Epictet. i. cap. 20, p. 79.

[152] Among the remaining passages of the ancients with which I am acquainted, in which mention is made of silver mirrors, the following deserves notice. Chrysostom, Serm. xvii. p. 224, who, in drawing a picture of the extravagance of the women, says, "The maid-servants must be continually importuning the silversmith to know whether their lady's mirror be yet ready." The best mirrors therefore were made by the silversmiths. It appears that the mirror-makers at Rome formed a particular company; at least Muratori, in Thesaur. Inscript. Clas. vii. p. 529, has made known an inscription in which *collegium speculariorum* is mentioned. They occur also in Codex Theodos. xiii. tit. 4, 2. p. 57, where Ritter has quoted more passages in which they may be found. But perhaps the same name was given to those who covered walls with polished stones, and in latter times to glaziers.

[153] Lib. xxxiii. c. 9. p. 627, and lib. xxxiv. c. 17, p. 669.

[154] Philosophical Transactions, vol. lxvii. p. 296.

[155] Quomodo Historia sit conscrib. cap. 51, Bipont edition, iv. p. 210, 535. Commentators have found no other way to explain κέντρον (a word which occurs in Lucian's description of the mirror), than by the word *centre*, to which, according to their own account, there can be here no allusion. In my opinion κέντρον signifies those faulty places which are not capable of a complete polish, on account of the knots or cracks which are found in them. Lucian

therefore speaks of a faultless mirror which represents the image perfect, as he afterwards informs us.

156 As the account of these experiments is given only in an expensive work, which may not often fall into the hands of those who are best able to examine it, I insert it here. “The ancient mirror, which I examined, was a metallic mixture, very tender and brittle, and of a whitish colour inclining to grey. When put into the fire, it remained a long time in a state of ignition before it melted. It was neither inflammable nor emitted any smell like garlic, which would have been the case had it contained arsenic. It did not either produce those flowers which are generally produced by all mixtures in which there is zinc. Besides, the basis of this mixture being copper, it would have been of a yellow colour had that semi-metal formed a part of it. I took two drams of it and dissolved them in the nitrous acid. A solution was speedily formed, which assumed the same colour as solutions of copper. It precipitated a white powder, which I carefully edulcorated and dried. Having put it into a crucible with a reductive flux, I obtained lead very soft and malleable.

“Having filtered the solution, I took a part of it, upon which I poured an infusion of gall-nuts, but it produced no change. A solution of gold, which I poured upon another part, made it assume a beautiful green colour; but no precipitate was formed: which is sufficient to prove that there was neither iron nor tin in the mixture.

“On the remaining part of the solution I poured a sufficient quantity of the volatile alkali to dissolve all the copper that might be contained in it. The solution became of a beautiful sapphire blue colour, and a white precipitate was formed. Having decanted the liquor, and carefully edulcorated the precipitate, I endeavoured to reduce it; but whether it was owing to the quantity being too small, or to my not giving it sufficient heat, I could not succeed. I had recourse therefore to another method.

“I took the weight of two drams of the mixture, which I brought to a high state of ignition in a cuppel. When it was of a whitish-red

colour, I threw upon it gradually four drams of sulphur, and when the flame ceased, I strengthened the fire in order to bring it to complete fusion. By these means I obtained a tender brittle regulus, whiter than the mixture, in which I observed a few small needles. Being apprehensive that some copper might still remain, I sulphurated it a second time, and then obtained a small regulus which was almost pure antimony.

"It results from these experiments, that the metal of which the ancients made their mirrors was a composition of copper, regulus of antimony, and lead. Copper was the predominant, and lead the smallest part of the mixture; but it is very difficult, as is well known, to determine with any certainty the exact proportion of the substances contained in such compositions."

[In the examination of an Etruscan mirror, which was placed in my hands for analysis by Professor Gerhardt of Berlin, it was found to consist, in 100 parts, of 67·12 copper, 24·93 tin, and 8·13 lead, approximating closely to an alloy of eight parts of copper to three of tin and one of lead. The oxide of tin obtained in the course of analysis was carefully examined, before the blowpipe, for antimony, but I did not succeed in detecting a trace of that metal. A similar mirror had been likewise analysed by Klaproth; he found 62 per cent. copper, 32 tin, and 6 per cent. lead, but no trace of antimony.—W. F.]

157 Of such large mirrors Seneca speaks in his Quæst. Nat. lib. i. Of the like kind was the mirror of Demosthenes mentioned by Plutarch, Lucian, and Quintilian.—Institut. Orat. xi. 3, 68, p. 572.

158 Lib. xxxvi. c. 26, p. 758.

159 Sueton. in Vita Domit. cap. xiv. p. 334.

160 Lib. xxxvi. 22, p. 752.—"Cappadociæ lapis, duritia marmoris, candidus atque translucidus, ex quo quondam templum constructum est a quodam rege, foribus aureis, quibus clausis claritas diurna erat."—Isidor. Origin. 16, 4. Our spar is transparent, though clouds and veins occur in it, like the violet and isabella-

coloured, for example, of that found at Andreasberg. Compare this explanation with what Salmasius says in Exercitat. Plin. p. 184.

161 Lib. xxxvii. cap. 5, p. 774.

162 Lib. xi. cap. 37, p. 617.

163 This dissertation of Abat may be found translated in Neuen Hamburg. Magazin. i. p. 568.

164 Academia di Cortona, vii. p. 34.

165 Origin. xvi. 7.

166 Goguet, ii. p. 111. Fabricii Biblioth. Græca. vol. i. p. 70.

167 Keyssler, i. pp. 17 and 441.

168 Lib. xxxvii. cap. 7.

169 De Lapid. § 61.

170 [This stone acquired its name from its being much used in ornaments by the Incas or Princes of Peru.]

171 De la Vega, ii. 28.

172 Montamy in Abhandlung von den Farben zum Porzellan, Leipzig, 1767, 8vo, p. 222, asserts that he saw, in a collection of antiquities, glass mirrors which were covered behind only with a black foil.

173 Lib. xxxvi. cap. 26, p. 758.

174 Lib. xxxiii. cap. 9, p. 627.

175 Trebell. Pollio, Vita Gallien. cap. 12.

176 Chemical Essays, vol. iv. p. 246.

177 Plin. lib. xxxiii.: Æs inaurari argento vivo, aut certe hydrargyro, legitimum erat. The first name here seems to signify native quicksilver, and the second that separated from the ore by an artificial process.

178 Hist. Nat. Supplem. i. p. 451.

179 Stob. Eclog. Antv. 1575, fol. p. 56.

180 De Placitis Philos. ii. cap. 20.

181 In Aratum, cap. 19.

182 Lib. i. cap. 8.

183 It is undoubtedly certain, that ὕαλος, which is translated *vitreous* or *glassy*, means any smooth polished body capable of reflecting rays of light. Originally it signified a watery body; and because watery bodies have a lustre, it was at length used for glass. See Salmas. ad Solin. p. 771.

184 More observations respecting the opinion of Philolaus may be found in the edition of Plutarch's work De Placitis Philosophorum by Ed. Corsinus, Flor. 1750, 4to, p. 61, and p. 23.

185 Professor Heeren having given me his opinion on this passage of Stobæus, I shall here insert it for the satisfaction of the learned reader. The critics, says he, will hardly be persuaded that the words καὶ τὸ ἀπ' αὐτοῦ πυροειδὲς κατὰ τὸ ἐσοπτροειδὲς are correct, as they can be translated different ways. With regard to the explanation of the matter, I build only on the plain meaning of the words. The author tells us, that Philolaus thought the sun to be a mirror; but we must conclude that he speaks of a mirror such as were then in use; a smooth plate of metal, and not a globe. In this case the first explanation of a glass globe falls to the ground. This is confirmed by Eusebius, who calls it ὑαλοειδὴς δίσκος, though it is possible that the latter word may be a gloss added by some

grammarian, or by Eusebius himself. If we enter further into the explanation, we must adopt the plain idea, that the rays of the sun fall upon this plate, and are reflected to us. I am however of opinion, that ὕαλος ought to be translated *glass*, ὑαλοειδὴς *glassy* or *vitreous*; for the intention of Philolaus evidently was to define the substance of the sun's body. The result of the whole is, Philolaus considered the sun as a plain plate of glass which reflected the rays or brightness of the æthereal fire. But that he was acquainted with a proper glass mirror does not thence follow with certainty.

186 Pourquoy reluient les fenestres de verre si fort? Pourtant que la nature de l'estain, duquel elles sont basties par dedans, fort clere, meslée avec le verre cler aussi de lui mesme reluyst d'avantage; et le quel estain outrepassant ses raïons par les petits pores du verre, et augmentant doublement la face extérieure du dit verre, la rend grandement clere.—Problemes d'Alexandre Aphrod., traduit par M. Herret. Paris 1555, 8vo, p. 50.

187 Origin. lib. xvi. 15, p. 394.

188 Origin. lib. xvi. 18, p. 396.

189 Lib. xxxvi. cap. 26, p. 759.

190 Bayle, Diction. Histor. vol. iv. p. 462.

191 Printed at Leipzig, 1504, in small folio. There is an edition also printed at Cologne in 1624, and Fabricius quotes a Venetian edition. Pisanus seems to have been a by-name given by some one to Peckham.

192 Specul. Natur. ii. 78, p. 129.

193 Ars Magna, cap. lxvii. p. 517, in Lullii Opera. Argent. 1607, 8vo.

194 Opus Majus, ed. Jebb. Lond. 1733, fol. p. 346.

[195] Franc. Assisiatis et Ant. Paduani Opera. Lugd. 1653, fol.

[196] Nicephori Schol. in Synesium, in Synesii Op. Par. 1612, fol. p. 419.

[197] In the collection of antiquities at St. Denis, an ancient mirror was shown, which was said to have belonged to Virgil. It was oval, and before Mabillon let it fall, was fourteen inches in length and twelve in breadth, and weighed thirty pounds. It is transparent, and of a brownish-yellow colour. According to experiments made on purpose, it was found to consist of artificial glass, mixed with a considerable portion of lead; and as it had been preserved in the above collection from the earliest periods, the practice of adding lead to glass must be very old. But whether this mirror was covered at the back, and how it was covered, though these are the most important points, I find nowhere mentioned. In the collection of the Grand Duke of Tuscany there is a piece of the same kind, said also to have been the mirror of Virgil. See Le Veil, Kunst auf Glas zu malen, Nurnb. 1779, 4to, p. 23, and Hist. de l'Acad. des Sciences, 1737, p. 412.

[198] Villaret, Hist. de France. Par. 1763, xi. p. 142.

[199] In Miscellanea Berolinensia, i. p. 263; but nothing further is said respecting the art, than that it was daily used in the glass-houses. Had I an opportunity, I should make experiments of every kind in order to discover a method of forming plane mirrors also in the like manner.

[200] Wecker, in his book De Secretis, lib. x. p. 572, seems to say, that one must lay the saturated tin leaf so carefully on the glass plate, that no air can settle between them. According to Garzoni, the tin leaf is spread out on a smooth stone table, and after it has been rubbed over with quicksilver, the glass is placed above it.

[201] Tome iii. p. 87, art. *Glace*.

[202] Dict. Géog. de la France. Amst. 1762, fol. v. pp. 415, 672.

[203] A furnace for casting large glass plates, before it is fit to be set at work, cost, it is said, 3500*l.* It seldom lasts above three years, and even in that time it must be repaired every six months. It takes six months to rebuild it, and three months to repair it. The melting-pots are as big as large hogsheads, and contain above 200 cwt. of metal. If one of them burst in the furnace, the loss of the matter and time amounts to 250*l.*—TRANS.

GLASS-CUTTING. ETCHING ON GLASS.

I do not here mean to enter into the history of engraving on stone, as that subject has been already sufficiently illustrated by several men of learning well acquainted with antiquities. I shall only observe, that the ancient Greek artists formed upon glass both raised and engraved figures; as may be seen by articles still preserved in collections, though it is probable that many pieces of glass may have been moulded like paste; for that art also is of very great antiquity[204]. It appears likewise that they cut upon plates of glass and hollow glass vessels all kinds of figures and ornaments, in the same manner as names, coats of arms, flowers, landscapes, &c. are cut upon drinking-glasses at present[205]. If we can believe that learned engraver in stone, the celebrated Natter, the ancients employed the same kind of instruments for this purpose as those used by the moderns[206]. They undoubtedly had in like manner a wheel which moved round in a horizontal direction above the work-table, or that machine which by writers is called a lapidary's wheel.

If this conjecture be true, what Pliny says respecting the various ways of preparing glass is perfectly intelligible. It is turned, says he, by the wheel, and engraven like silver. In my opinion we are to understand by the first part of this sentence, that the glass was cut by the wheel, like stone, both hollow and in relief, though it is possible that drinking-cups or vessels may have been formed from the glass metal by means of the wheel also[207]. In the latter part of the sentence we must not imagine that Pliny alludes to gravers like those used by silversmiths, for the comparison will not apply to instruments or to the manner of working, which in silver and glass must be totally different; but to the figures delineated on the former, which were only cut out on the surface in a shallow manner; and such figures were formed on glass by the ancient artists, as they are by our glass-cutters, by means of a wheel.

Many, however, affirm that the art of glass-cutting, together with the necessary instruments, was first invented in the beginning of the seventeenth century. The inventor is said to have been Casper Lehmann, who originally was a cutter of steel and iron; and who made an attempt, which succeeded, of cutting crystal, and afterwards glass, in the like manner. He was in the service of the emperor Rodolphus II., who, in the year 1609, besides presents, conferred on him the title of lapidary and glass-cutter to the court, and gave him a patent by which every one except himself was forbidden to exercise this new art. He worked at Prague, where he had an assistant named Zacharias Belzer; but George Schwanhard the elder, one of his scholars, carried on the same business to a far greater extent. The latter, who was a son of Hans Schwanhard, a joiner at Rothenburg, was born in 1601; and in 1618 went to Prague to learn the art of glass-cutting from Lehmann. By his good behaviour he so much gained the esteem of his master, who died a bachelor in 1622, that he was left his heir; and obtained from the emperor Rodolphus a continuation of Lehmann's patent. Schwanhard, however, removed to Nuremberg, where he worked for many of the principal nobility; and by these means procured to that city the honour of being accounted the birth-place of this new art. In the year 1652 he worked at Prague and Ratisbon by command of the emperor Ferdinand III., and died in 1667, leaving behind him two sons, who both followed the occupation of the father. The elder, who had the same christian name as the father, died so early as 1676; but the other, Henry, survived him several years. After that period Nuremberg produced in this art more expert masters, who, by improving the tools and devising cheaper methods of employing them, brought it to a much higher degree of perfection[208].

That the art is of so modern date seems to be confirmed by Zahn, who speaks of it as of a new employment carried on at that time, particularly at Nuremberg. He describes the work-table as well as the other instruments; and gives a figure of the whole, which he appears to have considered as the first[209]. It may be seen, however, from what I have already quoted, that this invention does not belong entirely to the moderns; and, to deny that the ancients were altogether unacquainted with it, would be doing them an injustice. It was forgotten and again revived; and this is the opinion of Caylus.

I must here remark, that before this invention there were artists, who, with a diamond, cut or engraved figures on glass, which were everywhere admired. Without entering, however, into the history of diamonds, which would require more materials than I have yet been able to collect, I will venture to assert that the ancient artists employed diamond dust for polishing or cutting other kinds of stones. Pliny[210] speaks of this in so clear a manner that it cannot be doubted. The same thing has been repeated by Solinus[211], Isidore[212], and Albertus Magnus[213], in a manner equally clear, and Mariette[214] considers it as fully proved; but it does not appear that the ancients made any attempts to cut this precious stone with its own dust; I mean to give it different faces and to render it brilliant. Whether they engraved on it in that manner I cannot pretend to decide, as the greatest artists are not agreed on the subject. Mariette[215] denies that they did; whereas Natter[216] seems not to deny it altogether, and Klotz[217] confidently asserts it as a thing certain. But the last-mentioned author knew nothing more of this circumstance than what he had read in the above-quoted writers.

The question which properly belongs to my subject is, whether the Greeks and the Romans used diamond pencils for engraving on other stones. That many ancient artists assisted their labour by them, or gave their work the finishing touches, seems, according to Natter, to be shown by various antique gems. But even allowing this to have been the case (for at any rate I dare not contradict so eminent a connoisseur), I must confess that I have found no proofs that the ancients cut glass with a diamond. We are however acquainted with the means employed by the old glaziers to cut glass: they used for that purpose emery, sharp-pointed instruments of the hardest steel, and a red-hot iron, by which they directed the rents according to their pleasure.

The first mention of a diamond being used for writing on glass occurs in the sixteenth century. Francis I. of France, who was fond of the arts, sciences, and new inventions, wrote the following lines with his diamond ring upon a pane of glass, at the castle of Chambord, in order to let Anne de Pisseleu, duchess of Estampes, know that he was jealous:

Souvent femme varie,
Mal habil qui s'y fie.

The historian recorded this not so much on account of the admonition, which is not new, as because it was then thought very ingenious to write upon glass[218]. About the year 1562, festoons and other ornaments, cut with a diamond, were extremely common on Venetian glasses, which at that period were accounted the best. George Schwanhard the elder was a great master in this art[219]; and in more modern times, John Rost, an artist of Augsburg, ornamented in a very curious manner with a diamond pencil, some drinking-glasses which were purchased by the emperor Charles VI.

I now come to the art of etching on glass, which properly was the subject of this article. As the acid which dissolves siliceous earth, and also glass, was first discovered in the year 1771, by Scheele the chemist[220], in fluor-spar, one might imagine that the art of engraving with it upon glass could not be older. It has indeed been announced by many as a new invention[221]; but it can be proved that it was discovered as early as the year 1670, by the before-mentioned artist Henry Schwanhard. We are told that some aquafortis having fallen by accident upon his spectacles, the glass was corroded by it; and that he thence learned to make a liquid by which he could etch writing and figures upon plates of glass[222]. How Schwanhard prepared this liquid I find nowhere mentioned; but at present we are acquainted with no other acid but that of fluor-spar which will corrode every kind of glass; and it is very probable that his preparation was the same as that known to some artists as a secret in 1721. The inventor however employed it to a purpose different from that for which it is used at present.

At present the glass is covered with a varnish, and those figures which one intends to etch are traced out through it; but Schwanhard, when the figures were formed, covered them with varnish, and then by his liquid corroded the glass around them; so that the figures, which remained smooth and clear, appeared when the varnish was removed, raised from a dim or dark ground. He perhaps adopted this method in order to render his invention different from the art known long before of cutting the figures on

the glass as if engraven. Had he been able to investigate properly what accident presented to him, he might have enriched the arts with a discovery which gave great reputation to a chemist a hundred years after.

I mentioned this old method of etching in relief to our ingenious Klindworth, who possesses great dexterity in such arts, and requested him to try it. He drew a tree with oil varnish and colours on a plate of glass, applied the acid to the plate in the usual manner, and then removed the varnish. By these means a bright, smooth figure was produced upon a dim ground, which had a much better effect than those figures that are cut into the glass. I recommend this process, because I am of opinion that it may be brought to much greater perfection; and M. Renard, that celebrated artist of Strasburg, whose thermometers with glass scales, in which the degrees and numbers are etched, have met with universal approbation, was of the same opinion, when I mentioned the method to him while he resided here, banished from his home by the disturbances in his native country.

It is probable that Schwanhard and his scholars kept the preparation of this liquid a secret, as the receipt for that purpose was not made known till the year 1725, though it is possible that one older may be found in some of those books which treat on the arts. In the above-mentioned year, Dr. John George Weygand, from Goldingen in Courland, sent to the editor of a periodical work a receipt which had been written out for him by Dr. Matth. Pauli of Dresden, then deceased, who had etched, in this manner on glass, arms, landscapes, and figures of various kinds[223]. We find by it that a strong acid of nitre was used, which certainly disengages the acid of fluor-spar, though the vitriolic acid is commonly employed for that purpose[224]. That the Bohemian emerald or *hesphorus*, mentioned in the receipt, is green fluor-spar, cannot be doubted, and will appear still more certain from the history of this species of stone, as far as I am acquainted with it, which I shall here insert.

In the works of the old mineralogists, fluor-spar is either not mentioned, or is classed among their natural glasses and precious stones; and in those of the first systematic writers it is so mingled with quartz and calcareous and gypseous spars, that it is impossible to discover it. The old German miners, however, distinguished it so early as the sixteenth century, and called it *fluss*; because they used it to accelerate the fusion of ores that

were difficult to be reduced to that state. Agricola, who first remarked this, changed the German name into *fluor*, an appellation, which, like many others, formed by him from German words, such for example as *quarzum* from *quarz*, *spatum* from *spat*, *wismuthum*, *zincum*, *cobaltum*, &c., became afterwards common. If a passage of the ancients can be quoted that seems to allude to fluor-spar, it is that of Theophrastus, where he says that there are certain stones which, when added to silver, copper, and iron ores, become fluid[225]. The first systematic writer who mentioned this kind of stone as a particular genus, was Cronstedt.

Besides being known by its metallurgic use, fluor-spar is known also by having the colours of some precious stones, so that it may be sold, or at least shown as such to those who are not expert judges; because the first time when heated in the dark it shines with a bluish-green lustre. It is possible that fluor-spar may have been among the number of that great variety of stones which the ancients, with much astonishment, tell us shone in the dark; though it is certain that the principal part of them were only light-magnets, as they are called, or such as retain for a certain period the light they have absorbed in the day-time. The observation, however, that fluor-spar emits light after it is heated, seems to have been first made when artificial phosphorus excited the inquiry of naturalists and chemists; and when they began to search in their own country for stones which, in the property of emitting light, might have a resemblance to the Bologna spar, made known about the year 1630. It is well known that the latter is prepared for that purpose by calcination. Stones of the like kind were sought for; and among these fluor-spar, which is not scarce in Germany.

In my opinion, the observation was made in the year 1676; for in that year Elsholz informed the members of the Society for investigating Nature, that he was acquainted with a phosphorus which had its light neither from the sun nor from fire, but which, when heated on a metal plate over glowing coals, shone with a bluish-white lustre; so that by strewing the powder of it over paper, one might form luminous writing. I doubt much whether this experiment was ever tried; at least I find no further account of it in the papers of the Society, nor in the re-publication of the above author’s first dissertation, which appeared in 1681[226].

As far as I know, Kirchmaier, professor at Wittenberg, was the first who disclosed the secret, in the year 1679[227]. Both call this phosphorus the smaragdine; because the ancients speak much of luminous emeralds, and because green fluor-spar is often exhibited as an emerald. Kirchmaier calls this mineral also *hesperus* and *vesperugo*; and these names have been often given since to fluor-spar, as in the receipt before-mentioned for making a liquid to etch on glass. Kirchmaier's information, however, must have been very little known; for the Jesuit Casatus, who, in 1684, wrote his Treatise on Fire, was not acquainted with it, as he has inserted only the words of Elsholz. This observation must have been new to Leibnitz himself, and to the Academy of Sciences at Berlin, in 1710; for the former then mentioned it to the Society as a philosophical novelty[228].

I shall remark, in the last place, that the manufacturing of vessels and ornaments of every kind from solid fluor-spar was begun in Derbyshire in the year 1765[229]. The articles formed of it are in England called spar ornaments, and sometimes *blue John*. Many beautiful colours must, as is said, be brought forward by means of fire. But the heat must be applied with great caution; for fluor-spar, as is well known, by a strong and particularly a sudden heating, cracks, and loses its transparency. Since writing the above, I find that M. Raspe[230] denies this bringing forward of colours by fire.

FOOTNOTES

[204] Mariette, Traité des Pierres gravées. Par. 1750, fol.

[205] The two ancient glasses found at Nismes, and described in Caylus' Recueil d'Antiquités, ii. p. 363, were probably of this sort.

[206] Natter, Traité de la Méthode antique de graver en Pierres fines, comparé avec la Méthode moderne. Lond. 1754, fol.

[207] Of this kind were the *calices audaces* of Martial, xiv. 94, and those cups which often broke when the artist wished to give them the finishing touch.

[208] See Sandrart's Teutsche Akademie, vol. i. part 2, p. 345, where there is much valuable information respecting the German artists. Compare also Doppelmayer's Nachricht von Nürnberg. Künstlern.

[209] Oculus Artificial. iii. p. 79.

[210] Lib. xxxvii.

[211] Cap. 52, p. 59.

[212] Origin. xvi. 8.

[213] De Miner. lib. ii. 2.

[214] Traité des Pierres gravées, i. pp. 90, 156.

[215] Ibid. p. 156.

[216] In the preface, p. 15.

[217] Ueber den Nutzen d. geschnitt. Steine. Altenb. 1768, p. 42.

[218] Le Veil, iii. p. 19. This anecdote however is not mentioned by Mezeray, Castelnau, or Laboureur; and Bayle must have been unacquainted with it, or he would have introduced it into his long article on the Duchesse d'Estampes.

[219] Doppelmayer, p. 232.

[220] Abhandlungen der Schwed. Akad. xxxiii. p. 122.

[221] Halle, Fortgesetzte Magie. Berlin, 1788, 8vo, i. p. 516. This author says that the invention came from England, where it was kept very

secret; but the honour of the second invention belongs to H. Klaproth.

222 Schwanhard, by the acuteness of his genius, proved what was before considered as impossible, and found out a corrosive so powerful that the hardest crystal glass, which had hitherto withstood the force of the strongest spirits, was obliged to yield to it, as well as metals and stones. By these means he delineated and etched on glass, figures of men, some naked and some dressed, and all kinds of animals, flowers, and plants, in a manner perfectly natural; and brought them into the highest estimation.—Sandrart, Teutsche Akademie, i. 2, p. 346.—Doppelmayer, p. 250, says, "After 1670 he accidentally found out by the glass of his spectacles, upon which some aquafortis had fallen, becoming quite soft, the art of etching on glass."

223 Breslauer Sammlung zur Natur- und Medicin-Geschichte. 1725, January, p. 107. "Invention of a powerful acid by which figures of every kind, according to fancy, can be etched upon glass.—When *spiritus nitri per distillationem* has passed into the recipient, ply it with a strong fire, and when well dephlegmated, pour it, as it corrodes ordinary glass, into a Waldenburg flask; then throw into it a pulverised green Bohemian emerald, otherwise called *hesphorus* (which, when reduced to powder and heated, emits in the dark a green light), and place it in warm sand for twenty-four hours. Take a piece of glass well cleaned and freed from all grease by means of a lye; put a border of wax round it, about an inch in height, and cover it all equally over with the above acid. The longer you let it stand the better, and at the end of some time the glass will be corroded, and the figures, which have been traced out with sulphur and varnish, will appear as if raised above the plane of the glass." This receipt has been inserted by H. Krunitz in his Œkonomische Encyclopedie, xi. p. 678.

224 Klindworth covers the glass with the etching ground of the engravers; but in the Annals of Chemistry for 1790, ii. p. 141, a solution of isinglass in water, or a turpentine oil varnish, mixed

with a little white lead, is recommended. Complete instructions for acquiring this art may be found there also.

[225] De Lapidibus, sect. 19.

[226] See Ephemerid. ac Nat. Cur. 1676, Dec. 1, obs. 13, p. 32; and Elsholtii De Phosphoris Observationes, Berol. 1681, 4to.

[227] G. C. Kirchmaieri De Phosphoris et Natura Lucis, necnon de Igne, Commentatio Epistolica. Wittebergæ, 1680, 4to.

[228] Miscellanea Berolin. 1710, vol. i. p. 97. The fluor-spar earth, or phosphoric earth, as it is called, which in later times has been found in marble quarries, and which some at present consider as an earth saturated with phosphoric acid, is mentioned by the Swede Hierne, in Prodromus Hist. Nat. Sueciæ. Henkel had never seen it.

[229] Watson's Chemical Essays, ii. p. 277.

[230] Descriptive Catalogue of Tassie's Engraved Gems, Lond. 1791, 2 vols. 4to, i. p. 51.

SOAP.

That the first express mention of soap occurs in Pliny and Galen, and that the former declares it to be an invention of the Gauls, though he prefers the German to the Gallic soap[231], has already been remarked by many. Pliny says that soap[232] was made of tallow and ashes; that the best was made of goats' tallow and the ashes of the beech-tree, and that there were two kinds of it, hard and soft. The author of a work on simple medicines, which is ascribed to Galen, but which however does not seem to have been written by that author, and of which only a Latin translation has been printed, speaks of soap being made by a mixture of oxen, goats', or sheep's tallow, and a lye of ashes strengthened with quicklime. He says the German soap was the purest, the fattest, and the best, and that the next in quality was the Gallic[233]. This account corresponds more exactly with the process used in Germany at present; whereas the French use mineral alkali, and instead of tallow, employ oil, which appears to be a later invention. Pliny in his description does not speak of quicklime; but as he mentions a mixture of goats' tallow and quicklime a little before, it is probable that the use of the latter was then known at Rome. Gallic and German soap are often mentioned by later writers[234], as well as by the Arabians, sometimes on account of their external use as a medicine, and sometimes on account of their use in washing clothes. The latter purpose is that for which soap is principally employed in modern times; but it does not seem to have been the cause of German soap being introduced at Rome. Washing there was the occupation of indigent scourers, who did not give themselves much trouble concerning foreign commodities. The German soap, with which, as Pliny tells us, the Germans coloured their hair red, was imported to Rome for the use of the fashionable Roman ladies and their gallants. There is no doubt that the *pilæ Mattiacæ*, which Martial recommends as a preventive of gray hair[235]; the *caustica spuma* with which the Germans dyed their hair[236]; and

the Batavian froth or lather which the Romans employed for colouring theirs[237], were German soap. It is probable that the Germans tinged it with those plants which were sent to Rome for dyeing the hair[238]; and according to the modern manner of speaking, it was more properly a kind of pomade than soap.

It appears that the Romans at first considered hair-soap as an ointment made from ashes; for we read in various passages of ancient authors, that the hair was dyed by means of ashes, or an ointment made of ashes and a certain kind of oil. It is however possible that they may have had such an ointment, which undoubtedly would be of a saponaceous nature, before they were acquainted with the German soap, or that they imitated the German pomade with different variations[239].

As soap is everywhere used for washing at present, a question arises what substitutes were employed before it was invented. Those with which I am acquainted I shall mention and endeavour to illustrate. They are all still used, though not in general; and they are all of a soapy nature, or at least have the same effects as soap; so that we may say the ancients used soap without knowing it.

Our soap is produced by a mixture of lixivious salts and tallow, by which means the latter becomes soluble in water. The greater part of the dirt on our linen and clothes consists of oily perspiration or grease, or dust which that grease attracts, and which either cannot be washed out, or, but very imperfectly, by water alone. But if warm water, to which lixivious salts have in any manner been added, be taken, and if dirty cloth be rubbed in it, the greasy dirt unites with the salts, becomes saponaceous, and is so far soluble in water that it may be washed out. There are also natural juices which are of a soapy quality, in the state in which we find them, and which can be employed in the stead of artificial soap. Of this kind is the gall of animals and the sap of many plants. The former being less strong in its effects on account of its slimy nature, is used at present particularly for coloured stuffs, the dye of which is apt to fade. As far as I know, however, it was not employed by the ancients[240], but it is certain that in washing they used saponaceous plants.

In the remotest periods it appears that clothes were cleaned by being rubbed or stamped upon in water, without the addition of any substance whatever. We are told by Homer, that Nausicaa and her attendants washed their clothes by treading upon them with their feet in pits, into which they had collected water[241]. The epithet black, which the poet gives to the water, might induce one to conjecture that it had been mixed with ashes, which would convert it into a lye; but where were the ashes to be found? Had they brought them along with them, the bard, where he before enumerates everything that they carried with them, and even oil, would not have failed to mention them; and such a conjecture is rendered entirely groundless by his applying the same epithet to pure water, in other places, where nothing can be supposed to have coloured it[242]. Water, when it stands in deep pits, reflects so few rays of light, that in a poetical sense it may very properly be called black.

We find however mention made at later periods of ashes, and a lye of ashes employed for washing; but I think very seldom, and I do not know how old the use of them may be. According to Julius Pollux, *konia*, mentioned by Aristophanes and Plato, was a substance used for washing; and he says expressly, that we are to understand by it a lye of ashes. This I mention for the sake of those, who, like me, place little confidence in the terms of art given in dictionaries. With the above lye, oil- and wine-jars were cleaned[243]; and it was employed also for washing the images of the gods[244]. The method of strengthening the lye by means of unslaked lime was known, at any rate, in the time of Paulus Ægineta; but it appears that the Romans were not acquainted with the salt itself, which is procured by dissolving common wood-ashes in water: I mean, they did not understand the art of producing it in a dry solid form, or of boiling potashes.

On the other hand, that fixed lixivious salt, the mineral which nature presents in many of the southern countries, was long known and used in washing. This was the *nitrum*, or, as the people of Attica pronounced it, the *litrum*, of the ancients, as has already been remarked by others[245]. It would however be worth the trouble to investigate the proofs still further. By examining them with more mineralogical and chemical knowledge than have hitherto been employed for that purpose, they might be further

strengthened, and serve to illustrate many obscure passages. For my part, I have neither leisure nor room here to undertake such a task, though I have collected many observations relative to that subject. It is certain at any rate, that the ancients employed *nitrum* for washing, and it is evident from the testimony of various authors, that it was much used in the baths[246].

That the people of Egypt, in the time of Pliny, made mineral alkali also from the ashes of some plants, we have reason to conclude, because he says that it was necessary to put the Egyptian nitre into vessels well-corked, else it became liquid. Natural alkali is never liable to do so, unless it be very much burnt; and as no reason is assigned for its assuming that form, we may believe that the Egyptian alkali was the strongly burnt ashes of those plants which are still used in Egypt for making salt, and perhaps the same with which the Spaniards were made acquainted by the Arabians, and which they cultivate for making soda.

Strabo speaks of an alkaline water in Armenia, which was used by the scourers for washing clothes[247]. Of this kind also must have been the lake Ascanius, which is mentioned by Aristotle[248], Antigonus Carystius[249], and Pliny[250]. It is worthy of remark, that the ancients made ointments of this mineral alkali and oil, but not hard soap, though by these means they approached nearer to the invention than the old Germans in their use of wood-ashes; for dry solid soap can be made with more ease from the mineral than the vegetable alkali; and when Hungarian, French, and German soap are of equal goodness, the last does more credit to the manufacturers because they cannot employ the mineral alkali. I shall here observe, that this alkali was used for washing by the Hebrews, and that it occurs in the sacred writings under the name of *borith*[251].

The cheapest however, and the most common article used for washing, was the urine of men and animals. When this excrement becomes old, the alkali disengages itself, which may be perceived by its fœtid smell; and such alkalised urine being warmed, and employed to wash greasy clothes, produces the same effects as the *nitrum* of the ancients. It is still used for the like purpose in our cloth manufactories.

To procure a supply of it, the ancient washers and scourers placed at the corners of the streets, vessels which they carried away after they had been filled by the passengers, who were at liberty to use them; and the practice of having such conveniences was certainly more decent than that of employing the walls of churches and other buildings, which the police of Dresden forbade some years ago, but with no effect. At Rome, that which at present spoils and renders filthy our noblest edifices, was converted to use. When clothes were washed, they were trod upon with the feet, as was the case in the cloth manufactories at Leeds, Halifax, and other places of England, where the urine was collected by servants, and sold by measure to the manufacturers under the name of *old lant*. On account of the disagreeable smell attending their employment, scourers at Rome were obliged to reside either in the suburbs or in some of the unfrequented streets[252].

My readers here will undoubtedly call to remembrance the source of taxation devised by the emperor Vespasian, who, as his historians tell us, *urinæ vectigal commentus est*[253]. It is not certainly known in what manner this impost was regulated. Did the emperor declare that article, which was not *subterraneum rarius*, to be a regale as a *res derelicta*, so that the scourers were obliged to pay him what he thought a reasonable sum proportioned to the benefit which they derived from it? Or was it imposed only as a poll-tax? For every tax upon anything indispensably necessary to all, is, to speak in the language of finance, the same as what is called a poll-tax, or a tax paid by every one who has a head. The latter conjecture is the most probable, especially as this tax continued two centuries, till the time of Anastasius, and as we read also of *vectigal pro urina jumentorum et canum*, which was exacted from every person who kept cattle. Vespasian therefore was not fortunate in the choice of a name for his tribute, which on that account must have been undoubtedly more detested. A poll-tax at present is called by those who do not speak favourably of it, the Turkish-tax, because the Turks impose it on all unbelievers. When it was introduced by Louis XIV. in 1695, he called it *la capitation*.

Of plants with a saponaceous juice, the ancients, at any rate, used one instead of soap; but it is difficult or rather impossible to define it. I shall not therefore content myself merely with transcribing the passages where it is mentioned, but I shall arrange whatever I can find respecting it in such a

manner, as, according to my opinion, the names of plants ought to be explained in dictionaries.

Στρουθίον, Struthium, Latinis Herba lanaria, et Plinio etiam Radicula.

1. Est planta spinosa, *Theophrastus*, *Plinius*.
2. Grata aspectu, sed sine odore, *Theophrastus*, *Plinius*.
3. Folio oleæ, *Plinius*; vel papaveris Heraclei, *Theophrastus*.
4. Caule ferulaceo, tenui, lanuginoso, eduli, *Plinius*.
5. Radice magna, acri, medicinali, *Plinius*, *Dioscorides*; spumescente, *Lucian*.
6. Floret æstate, *Theophrastus*. *Plinius*; sed semen nullum, *Plinius*.
7. Nascitur saxosis et asperis locis, *Plinius*.
8. Sponte, præcipue in Asia Syriaque; trans Euphratem laudatissima; sativa ubique, *Plinius*.
9. Radix conditur ad lanas lavandas, *Theophrastus*, *Plinius*, *Dioscorides*, *Columella*, et alii.
10. Herba ovibus lac auget, *Plinius*.

The above is all that the ancients have told us respecting this plant. The information is indeed very scanty, and at the same time it is not altogether certain; but even if it were, it would be sufficient only to confute some conjectures, but not to establish the systematic name of the plant. I call the properties of it described to us uncertain: first, because I do not know whether Pliny did not mean to distinguish the wild plant from that which was cultivated, and many have understood as alluding to the former that which I have applied to both: secondly, because the words of Theophrastus, being in one passage evidently corrupted, will admit of various constructions; and because in another, on account of some exceptions, of which he speaks, they appear at least to me unintelligible: thirdly, because Pliny, who gives us the best account of it, is the only author who calls the *struthium* or soap-plant *radicula*, a name by which is rather to be understood a dye-plant of the same kind as madder. We have reason therefore to suspect that he has confounded the properties of the two plants, especially as the fourth property was ascribed by others to a *Rubia*, *Asperula*, or *Galium*, which was cultivated in Syria, and named often

radicula Syriaca. On the other hand, this diminutive is very ill-suited to a root which Pliny himself calls large.

The words of that author, “tingenti, quicquid sit cum quo decoquatur,” have been by some explained as if he meant that the *struthium* was a dye-plant, though as a soapy plant it must have been destitute of colour; and they have hence deduced a proof that Pliny confounded the *struthium* with the *radicula* used in dyeing. On the other hand, Hardouin reads *unguentis* instead of *tingenti*. He assures us that he found the former in manuscripts, and is of opinion that the sap of the *struthium* was used also for ointments.

In my opinion, however, *tingenti* must be retained; and the meaning is that when cloth was to be dyed it was necessary to prepare it for that purpose by soaking it and washing it with the sap of this plant. This he expressly tells us himself; “tingentibus et radicula lanas præparat.” It is probable that the ancient dyers mixed their dye-liquors with the juice of the *struthium*, for the same purpose as bran and the seeds of fenugreek are added to dye-liquors at present; that is, to render them thicker and more slimy, in order that the colouring particles may be longer and more equally suspended in or diffused through them[254]. The words *quidquid sit cum quo decoquatur* will now become intelligible. Whatever may be employed for dyeing, says the author, the addition of the juice of the *struthium* is serviceable.

As what has been said contains nothing that can enable us to determine the genus of the *struthium* according to the rules of botany, we may be allowed to conjecture that it was one of those plants still used for the like purpose in Italy and other neighbouring countries. Fuchs thinks it must have been the *Saponaria officinalis* (soap-wort), the roots of which indeed contain a saponaceous juice that readily changes the saliva into froth. The root was employed for that purpose by the impostor in Lucian; and the juice is used at present for cleaning wool and cloth. In the Helvetian Alps, the sheep, before they are shorn, are washed with a decoction of the plant and its roots; and with a mixture of ashes it serves for cleaning linen. The taste of it is so sharp, that it is compared by some to that of the small burnet-saxifrage.

This *Saponaria officinalis* however differs too much from the remaining properties[255] of the *struthium*. Its root is as thick only as a quill, or at most as one's finger. The stem, which is three feet in height, throws out many branches, and cannot be called *caulis ferulaceus, tenuis*. It is not rough and prickly, and, instead of growing in poor rocky soil, it is rather fond of deep ground and the borders of corn-fields.

We may therefore conjecture with more probability that the *Gypsophila Struthium*, Linn.[256], a plant still used for washing in the lower part of Italy and Spain, is the *struthium* of the ancients. This opinion acquires some strength by its being adopted among the Italians and Spaniards; and because the plant, as Pliny says, grows in a rocky soil and on the mountains. It is also still called *lanaria* by the Calabrian peasants. It has a tender stem; its leaves are so like those of the olive-tree that they might be compared to them by those who are not botanists; and its root is large, but it is neither rough nor prickly. This contradiction may be accounted for by supposing that Pliny, through a mistake, of which I have already accused him, ascribed falsely to the soap-plant the prickly or rough leaves of the dye-plant which had an affinity to madder. But even after this explanation there still remains to be got over a dubious passage of Theophrastus, who indeed seems to make the plant prickly also.

I do not therefore place entire confidence in this opinion; but suspect rather that we shall receive from the East an account of a plant, still used there, which will correspond more exactly with the soap-plant described by Pliny. I am inclined to think that I have already found some precursory information respecting it in Bauhin, who says that in Syria there is another kind of soap-plant, which has prickly leaves like the thistle, and a thick root of a sharp acrid taste. The root, he adds, was employed for washing clothes and wool; and the confectioners of Damascus formed of it, with honey and wine, a kind of sweetmeat which appeared as white as if it had been made of the finest flour and sugar, and which was so hard that it could scarcely be broken with the teeth. This plant seems to belong to those, the cultivation of which was abandoned in Europe, after the use of them was rendered superfluous by newer discoveries.

That the ancients employed their *struthium* for washing wool is confirmed by various authorities; but I do not remember to have found any

evidence of its being used for cleaning clothes which had been worn. Salmasius however quotes a passage from the works, unfortunately never printed, of the old chemist Zosimus, in which he gives directions for restoring, by means of the soap-plant, the lustre of pearls which have become yellow[257].

The meal of many kinds of seeds may be used for washing, as well as various kinds of bran. That of almonds, which on account of its oil is remarkably soft, is employed at present for washing the hands by those who are desirous of having a white delicate skin. Cloth, the colours of which easily fade, and which will neither endure soap nor hard rubbing, may be washed extremely well with bran. Our fullers, therefore, and stocking manufacturers use oat-, barley- and bean-meal, especially when they wish the cloth to be slowly milled. Whether the ancients employed bran in the same manner I have not had an opportunity of examining. I am rather inclined to think that they did; and there is a passage of Galen which seems to allude to the use of bean-meal[258]. In all probability the beans of the ancients were the smallest and roundest variety of our horse-beans, or those used as fodder.

In the last place, the ancients, at those periods of which I speak, used fullers-earth much oftener than it is used at present. Till the countries where it was procured be described by travellers who unite a knowledge of antiquities with skill in mineralogy, the species of this earth, mentioned in the works of ancient authors, cannot be distinguished with accuracy. But from the purposes to which they were applied, we can with certainty conclude that they must have been partly of the nature of marl and partly of the nature of soapstone.

According to the then usual method of washing, by which the clothes were stamped with the feet, the *cretæ fulloniæ*, as Pliny[259] calls them, acted in the same manner as our fullers-earth employed at present, partly by scouring and partly by absorbing the greasy dirt. The ancients, after their manner, gave them names only from the countries where they were produced; and hence we find mention made of *terra Cimolia*[260], *Chia*[261], *Lemnia*[262], *Sarda*[263], *Umbria*[264], *Samia*, *Tymphæa*[265], and others. Many of

them, like that brought from Sardinia, could not be used in cleaning coloured stuffs; and for this reason, perhaps, because some colours would not stand hard scouring, or endure their caustic nature.

The fullers, however, did not use these earths merely for washing, but also for whitening many kinds of cloth. This was done by rubbing fine white earth into the cloth, in the same manner as soldiers do to give some parts of their dress a brighter appearance. A like process is employed by glovers and those who wash or clean leather. The earth used by the latter is a yellowish-white iron-ochre, called from the purpose to which it is applied collar-earth[266]. When a perfect white was required, a kind of white potters-clay or marl was employed; and the closer it adhered to the cloth, and the less easily it could be rubbed out, it was so much the better. The poor at Rome rubbed it over their clothes on festivals, in order that they might appear brighter[267].

It deserves here to be particularly remarked, that some of these earths, such as that of Chios, were employed in the baths instead of nitrum; and this is the case in the Levant still. De la Valle extols in this respect a kind of reddish earth, and says that people of the first distinction never bathe without it. Perfumes are often mixed with it; and it is formed into small balls, which when used are suffered to dissolve in the water. Different kinds of vessels, and particularly those in which wine and oil had been kept, were cleansed with these earths also[268]. Glass flasks which have had oil in them, cannot be cleansed better or more speedily than by shaking in them a mixture of fullers-earth or potters-clay. When these are not to be had, blotting-paper may be used. The oil is absorbed by the earth or the paper, and with them can be easily washed out.

To render cloth perfectly white, it was also fumigated with sulphur by the fullers, who were not ignorant that many colours were destroyed by its vapours[269]. We are told by Apuleius that the wife of a scourer concealed her gallant under a vessel of basket-work, over which cloth used to be laid to whiten by the effects of sulphur kindled under it. Our washer-women employ a cask in this mode of bleaching, and our clothiers a small close apartment, in which the wet cloth is suspended upon hooks.

Pliny has described the method of washing used at Rome, but many things respecting it appear to me obscure[270]. The cloth was first washed with Sardian earth; it was then fumigated with sulphur, and afterwards rinsed with real Cimolian earth. The word *desquamatur* was undoubtedly a term of art, which cannot be further explained, because we are unacquainted with the operation to which it alludes. Pliny seems to have been particular in mentioning real Cimolian earth, because the false kind became black by the steam of the sulphur which the cloth absorbed. Was it adulterated with some metallic oxide or with white lead? It was dear enough to induce people to mix it with such articles; and in that case it must necessarily have become black.

The expression *funditur sulphure* seems to be attended with no less difficulty. In comparing the different readings, I find that the oldest editions have *offunditur*, which has been changed into *effunditur*, and lastly into *funditur*. It is probable however that instead of *offunditur* we ought to read *offenditur*, which would make the whole clear. I am much surprised that this reading was not adopted by Hardouin. As Pliny says in other parts of his work "offendit stomachum," and "offendit aciem oculorum," he might undoubtedly have applied that word to the earth and its colour.

Fast colours, which the acid of sulphur might render pale, but could not entirely destroy, would by washing with Cimolian earth be improved or rather restored, as the earth would absorb and carry off the acid. There was also another kind of earth (*saxum*) which was useful in the preparation of cloth fumigated with sulphur, but which injured the dye, probably because it was too calcareous, and which was perhaps our common chalk.

I do not intend to treat here of the whole art of Roman fullers, which belongs rather to the history of weaving or manufacturing cloth in general; but I hope I shall be forgiven if I add the few following observations. The fullers received the cloth as it came from the loom, in order that it might be scoured, walked and smoothed. It was walked by being stamped upon with the feet. The rough wool raised by this operation was combed off, partly with the skin of a hedgehog, and partly with the tops of some plants of the thistle kind, in order to give the cloth a nap. Shearing seems not then to have been known: I have at least met with no passage where it is mentioned: and the case is the same with the use of presses; which, in my

opinion, were not invented till the sixteenth century. The whole process of smoothing seems to have consisted in making the wool or nap lie as evenly as possible one way, which certainly must have given to the cloth a much better appearance.

As cloth at present is more dressed and shorn on one side than another, the ancient fullers prepared theirs in the like manner; so that clothes could be turned, after the inside of them had been new dressed. Whether they made felt, also, I have not yet inquired; but I conjecture that the manufacturing it was the occupation of those called *lanarii*, *coactores*, and *coactilarii*.

The occupation of the fullers was at Rome very extensive, and afforded employment to a great number of people, but it at length entirely decayed. Schöttgen is of opinion that it belongs to those arts which have been lost. But other writers have declared arts which are exercised now in greater perfection than formerly to be lost, merely because they were not acquainted with them; or because, on account of the alterations they have undergone, they did not know where to find them. All the different operations of fulling have become so complex by new methods, improvements, and inventions, that they can no longer be conducted by one man; and the whole business has for that reason been separated or divided into several distinct branches.

The scouring of cloth when it comes from the loom, was, together with walking, separated from the rest, after the invention of the walk-mill. How old that invention may be, I cannot accurately determine; but we find it mentioned in the beginning of the thirteenth, and even at the end of the tenth century. Such a mill formerly was call *fullencium*, or *molendinum cum fullone*[271]. The dressing and smoothing of cloth, since the invention of shearing and pressing, requires so much art, that these operations can be performed only by skilful workmen, who are called cloth-shearers or cloth-dressers. The scouring of cloth dirtied in manufacturing, is by the invention of soap, bleaching, and other processes, become so easy that it can be performed by women. The Romans for the most part wore a white dress made in the form of a cloak; which indeed, as shirts were not then used, must have often stood in need of being cleaned[272]. We, on the other hand, wear in general short close clothes of coloured cloth; which by the fashion

in which they are made, are less exposed to be dirtied; and we are more accustomed also to use clothes of linen or cotton, which can be washed with much less labour. Felt, which is employed almost for hats alone, is manufactured by our hat-makers. Whoever takes a general view of all these employments together, will be readily convinced that they maintain more people, and in a better manner, than the whole *ars fullonia* did at Rome.

[The principal kinds of soap manufactured in this country are,—white soap, composed chiefly of tallow and soda, but for some purposes of olive oil and soda; yellow soap, made of tallow, rosin and soda, a little palm oil being occasionally added; mottled soap, formed of tallow, kitchen stuff and soda, its peculiar appearance being communicated by dispersing the lees through it towards the end of the operation; brown soap, made from palm oil, rosin and soda. Soft soap is made with potash and drying oils, either alone or mixed with tallow, and other coarse fatty matters. The fatty matter is mixed with the alkaline ley, and the whole boiled gently for some time, until the fat is completely saponified, which may be known by its becoming clear and transparent, and its susceptibility of being drawn into long threads. A quantity of common salt is then added to the boiling mixture, until the soap loses its thready character, and drops from the spatula in short thick lumps. The soap is then removed, either after cooling, or at once ladled out. Common fatty matters, as tallow, fat-oils, &c., are compounds of a fatty acid with a base, thus resembling salts; the base is a peculiar sweet principle, glycerine; by ebullition with the caustic lye, the neutral fatty compound is decomposed, the fatty acid combining with the base soda, and forming the soap, whilst the glycerine with the excess of alkali remains in the liquid.

The so-called *silicated* soap, of which large quantities are now manufactured, is made by combining silicate of soda with hard soap in the hot and pasty state; in this way from 10 to 30 per cent. of the silicate may be introduced. Such soap possesses, according to Dr. Ure, very powerful detergent qualities, but it is apt to feel hard and somewhat gritty in use. The silicated soda is obtained by boiling ground flints in a strong caustic lye. Many substances are used to adulterate soap, such as potatoe-starch, clay, &c., for which *improvements*, as they are termed, numerous patents have been granted in this country.

In Great Britain the hard kind of soap is chiefly made at Liverpool and London, but in considerable quantities also at Runcorn, Bristol, Brentford, Hull, Bromsgrove, Plymouth and Sethwick, and at Glasgow and Leith in Scotland; the soft soap is made principally at Liverpool, Glasgow and Bradford; and silicated soap is likewise extensively manufactured at Liverpool.

From the excise returns, it appears that 140,712,535 pounds of hard, 9,788,851 pounds of soft, and 3,921,862 pounds of silicated soap were made in England in 1841; and 10,708,464 pounds of hard, and 4,535,030 pounds of soft soap in Scotland; making in all 169,666,742 pounds, which is an increase of about 30 per cent. since 1832[273].

The excise duty on soap was first imposed in Great Britain in 1711, when it was fixed at 1*d.* per pound. It was raised in 1713 to 1½*d.* per pound; and again, in 1782, when hard and soft soap were first distinguished, the former being rated at 2¼*d.*, and the latter at 1¾*d.* per pound. In 1816, that on hard soap was increased to 3*d.* per pound. But since May 31, 1833, the duty has been 1½*d.* per pound on hard soap, and 1*d.* per pound on soft. In 1839, the number of soap manufacturers in England was 177; in Scotland 19; and in Ireland 183. Each requires an annual license, costing 4*l.*

An allowance of duty is made on soap used in the woollen, silk, flax, and cotton manufactures, which in 1841 was granted on 10,190,160 pounds of hard, and 9,090,184 pounds of soft soap; the allowances amounting to 78,112*l.* In the same year the net amount yielded by the soap-duty to the public revenue was 815,864*l.* Ireland is not subject to the soap-duty.

The soap-maker was formerly subjected to an arbitrary and vexatious interference from the excise; but of late years the regulations have been greatly improved, and there is now no superintendence of the process of manufacture, which may be conducted in any way and of any material.]

FOOTNOTES

[231] Plin. xviii. 12, sect. 51, p. 475.

232 It is beyond all doubt that the words *sapo* and σάπων were derived from the German *sepe*, which has been retained in the Low German, the oldest and original dialect of our language. In the High German this derivation has been rendered a little more undistinguishable by the *p* being changed into the harder *f*. Such changes are common, as *schap*, *schaf*; *schip*, *schiff*, &c.

233 De Simplicibus Medicaminibus, p. 90, G.

234 According to Aretæus De Diuturnis Morbis, ii. 13, p. 98, soap appears to have been formed into balls.

235 Mart. xiv. 27. This soap acquired the epithet of *Mattiacum* from the name of a place which was in Hesse.

236

Caustica Teutonicos accendit spuma capillos,
Captivis poteris cultior esse comis.—Mart. xiv. 26.

These lines are generally explained in this manner:—"Dye thy hair with soap, and it will become more beautiful than that of the Germans." But in this case all the wit of the advice is lost; and the expression, "eris cultior quam comæ captivæ," seems to me to be very improper. I should rather translate them as follows:—"Let the Germans dye their hair with pomade; as they are now subdued, thou mayst ornament thyself better with a peruke made of the hair of these captives." This was a piece of delicate flattery to Domitian and the Roman pride. That prince thought he had conquered the Germans; and the most beautiful German hair, that which was not dyed, could be procured, therefore, at Rome, much easier than before. If the title of this epigram was written by Martial himself, it contains the first mention of the word *sapo*.

237

Fortior et tortos servat vesica capillos,
Et mutat Latias spuma Batava comas.—Mart. viii. 23, 19.

The first line of the above proves that people then covered their heads, in the night-time, with a bladder to keep their hair, after it was dressed, from being deranged; and a bladder was undoubtedly as fit for that use as the nets and cauls employed for the like purpose at present.

238

Femina canitiem Germanis inficit herbis.

Ovidius De Arte Amandi, iii. 163.

239

Valer. Max. i. 5, p. 135: Capillos cinere rutilarunt.

Ad rutilam speciem nigros flavescere crines,
Unguento cineris prædixit Plinius auctor.

Q. Serenus, De Medic. iv. 56.

Serenus seems to allude to a passage of Pliny, xxiii. 2, p. 306, where he speaks of an ointment made from the burnt lees of vinegar and *oleum lentiscinum*. The same thing is mentioned in Dioscorides, v. 132, p. 379. Servius, Æn. iv. quotes the following words from Cato: "Mulieres nostræ cinere capillum ungitabant, ut rutilus esset crinis." Alex. Trallianus, 1, 3, gives directions how to make an ointment for gray hair from soap and the ashes of the white flowers of the *Verbascum*. The *Cinerarii*, however, of Tertullian, lib. ii. *ad uxor.* 8, p. 641, seem to have been only hair-dressers, who were so called because they warmed their curling-irons among the hot ashes.

240 Pliny says that spots of the skin may be removed by ox-gall.

241 Odyss. vi. 91.

242 Iliad, ix. 14, and xvi. 4.

243 Geopon. vii. 6.—Plin. xiv. cap. 21.—Columella, xii. 50. 14.

[244] Arnobius, vii. p. 237.

[245] The word λίτρον in Pollux ought not to have been translated *sapo*.

[246] Cicer. Ep. Fam. viii. 14.—Pollucis Onom. viii. 9, 39; x. 135.—Ovid. De Medicam. Faciei, ver. 73 et 85.—Phavorini Dictionar. p. 527. Gynesius calls clothes washed with *nitrum*, νιτρούμενα, *nitro perfricata*.

[247] Lib. xi. p. 801.

[248] De Mirabil. Auscult. c. 54.

[249] Hist. Mirab. c. 162, p. 216.

[250] Lib. xxxi. 10, p. 564.

[251] J. D. Michaelis Commentationes, 4to, p. 151. I must mention also C. Schoettgenii Antiquitates Fulloniæ, Traj. 1727, 8vo. My readers will do me a pleasure if they compare the above work with this article. No one will accuse me of vanity when I pretend to understand the theory of washing better than the learned Schöttgen; but if I have explained the passages which he quotes in a more satisfactory manner, and turned them to more advantage, I must ascribe this superiority to my knowledge of that art. I shall here take occasion to remark, that there is no subject, however trifling, which may not be rendered useful, or at least agreeable, by being treated in a scientific manner; and to turn such into ridicule, instead of displaying wit, would betray a want of judgment.

[252] Plin. xxviii. 6; xxviii. 8.—Martial. vi. ep. 93.—Athenæus, xi. p. 484. Macrobius, ii. 12, speaking of drunken people, “Dum eunt, nulla est in angiporto amphora, quam non impleant, quippe qui vesicam plenam vini habeant.” This passage is quoted also in Joh. Sarisberg. Polior. viii. 7, p. 479.

[253] Sueton. in Vita Vespas. viii. 23.

[254] Porner's Anleitung zur Farbekunst, p. 31.

[255] Those numbered 3, 4, 5, 6.

[256] This plant was sent by Imperati to Casp. Bauhin, under the name of *lanaria veterum*; and the latter made it first known in his Pinax Plant. iv. p. 206. The former described it himself, and gave a bad engraving of it, in Hist. Nat. p. 871. Löffling found this plant on the Spanish mountains, as well as in the neighbourhood of Aranjuez; and he relates, that in the province of La Mancha the people boil clothes that are to be washed with the root of this plant *instead of soap*. Linnæus did not hesitate to declare the *struthium* of the ancients and the *struthium* of his system to be the same plant; and he gave his countrymen reason to hope that their *Gypsophila fastigiata*, which has a great resemblance to it, might be employed in the like manner.—Amœnitat. Academ. v. p. 329.

[257] Salmas. ad Solin. p. 818. a.

[258] De Alimentor. Facultate, i. cap. 19. in Op. vol. iv. p. 315.

[259] Lib. xvii. 18.

[260] Pollux.—Plin.

[261] Dioscor.

[262] This *terra Lemnia* is entirely different from sealing-earth. See Galen. De Simplic. Med.

[263] Plin.

[264] Plin. The *Sarda* was cheap, and purchased by measure; the *Umbria* was dearer, and sold by weight.

[265] Theophrast. Dioscor.

[266] I here mean that it got its name from being employed to clean that piece of armour, formerly used, which covered only the breast and the back, and which was called a *koller*. The Swedes also call yellow iron-ochre *kiöllerfärg* or *kyllerfarg*.

[267] See Taubmann's Annotations to Plauti Aulular. iv. sc. 9, 6.

[268] Geopon. vii. 6.—Plin. xiv. cap. 21.—Columella, xii. 50, 14.

[269] Pollux, vii. 11, 41, 715.—Plin. xxxv. 17, p. 719; and xxxv. 15, p. 714.—Isidor. Origin. xvi. 1.

[270] Lib. xxxv. cap. 17, sec. 57.

[271] Du Cange in his Glossarium.

[272] I acknowledge myself one of those who cannot form a proper idea of the Roman *toga*. It is certain that the weavers made each piece of cloth only large enough to be fit for this article of dress; or that when one *toga* was wove, it was cut from the loom, in order that another might be begun. On this account we find so often the expressions *texere vestes*, *texere togas*. It appears, also, that the *toga*, when it came from the hands of the weaver, was quite ready for use; and we therefore never read of tailors, but when torn clothes were to be mended. The *toga* had no sleeves, and perhaps no seam. If it was stitched along the edges before, half-way up, the assistance of a tailor would not be necessary for that purpose. It was bound round the body with a girdle, and fastened with clasps. Such a mantle could be easily made and easily scoured. One may now readily comprehend why the Roman authors never mention cloth manufactories, or cloth, among the articles of commerce, but speak only of clothes; and why we never read of cloth being measured.

[273] Waterston's Encyclopædia of Commerce.

MADDER.

This plant, the root of which is either dried and bruised, or used fresh, for dyeing red, has a weak, square, jointed stem; and rises to the height of eight feet when supported, otherwise it creeps along the ground. At each joint there are from four to six leaves, about three inches in length, almost an inch broad in the middle, and pointed at both ends. The upper side of the leaves is smooth; but the middle nerve of the under side is armed with small rough prickles; and others of the same kind may be found on the stem. On this account, the leaves, which drop annually, adhere readily to other bodies, like those of the *asperugo*. The branches, which in June bear flowers divided into four yellow leaves, proceed from the joints. The fruit, a kind of berry, which, towards the time of its ripening, though that seldom happens among us, is first of a brownish colour, and then black, contains a round seed. The roots grow sometimes to the thickness of one's finger, push themselves deep into the earth, are surrounded by many small fibres, have a yellowish-red pith, and are covered with a black bark or rind. This plant grows wild in the Levant, as well as in Italy, the southern parts of France, and in Switzerland. The cultivated kind is well known, and is propagated with much advantage in various countries of Europe.

When one compares this short description with what Dioscorides says of a plant which he calls *ereuthodanon*, it will be readily seen that he meant our madder. He even compares its long square stem, armed with a great many hooks, to that of the *asperugo*; and he tells us that the leaves stand in the form of a star around the joints. The fruit was at first green, then red, and lastly black. The thin long roots, adds he, which are red, serve for dyeing; and on that account the cultivated kind (he must therefore have been acquainted with the wild sort) is reared with much benefit in Galilee, around Ravenna in Italy and in Caria, where it is planted either among the olive-trees, or in fields destined for that purpose. It is remarked in some manuscripts, that this plant had a name given it by the Romans, which, as Marcellus Virgil observes, meant the same thing as *Rubia sativa*, and that it

was called in Etruria *Lappa minor*, doubtless because, like the bur, it adhered to other bodies. On account of the colour which it communicated, it was called also sometimes *cinnabaris*[274].

In opposition to this asserted identity I find only one doubt; namely, that among those plants which, on account of the position of their leaves, were called *stellatæ*, and which were all so like that we must reduce them to one natural order, there are more sorts, the roots of which dye red, and which on that account are very improperly called wild madder. Why, therefore, should the plant of Dioscorides be our madder, and not some other plant of the like nature? For this reason, in my opinion: because the ancients, who were acquainted with all these plants, which grew wild in their lands, were equally prudent as the moderns, and cultivated that kind only which was the most productive or beneficial, viz. our *Rubia tinctorum*.

This opinion will be strengthened by comparing the accounts given of that plant by other ancient writers. Theophrastus agrees almost perfectly with Dioscorides; and adds, that it did not grow upright, but was fond of reclining. The comparison, therefore, with the leaves of ivy cannot be just; but that I shall leave to the critics. Pliny says expressly, that the *erythrodanum* or *ereuthodanum* was in his mother-tongue called *rubia*; and that its red roots were used to dye wool and leather red[275].

In the middle ages this plant was called *varantia*, a name which must have arisen from *verantia*. The latter means the real, genuine dye; as *aurantia* signified a golden yellow. Till the year 1736, this plant was little regarded, except among dyers, farmers and merchants, who purchased it from the farmers, in order to sell it to the dyers with profit; and among a few herb-dealers and physicians, who, on the authority of the ancients, ascribed to it eminent virtues, which others doubted or altogether denied. In the above year, however, a property of it was discovered by accident, as usual, which rendered it an object of more attention. John Belchier, an English surgeon, having dined with a cotton-printer, observed that the bones of the pork which was brought to the table were red. As he seemed surprised at this circumstance, his host assured him that the redness was occasioned by the swine feeding on the water mixed with bran in which the cotton cloth was boiled, and which was coloured by the madder used in

printing it. Belchier[276], to whom this effect was new, convinced himself by experiments that the red colour of the bones had arisen from the madder employed in printing the cotton, and from no other cause; and he communicated his discovery to the Royal Society, in a paper which was printed in their Transactions.

This singularity was now soon known to all the naturalists, several of whom made new experiments, the result of which brought to light many truths useful to physiology. Besides the roots of madder, those of the *Galium* (yellow ladies-bed-straw) and other plants which have an affinity to madder, produce the like effects; but this is the case neither with saffron nor woad, nor with many others much used in dyeing. The colouring takes place soonest in young animals; and is strongest where the bones are hardest and thickest. On the other hand, it does not reach the soft parts; appears only a little in the milk; and in general is not perceptible in the animal juices[277].

As the English calico-printers were acquainted with this effect of madder before it was known to naturalists, it is not improbable that it was known much sooner in other places, where the plant has been much cultivated and used since the earliest periods. From what J. E. Stief says, we have reason to believe that the people in the neighbourhood of Breslau, his native city, who gave the stalks of the madder plant to their cows instead of straw, must have first discovered that it possessed the property of communicating a red colour to the bones[278].

As many truths not yet investigated by means of new experiments, and which on that account have not yet been acknowledged, are concealed among the evidently false assertions to be found in the works of the ancients, and as these works were thrown aside too early, before their contents were properly examined, I was induced to suspect that some hints of this colouring property might also be mentioned in them, which indeed is the case.

We learn from the works of Galen and Dioscorides, that the ancient physicians remarked that the use of certain roots, which they administered to their patients, communicated a colour to their urine and excrements; and this observation has been repeated by Cardan, Thurneisser, Porta, Castor, Durantes, and others. Had those ancient physicians, who often prescribed

these roots, and paid attention to the colour of the excrements of their patients, been accustomed to open their bodies when they died under their hands, they would have perhaps remarked, in human bones, what was observed long after in the bones of animals, when the roots were no longer used in medicine; and what, if I am not mistaken, was never yet observed in the bones of the human species[279].

Böhmer, who made researches respecting the antiquity of this observation, found it neither in Rombert. Dodonæus, Mich. Ettmuller, Morin, Will. Salmon, nor others, who, however, speak of coloured urine. In his opinion the oldest writer who speaks of coloured bones is Mizaldus; but what he relates is all taken from the treatise of Lemnius De Miraculis Occultis Naturæ; and the latter therefore is the oldest writer that I at present can mention as acquainted with this property. He was a physician in Zealand, where madder has been cultivated since the earliest ages, and where he had an opportunity of remarking it. He says that the bones of animals became red, as had been observed when the flesh was dressed, by their eating only the leaves, and not the roots. In the first edition of the above work, printed in octavo, in the year 1559, which consists of two books, this information will not be found; but it may be contained in the second of 1564, which comprehends four books.

[The madder plant is much cultivated in Holland, but Macquei observes that the Dutch were first indebted to the Flemish refugees for their knowledge of the method of preparing this plant. Its culture has often been attempted in England, but always without success[280]. It is also largely cultivated in Alsace and Provence in France, especially near Avignon, in Asiatic Turkey, and in Italy; from which places it is largely exported. The Turkey and Provence madder is procured from *Rubia peregrina*; the remainder from *R. tinctorum*. To prepare the root, which is the part used in dyeing, it is removed from the ground, picked, dried and ground.

Madder contains three distinct colouring principles; two of these are red, viz. alizarine and purpurine, and one, xanthine, is yellow.

Since 1836, two new products have been introduced into commerce, which are destined to replace madder in the operations of dyeing and calico-printing; one is called garancine, the other colorine. Garancine is

prepared by washing and macerating madder, and filtering through linen. The grounds are then crushed and mixed with sulphuric acid, equal to half the amount of madder first employed; the acid should be somewhat dilute. It is then poured hot upon the madder, agitated, and when the mixture appears intimate, the temperature is raised to 212°, and maintained for about an hour. It is then again mixed with water, filtered, and thoroughly washed. It is finally pressed, dried and passed through the sieve. This is the process patented by MM. Lagier, Robiquet and Colin, in 1828.

It was first introduced into commerce by the house of Lagier and Thomas, at Avignon, in 1829.

The great advantage of garancine over madder is that it does not change the white, and that the bleaching of the stuffs dyed with it is reduced to a mere nothing. Hot water or bran are the only means used for clearing them. Madder is an adjective colour, that is to say, one which requires to be combined with some basic substance or mordant to render its fixture upon the dye-stuff permanent.]

FOOTNOTES

274 Some also may with equal propriety have called it *sandyx*; and I am of opinion that under this name we are to understand our madder, at least in a passage of Virgil, Eclogue iv. 45, where he says, “Sponte sua sandyx pascentes vestiet agnos.” As the wool of the sheep became red by eating the madder which grew in the fields, it could be immediately manufactured, without dyeing it artificially. We manufacture the wool of our brown sheep in its natural colour, and this was done also by the ancients. Cloths of this kind were the *panni nativi coloris*, as they are called by Pliny, xxxvi. 7; and the words of Martial, xiv. 133, allude to a dress made of such cloth:

> Non est lana mihi mendax, nec mutor aëno,
> ... me mea tinxit ovis.

I shall here take occasion to remark, that the word *lutum*, in the line preceding the above passage of Virgil, must be translated *yellow-weed*, and not *woad*. The former, *Reseda luteola*, dyes yellow; but the latter, *Isatis*, dyes blue. *Lutum*, however, in Cæsar De bello Gallico, v. 14, seems to have been *woad*: "Omnes se Britanni luteo inficiunt, quod et cæruleum efficit colorem." It appears, therefore, that both names were liable to be confounded in the Latin, as they are in the German; unless Davis be right, who, instead of *luteo*, reads *vitro*. That *sandyx*, in Virgil, signifies a plant rather than a mineral, is to me far more probable. The author speaks of plants which the sheep ate while feeding (*pascentes*); and both the above-mentioned dye-plants, yellow-weed and woad, grow wild in Italy. The opinion of Pliny, who understood the passage so, is not to be despised; and therefore the poetical account, that the pasture dyed the wool, is not altogether without foundation; especially as not only the roots, but also the leaves of madder, communicate a colour to the solid parts of animal bodies. I will however allow that most people readily fall into the error of being led away by imagination; and often suppose that they find in passages of ancient authors more than others can discover, or perhaps even than they contain.

275 Lib. xxiv. 9, p. 341.

276 The first account of this circumstance may be found in the Philosophical Transactions, vol. xxxix. n. 442, p. 287; n. 443, p. 299. Among the principal experiments made on this subject, are those of the Italian Matth. Bazanus, in Comment. Bononiens. and of J. H. Benj. Böhmer, in a dissertation entitled Radicis Rubiæ tinctorum effectus in Corpore Animali, Lips. 1751. Other works and observations relative to this singularity are mentioned in Haller's Elementa Physiologiæ, v. p. 327.

277 That the *Rubia* colours the milk has been denied by many, who are mentioned in Haller's Physiol. viii. p. 328. Young, in his Treatise De Lacte, says only that it has no effect on carnivorous animals. Being once engaged in making experiments on the madder dye, I

gave the plant to a cow for several days, and I found that the milk became reddish and streaked with veins which were of a darker colour than the other parts. That well-known farmer, Gugenmus, gave the madder-plant, formed into hay, to his cows, who ate it readily. Their milk was somewhat reddish, and the butter and cheese acquired by these means in winter an agreeable colour. Perhaps the effects do not take place when the animals get other food at the same time. Or may not the state of their health occasion some difference? This much is certain, that *Chelidonium* (swallow-wort) makes the milk of cows that are weak appear bloody, while the same effect does not follow, or at least immediately, in those that are strong. Ruellius, De Natura Stirpium, Basiliæ, 1543, fol. p. 572, says of the Rubia, "Folia capillum tingunt." If he meant that the hair became red by eating the leaves, he committed a mistake.

278 Dissertatio de Vita Nuptiisque Plantarum. Lipsiæ, 1741, p. 11.

279 I do not know that any one ever remarked human bones to have been dyed by madder, though the proposal for using the roots of it against the rachitis might have given occasion to make observations on that subject. See G. L. Hansen, Diss. de Rachitide. Gottingæ, 1762, p. 36. Professor Arnemann, who has a very numerous and valuable collection of skeletons, and who carefully examined many of the like kind during his travels, assured me that he never saw any bones that had been dyed by madder in the human body.

280 On Vegetable Substances, by the Society for the Diffusion of Useful Knowledge.

JUGGLERS, ROPE-DANCERS, AUTOMATA, ETC.

Under this title I comprehend not only those properly called jugglers, who, for the sake of money, by quick and artful motions of their hands, bodies, and limbs, and by various preparations, delude the senses in an agreeable manner, or practise an innocent deception on the spectators, so that they think they hear and see what they do not really hear and see, but also rope-dancers; people who place their bodies in positions according to all appearance dangerous; and those who for pay exhibit animals taught to perform uncommon tricks, as well as automata, which by their concealed construction seem to produce wonderful effects.

But is it worth while to inquire into the antiquity of all these arts, unprofitable to the public, which form the favourite amusements of the populace? The selfish question *cui bono*, which is often thrown out by way of reproach to men of letters, but oftener to naturalists, and even to jurists, when, in their researches, they advance beyond the beaten track, I might easily get rid of by civilly telling the querists to pass over this article if they think they are not likely to derive benefit from it. I might also apologise for employing my time and labour on this subject, by using the words of a certain historian: “Frivola hæc fortassis cuipiam et nimis levia esse videantur, sed curiositas nihil recusat.” I shall however adopt neither of these methods; as I flatter myself that this essay may afford as much amusement as many that are read daily; and that therefore it may not only be excused, but even justified.

Those arts and employments which are most necessary in life were undoubtedly the earliest, and they have still continued to be the most important; but when these were sufficiently occupied, or carried on by as many persons as could live by them, the rest, who were excluded from them, conceived the idea of amusing the former when tired with their labour, that by these means they might obtain from them a part of the fruits

of their industry. I request my readers to reflect how many occupations have been devised for no other purpose. They will find that several of these have acquired a pre-eminence over the necessary or useful arts; and to the same class belong jugglers.

All political writers tell us, as a fundamental principle of government, that population ought to be increased. This maxim however is just only under certain circumstances; that is, when employment can be procured to a greater number of inhabitants than a country already possesses. Of beggars we have to maintain too many. All our trades and occupations are not only filled up with workmen, but overflow. Our farmers can employ no more labourers, and our manufacturers no more hands than they have at present; our regiments are full; and in every employment there are more candidates and more supernumeraries than is consistent with the good of the public. Must it not therefore give us pleasure, when necessity invents new means of acquiring a livelihood, although they could be dispensed with? It is much better that those who have learned no useful art; who have lost their youth in the service of others; or who are destitute, through any other cause, should gain their bread by amusing their fellow-citizens, than that they should either beg or steal.

These arts are indeed not unprofitable, for they afford a comfortable subsistence to those who practise them; but their gain is acquired by too little labour to be hoarded up; and, in general, these roving people spend on the spot the fruits of their ingenuity; which is an additional reason why their stay in a place should be encouraged. I have however known some who saved so much from their earnings, that, in their old age, they were enabled to enter into some business more certain as well as more profitable.

People of this description will never want encouragement and support while they exhibit with confidence anything uncommon, and know how to suit the nature of their amusements to the taste of the spectators. The greater part of mankind love deception so much, that they reward liberally those who impose on their senses, as is proved by the ready sale of gilt articles, artificial gems, and a thousand other things which are not in reality what they appear to be. I do not know whether Montagne is right in considering it as a sign of the weakness of our judgement, that we take a pleasure in beholding objects on account of their rarity, novelty, or the difficulty that

attends them, though they may be subservient to no useful purpose[281]. This appears to me to proceed from that innate curiosity which serves as a spur to incite us to enlarge our knowledge, and to engage in researches and undertakings that often lead to discoveries of greater importance.

Jugglers indeed seldom exhibit anything that can appear wonderful to those acquainted with natural philosophy and mathematics; but these even often find satisfaction in seeing truths already known to them applied in a new manner; and they readily embrace every opportunity of having them further illustrated by experiments. Many however are too precipitate, and attempt to explain before they have sufficiently examined, of which the golden tooth at the end of the sixteenth century, the conjuring-rod at the end of the seventeenth, and the chess-player and speaking-machine at the end of the eighteenth, may serve as instances. But it often happens, that what ignorant persons first employ, merely as a show, for amusement or deception, is afterwards ennobled by being applied to a more important purpose. The machine with which a Savoyard, by means of shadows, amused children and the populace, was by Lieberkühn converted into a solar microscope; and to give one example more, which may convince female readers, if I can hope for such, the art of making ice in summer, or in a heated oven, enables guests, much to the credit of their hostess, to cool the most expensive dishes. The Indian discovers precious stones, and the European, by polishing, gives them a lustre.

But if the arts of juggling served no other end than to amuse the most ignorant of our citizens, it is proper that they should be encouraged for the sake of those who cannot enjoy the more expensive deceptions of an opera. They answer other purposes however than that of merely amusing; they convey instruction in the most acceptable manner, and serve as a most agreeable antidote to superstition, and to that popular belief in miracles, exorcism, conjuration, sorcery, and witchcraft, from which our ancestors suffered so severely. Wherever the vulgar were astonished at the effects of shadows, electricity, mirrors, and the magnet, interested persons endeavoured by these to frighten them; and thus misapplied the powers of nature to promote their own advantage. The pontiffs and their clergy ought, undoubtedly, to be detested for discouraging experimental philosophy. That science they considered as a formidable enemy; and they thought they gained no small advantage when they induced the house of Medici, by

granting it the cardinalship, to suppress the Academy del Cimento. When Gasner exhibited his deceptions, some one proposed to him to try his art at Berlin or Göttingen, and to drive out there if it were only the smallest of all the devils; but these cities were not theatres where he was likely to succeed, and he never ventured to appear in them[282]. It is however better that the populace, if they will absolutely pay for being deceived, should be exposed to a momentary deception from jugglers than to a continual deception from priests. As the former are not covered with the sacred cloak of religion, their deceptions are more easily seen through and detected; and they consequently soon cease to be hurtful. So late as the year 1601, a horse, which had been taught to perform a number of tricks, was tried, as possessed by the devil, and condemned to be burnt[283]. At present horses of this kind are so often exhibited publicly in the heretical countries of Europe, that the Spanish Inquisition, perhaps, will soon be ashamed of considering such proofs of the docility of these animals, and of the patient dexterity of their teachers, as the work of the devil, as they did at the above period. Those who view the art of the juggler in the same light as I do, will, I hope, forgive me for introducing these observations, and allow me to continue them while I inquire into the antiquity of this employment; especially as I shall endeavour by these means to illustrate more fully my subject.

Had that book which Celsus wrote against the Magi been preserved, we should have been much better acquainted with the art of the ancient conjurors or jugglers. This Celsus, without doubt, is the same author whose virulent attack against the Christians was refuted by Origen; and we have, therefore, greater cause to regret that a work on the above subject, by so learned and acute a philosopher, should have been lost. He is mentioned with respect by Lucian, and even by Origen; and the former derived from him the account which he gives of Alexander the impostor[284]. More ancient authors also wrote upon the same subject. Some of them are mentioned by Diogenes Laërtius in his preface; and Suidas quotes the Magicon of Antisthenes, though neither of these speaks of Celsus; but of all those writings none are now extant.

The deception of breathing out flames, which at present excites in a particular manner the astonishment of the ignorant, is very ancient. When the slaves in Sicily, about a century and a half before our æra, made a

formidable insurrection, and avenged themselves in a cruel manner for the severities which they had suffered, there was amongst them a Syrian named Eunus[285], a man of great craft and courage, who, having passed through many scenes of life, had become acquainted with a variety of arts. He pretended to have immediate communication with the gods; was the oracle and leader of his fellow-slaves; and, as is usual on such occasions, confirmed his divine mission by miracles. When, heated by enthusiasm and desirous of inspiring his followers with courage, he breathed flames or sparks among them from his mouth while he was addressing them. We are told by historians, that for this purpose he pierced a nut-shell at both ends, and, having filled it with some burning substance, put it into his mouth and breathed through it. This deception, at present, is performed much better. The juggler rolls together some flax or hemp, so as to form a ball about the size of a walnut; sets it on fire; and suffers it to burn till it is nearly consumed; he then rolls round it, while burning, some more flax; and by these means the fire may be retained in it for a long time. When he wishes to exhibit, he slips the ball unperceived into his mouth and breathes through it; which again revives the fire, so that a number of weak sparks proceed from it; and the performer sustains no hurt, provided he inspire the air not through the mouth, but the nostrils[286].

By this art the rabbi Bar-Cocheba, in the reign of the emperor Hadrian, made the credulous Jews believe that he was the hoped-for Messias[287]; and two centuries after, the emperor Constantius was thrown into great terror, when Valentinian informed him that he had seen one of the body-guards breathing out fire and flames in the evening[288].

For deceptions with fire the ancients employed also naphtha, a liquid mineral oil, which kindles when it only approaches a flame. Galen informs us, that a person excited great astonishment by extinguishing a candle and again lighting it, without any other process than holding it immediately against a wall or a stone. The whole secret of this consisted in having previously rubbed over the wall or stone with sulphur. But as the author, a few lines before, speaks of a mixture of sulphur and naphtha, there is reason to think that he alludes to the same here. Plutarch[289] relates how Alexander the Great was astonished and delighted with the secret effects of naphtha,

which were exhibited to him at Ecbatana. The same author, as well as Pliny, Galen, and others, has already remarked, that the substance with which Medea destroyed Creusa, the daughter of Creon, was nothing else than this fine oil[290]. She sent to the unfortunate princess a dress besmeared with it, which burst into flames as soon as she approached the fire of the altar. The blood of Nessus, wherein the dress of Hercules, which took fire likewise, had been dipped, was undoubtedly naphtha also[291]; and this oil must have been always employed when offerings caught fire in an imperceptible manner[292]. In all periods of the world priests have acted as jugglers to simple and ignorant people.

In modern times, persons who could walk over burning coals or red-hot iron, or who could hold them in their hands and their teeth, have often excited wonder. In the end of the seventeenth century, an Englishman, named Richardson, who, as we are assured, could chew burning coals, pour melted lead upon his tongue, swallow melted glass, &c., rendered himself very famous by these extraordinary feats[293]. Laying aside the deception[294] practised on the spectators, the whole of this secret consists in rendering the skin of the soles of the feet and hands so callous and insensible, that the nerves under them are secured from all hurt, in the same manner as by shoes and gloves. Such callosity will be produced if the skin is continually compressed, singed, pricked, or injured in any other manner. Thus do the fingers of the industrious sempstress become horny by being frequently pricked; and the case is the same with the hands of fire-workers, and the feet of those who walk bare-footed over scorching sand[295].

In the month of September, 1765, when I visited the copper-works at Awestad, one of the workmen, for a little drink-money, took some of the melted copper in his hand, and after showing it to us, threw it against a wall[296]. He then squeezed the fingers of his horny hand close to each other; put it a few minutes under his armpit, to make it sweat, as he said; and, taking it again out, drew it over a ladle filled with melted copper, some of which he skimmed off, and moved his hand backwards and forwards, very quickly, by way of ostentation. While I was viewing this performance, I remarked a smell like that of singed horn or leather, though his hand was

not burnt. The workmen at the Swedish melting-houses showed the same thing to some travellers in the seventeenth century; for Regnard saw it in 1681, at the copper-works in Lapland. It is highly probable that the people who hold in their hands red-hot iron, or who walk upon it, as I saw done at Amsterdam, but at a distance, make their skin callous before, in the like manner. This may be accomplished by frequently moistening it with oil of vitriol; according to some the juice of certain plants will produce the same effect; and we are assured by others that the skin must be very frequently rubbed, for a long time, with oil, by which means, indeed, leather also will become horny.

Of this art, traces may be found also in the works of the ancients. A festival was held annually on Mount Soracte, in Etruria, at which the Hirpi, who lived not far from Rome, jumped through burning coals; and on this account they were indulged with peculiar privileges by the Roman senate[297]. Women also, we are told, were accustomed to walk over burning coals at Castabala in Cappadocia, near the temple dedicated to Diana[298]. Servius remarks, from a work of Varro now lost, that the Hirpi trusted not so much to their own sanctity as to the care which they had taken to prepare their feet for that operation.

I am not acquainted with everything that concerns the trial by ordeal, when persons accused were obliged to prove their innocence by holding in their hands red-hot iron; but I am almost convinced that this also was a juggling trick of the priests, which they employed as might best suit their views. It is well known that this mode of exculpation was allowed only to weak persons, who were unfit to wield arms, and particularly to monks and ecclesiastics, to whom, for the sake of their security, that by single combat was forbidden. The trial itself took place in the church entirely under the inspection of the clergy; mass was celebrated at the same time; the defendant and the iron were consecrated by being sprinkled with holy water; the clergy made the iron hot themselves; and they used all these preparatives, as jugglers do many motions, only to divert the attention of the spectators. It was necessary that the accused persons should remain at least three days and three nights under their immediate care, and continue as long after. They covered their hands both before and after the proof; sealed and unsealed the covering: the former, as they pretended, to prevent the

hands from being prepared any how by art; and the latter to see if they were burnt.

Some artificial preparation was therefore known, else no precautions would have been necessary. It is highly probable that during the first three days the preventive was applied to those persons whom they wished to appear innocent; and that the three days after the trial were requisite to let the hands resume their natural state. The sacred sealing secured them from the examination of presumptuous unbelievers; for to determine whether the hands were burnt, the last three days were certainly not wanted. When the ordeal was abolished, and this art rendered useless, the clergy no longer kept it a secret. In the thirteenth century an account of it was published by Albertus Magnus, a Dominican monk[299]. If his receipt be genuine, it seems to have consisted rather in covering the hands with a kind of paste than in hardening them. The sap of the *Althæa* (marsh-mallow), the slimy seeds of the flea-bane, which is still used for stiffening by the hat-makers and silk-weavers, together with the white of an egg, were employed to make the paste adhere; and by these means the hands were as safe as if they had been secured by gloves. The use of this juggling trick is very old, and may be traced back to a pagan origin. In the Antigone of Sophocles, the guards placed over the body of Polynices, which had been carried away and buried contrary to the orders of Creon, offered, in order to prove their innocence, to submit to any trial: "We will," said they, "take up red-hot iron in our hands, or walk through fire[300]."

The exhibition of balls and cups, which is often mentioned in the works of the ancients as the most common art of jugglers, is also of great antiquity. It consists in conveying speedily and with great dexterity, while the performer endeavours by various motions and cant phrases to divert the attention of the simple spectators from observing his movements too narrowly, several light balls, according to the pleasure of any person in company, under one or more cups; removing them sometimes from the whole; and conveying them again back in an imperceptible manner. In general, three leaden cups are used, and as many balls of cork; and to prevent all discovery by their slipping from the thumbs of the juggler, or making a noise, as he must lay hold of them with much quickness, the table before which he sits is covered with a cloth.

These small balls were by the ancients called *calculi*; and the cups *acetabula*, or *paropsides*. Casaubon[301] has already quoted most of those passages in ancient authors which relate to this subject; and they have been repeated by Bulenger[302]; but neither of these writers makes mention of the fullest and clearest description given in the letters of Alciphron[303]. We have there an account of a countryman who came to town, and was conducted by a merchant to the theatre, where he saw with great astonishment the exhibition of cups and balls. "Such an animal," says he, "as the performer I would not wish to have near me in the country; for in his hands my property would soon disappear." The art of oratory, because it deceives the auditors, is frequently compared to that of balls and cups. From the Latin word *gabata*, mentioned by Martial, together with *paropsides*, the French have made *gobelets* and hence their common expressions *jouer des gobelets*, and *joueur des gobelets*, which they use when speaking of jugglers.

In all ages of the world there have been men who excited great wonder by extraordinary strength. Instances of this have been already collected; but they do not belong to my present subject[304]. I can, however, prove that above fifteen hundred years ago there were people who, by applying a knowledge of the mechanical powers to their bodies, performed feats which astonished every ignorant spectator; though it is certain that any sound man of common strength could perform the same by employing the like means. Of these one may say with Celsus, "Neque hercule scientiam præcipuam habent hi, sed audaciam usu ipso confirmatam."

About the beginning of the last century, such a strong man, or Samson, as he called himself, a native of Germany, travelled over almost all Europe; and his pretended art has been mentioned by so many writers, that we may conclude it had not been often exhibited before; and that it was then considered as new. His name was John Charles von Eckeberg; he was born at Harzgerode in Anhalt; and at that time was thirty-three years of age. When he fixed himself between a couple of posts, on any level place, two or more horses were not able to draw him from his position; he could break ropes asunder, and lift a man up on his knee while he lay extended on the ground. But what excited the greatest astonishment was, that he suffered

large stones to be broke on his breast with a hammer, or a smith to forge iron on an anvil placed above it.

This last feat was exhibited even in the third century, by Firmus or Firmius, who, in the time of Aurelian, endeavoured to make himself emperor in Egypt. He was a native of Seleucia in Syria; espoused the cause of Zenobia, the celebrated queen of Palmyra; and was at length executed publicly by order of the emperor Aurelian. It is of this Firmus, and not of another, who a century after was overcome in Africa by the father of the emperor Theodosius, that Vopiscus speaks where he relates that he could suffer iron to be forged on an anvil placed on his breast. For this purpose he lay on his back; but he put himself in such a position, by resting with his feet and shoulders against some support, that his whole body formed an arch; so that he seemed rather to be suspended than to lie at full length[305]. This art, which is explained and illustrated by Desaguliers[306] and Professor Kuhn[307] of Dantzic, has now become so common that it is often exhibited without occasioning much surprise.

In the works of the ancients, rope-dancers are frequently mentioned. The passages where they occur have been collected by various authors, though never completely; and I am inclined to think that those who have seen many performers of this kind would be able to clear up some that are obscure. I have seen many myself; but I have forgot the greater part of what I observed; and there are other reasons also which prevent me from undertaking that task: I dread the reproach of “multum agendo nihil agis.” That I may not, however, pass over this subject entirely, I shall present the reader with what follows[308]. We meet with various appellations given to rope-dancers, which do not, as some have imagined, point out different kinds, but allude only to new-invented arts, leaps, or dexterities, which, while recommended by novelty, were much wondered at, though they were afterwards imitated by all. To these belong the *schœnobatæ*, *oribatæ*, *neurobatæ*, *petaminarii*, *funambuli*, &c. Some of the ancient rope-dancers seem to have used a balancing-pole, or at least to have had weights in their hands to preserve an equipoise[309]. It is certain also that rope-dancers were not wanting in the middle ages. In the year 1237 they were very common in

Italy[310]; and in 1393 there were some of them at Augsburg, who exhibited their dexterity on the rope, and received from each spectator three German halfpence[311].

To place men upon the shoulders of each other in such a manner that every row consists of a man fewer, till they form a pyramid ending in a single person, upon whose head a boy often stands with his feet upwards, is likewise an ancient piece of dexterity. This exhibition is varied many ways; and on that account it is difficult to form even conjectures respecting it, especially as the description given of it by a Roman poet is very unintelligible[312].

I am however still less acquainted with an art in which hoops and wheels were employed by the *petauristæ*, who excited great astonishment among the populace. The first part of the art may have consisted in nothing more than the varied contortions and tumbling which we still see practised by children trained for that purpose. Cilano explains a well-known passage of Manilius, as if the performers had darted through suspended iron hoops, made often red-hot. Of this I entertain less doubt than how we ought to understand the *corpora jactata petauro* of Juvenal[313]; and the *corpora valido excussa petauro* of Manilius[314], which many have attempted to explain already. At any rate this wheel was different from that upon which a female dancer, as mentioned by Xenophon, wrote and read while it turned round with great velocity[315].

The art of exhibiting various feats of horsemanship, which has been practised so much in modern times, seems to have come first from the East. At any rate, those performers in that way who, in the thirteenth century, were at the Byzantine court, and who travelled all over Europe, came from Egypt. They could stand on the horses when at a gallop; mount and dismount while on full speed at the chase; tumble on horseback, and do many other things equally extraordinary[316]. At the end of the sixteenth century, an Italian, who had learned this art while a slave in Turkey, went about exhibiting his dexterity in various parts of Europe. Montagne saw

him at Rome in 1581[317]; and the year following he was at Paris[318]. Some of these feats were performed by the ancient *desultores*.

Whether the ancients taught horses, dogs, birds, and other animals, to perform various tricks which are frequently exhibited at present for money, I do not know; but it is certain that what they made the elephant, which undoubtedly is the most sagacious and tractable of all animals, perform, exceeds everything yet known of the kind. Without repeating what has been so often related, I shall only mention the elephant which walked upon a rope backwards and forwards, as well as up and down; and which Galba first caused to be shown to the Roman people. After this, so much confidence was placed in the dexterity of the animal, that a person sat on an elephant's back while he walked across the theatre upon a rope extended from the one side to the other. Lipsius, who has collected the testimonies, thinks they are so strong that they cannot be doubted[319].

The training of horses to obey a private signal, imperceptible to the most attentive spectator, and to perform actions which appear, to those unacquainted with the art, to display rational faculties, I have never found mentioned in the works of the ancients. That the Sybarites however taught their horses to dance to the sound of music, is asserted by a variety of authors[320]. In the sixteenth century, dogs trained in the like manner excited great wonder[321].

In the year 1766, an Englishman, named Wildman, made himself much known by taming or training bees, in such a manner that they not only followed him wherever he went, but settled even on his face and hands without stinging him, and seemed as if obedient to his orders[322]. Some years after, a person who practised the like art, travelled about through Germany, and gave himself out to be Wildman; but M. Riem proved that he was not Wildman, and published the secret by which he acquired so much power over these insects[323]. I cannot say whether the ancients were acquainted with this art; but I shall here remark, that it was known in the kingdom of Galam, at Senegal, a hundred years before Wildman; for when Brue, a Frenchman, was there in 1698, he was visited by a man who called himself the king of the bees[324]. "Let his secret," says that traveller, "consist

in what it may, this much is certain; that they followed him wherever he went, as sheep do their shepherd. His whole body, and particularly his cap, was so covered with them that they appeared like a swarm just settled. When he departed they went along with him; for besides those on his body, he was surrounded by thousands which always attended him[325].”

In modern times, persons destitute of arms and hands, or who have these limbs formed very imperfectly, but who possess the art of supplying that want by the use of their feet and toes, show themselves sometimes for money; and as they entertain the spectators by exciting their wonder, they deserve from them that support which they are not able to obtain in any other manner. Instances of such people who had acquired this art, have been very common within the last two centuries[326]; but in the works of the ancients I have found only one. An Indian king, named Porus, sent to the emperor Augustus an embassy with presents, among which were some rare animals, and a man without arms, who with his feet, however, could bend a bow; discharge arrows; and put a trumpet to his mouth and blow it. Dio Cassius confesses that he did not know how this was possible; but Strabo refers for his authority to Nicolaus of Damascus, who saw all the presents as they passed through Antioch[327]. Had this deformed person, whom Strabo compares to a Hermes, travelled about, according to the modern practice, as a show, he would have been better known, and in all probability his example would have induced others to imitate his art[328]. Manilius says, however, that there were people, who, in playing at ball, could use their feet with as much dexterity as their hands, who could catch the ball with them, and again throw it back; but the poet, perhaps, did not allude to the small hand-ball, but to the large one which is struck with the fist, and which may be stopped also by the foot. Besides, the passage is read and explained different ways[329].

Figures or puppets, which appear to move of themselves, were employed formerly to work miracles; but they could hardly be used for that purpose at present in any catholic country of Europe, though they still serve to amuse the vulgar. Among these are the *marionettes*[330], as they are called, the different parts of which are put in motion imperceptibly by a thread. Of

a still more ingenious construction are those which are moved by the turning of a cylinder, as is the case in the machines with which some of the old miners in Germany earn a livelihood; but the most ingenious of all are those which are kept in continual movement for a certain time, by the help of wheels with a weight or spring. The latter are called *automata*; and, when they represent human figures, *androides*. Under the former general name are comprehended our watches, the most useful of all, and also jacks[331], with many others. The latter appellation is given to small puppets, which, when their inner works have been wound up, run upon the table or pavement, and as they advance move their head, eyes, and hands. They have been exhibited sometimes under the name of *courrante Margarethe*, which gave rise perhaps to the word *marionette*.

The proper *marionettes* are very old. They were common among the Greeks, and from them they were brought to the Romans. They were known by the name of *neurospasta*, and were much used at their shows. Aristotle speaks of some which moved their head, eyes, hands and limbs in a very natural manner[332]. They are mentioned with equal precision by Galen, Xenophon, Antoninus, Horace, Gellius, and others. To these belong the *phalli*, which were carried round during the festivals of Osiris and Bacchus, and of which one member only, that properly meant by the name, and which was almost as large as the whole body, moved upon certain threads being pulled[333]. Count Caylus has given an engraving of the body of a small puppet, made of ivory or bone; but he requires too much when he desires us to consider that fragment, merely on his word, as a piece of Greek or Roman antiquity. He at least ought to have informed us where it was found, and by what means he procured it. In regard to such articles, it is as easy to deceive as to be led into an error; and objects of bone are certainly of no great duration[334].

The question concerning the antiquity of automata, properly so called, which are moved by wheels, weights and springs, I shall leave to those who have read the works of the ancient mathematicians, and who may be desirous of writing on the history of mechanics. As far as I know, the ancients were not acquainted with the art of making them, unless some propositions of Ctesibius, mentioned by Vitruvius, allude to that subject.

When clocks were brought to perfection, some artists added to them figures, which at the time of striking performed various movements; and as they succeeded in these, some attempted to make, detached from clocks, single figures, which either moved certain limbs, or advanced forward and ran. In the middle of the sixteenth century, when Hans Bullmann[335], a padlock-maker at Nuremberg, constructed figures of men and women which moved backwards and forwards by clock-work, beat a drum, and played on the lute according to musical time, they excited universal astonishment as a new invention. It was about the same period that watches came into use. The accounts however which speak of much older automata deserve to be examined with more attention.

The most ancient of all are undoubtedly the tripods constructed by Vulcan[336], which being furnished with wheels, advanced forwards to be used, and again returned to their places. But what was impossible to the gods of Homer? An unbeliever might conjecture that these tripods, which are mentioned also by Aristotle[337], and which perhaps were only a kind of small tables or dumb-waiters, had wheels so contrived that they could be put in motion and driven to a distance on the smallest impulse, like the fire-pans in our country beer-houses, at which the boors light their pipes.

That Dædalus made statues which could not only walk, but which it was necessary to tie, in order that they might not move, is related by Plato[338], Aristotle, and others. The latter speaks of a wooden Venus, and remarks that the secret of its motion consisted in quicksilver having been poured into it. What the author here means I cannot comprehend; but I do not imagine that this Venus threw itself topsy-turvy backwards, like the Chinese puppets. However this may be, it is astonishing that the Chinese should have fallen upon the invention of giving motion to puppets by means of quicksilver, and in so ingenious a manner, that Muschenbroek[339] thought it worth his while to describe their whole construction, and to illustrate it by figures. But before this method was known in Europe, Kircher had an idea of putting a small waggon in motion by adding to it a pipe filled with quicksilver, and heating it with a candle placed below it[340]. The account of

Aristotle is more mysterious, for he does not inform us how the quicksilver acted.

Callistratus, another writer, who was the tutor of Demosthenes, gives us to understand that the statues of Dædalus were made to move by the mechanical powers[341]. But what has been asserted by Palæphatus, and by Gedoyn[342], Banier, Goguet, and others among the moderns, is most probable. The first statues of the Greeks were imitations of those of the Egyptians, for the most part clumsy figures, with their eyes shut, their arms hanging down close to the body on each side, and their feet joined together. Those made by Dædalus had their eyes open, as well as their feet and hands free; and the artist gave them such a posture, that they seemed either reclining, or appeared as if ready to walk or to run. As Anacreon[343], struck with wonder, exclaimed when he saw a waxen image of his favourite object, "Begone, wax, thou wilt soon speak!" the astonished Greeks in like manner cried out, when they beheld the statues of Dædalus, "They will soon walk." The next generation affirmed that they really walked; and their posterity, adding still to what was told them, asserted that they would have run had they not been bound.

Equally imperfect is the account given of the wooden pigeon constructed by Archytas of Tarentum. We are informed that it flew; but when it had once settled, it could not again take flight. The latter is not incredible; but even if we allow that aërostatic machines were then known, it is impossible to believe the former. At present one cannot determine with any probability, what piece of mechanism gave rise to this relation[344]. The head of Albertus Magnus, which is said not only to have moved, but to have spoken, is too little known for any opinion to be formed concerning it. The construction of it must have been very ingenious and complex, if it be true that he was employed upon it thirty years[345].

In the fourteenth and following centuries, automata, as I have said, were frequently made. Among these was the iron fly of John Müller or Molitor, or, as he is sometimes called, Regiomontanus, which is said to have flown about; and his artificial eagle, which flew to meet the Emperor Maximilian on his arrival at Nuremberg, June the 7th, 1470. None of the

contemporary writers, however, though they often speak of this very learned man, make the least mention of these pieces of mechanism; and it is probable that the whole tale originated with Peter Ramus[346], who never was at Nuremberg till the year 1571. J. W. Baier[347] endeavours to prove that the above-mentioned fly, moved by wheel-work, leaped about upon a table; and that the eagle perched upon the town-gate, stretched out its wings on the emperor's approach, and saluted him by an inclination of its body. We know that Charles V., after his abdication, amused himself during the latter period of his life with automata of various kinds[348].

The most ingenious, or at least the most celebrated automata, were those made by Vaucanson, which he exhibited publicly at Paris, for the first time, in 1738. One of them, which represented a flute-player sitting, performed twelve tunes, and, as we are assured, by wind issuing from its mouth into a German-flute, the holes of which it opened and shut with its fingers. The second was a standing figure, which in the like manner played on the Provençal shepherd's pipe, held in its left hand, and with the right beat upon a drum or *tambour de Basque*. The third was a duck, of the natural size, which moved its wings, exhibited all the gestures of that animal, quacked like a duck, drank water, ate corn, and then after a little time let drop behind it something that resembled the excrement of a duck[349]. These pieces must have been often imitated. I saw some of the like kind in the year 1764, at the palace of Zarsko-Selo, near Petersburg, and was told that they had been purchased from Vaucanson[350]. As far as I can remember, the tambourin was damaged. I saw there also a regiment of soldiers, which went through their exercise, moved by wheel-work[351].

In the year 1752, one Du Moulin, a silversmith, travelled about through Germany with automata like those of Vaucanson. In 1754, he wished to dispose of them to the margrave of Bayreuth; but he was obliged to pawn them in Nuremberg, at the house of Pfluger, who offered to sell them for 3000 florins, the sum lent upon them. They were afterwards purchased by counsellor Beireis, at Helmstadt, who kindly showed them to me. It is much to be regretted that the machinery of them is greatly deranged; the flute-player emits only some very faint tones; but the duck eats, drinks, and

moves still. The ribs, which are of wire, had been covered with duck's feathers, so as to imitate nature; and as these are now lost, one can see better the interior construction; respecting which I shall only observe, that the motion is communicated by means of a cylinder and fine chains, like that of a watch, all proceeding through the feet of the duck, which are of the usual size. Nicolai[352] says that Du Moulin came to Petersburg in 1755, and died at Moscow in 1765. It is probable that he made the automata which I saw in Russia. Those which he left behind him at Nuremberg seem either not to have been completed, or to have been designedly spoiled by him; for they appeared to have defects which could not be ascribed to any accident. M. Beireis however has begun to cause them to be repaired.

Of all these automata, the duck I confess appeared to me the most ingenious; but I can prove that like pieces of mechanism were made before the time of Vaucanson. We are told by Labat[353], that the French general De Gennes, who, about the year 1688, defended the colony of St. Christopher against the English, constructed a peacock which could walk about, pick up from the ground corn thrown before it, digest it, according to appearance, and afterwards drop something that resembled excrement. This man was of an ancient noble family in Brittany, which had however been so reduced, that the father carried on a handicraft. The son became acquainted with the marquis de Vivonne, who, on account of his promising talents, bred him to the sea. He rose to be commander of a vessel, conducted a squadron to the Straits of Magellan, where it was intended to form a colony, and obtained in Cayenne a tract of land, which he got erected into a county, under the name of Oyac. He invented machines of various kinds useful in navigation and gunnery, and, as we are told, constructed clocks that moved without weights or springs.

The flute-player also of Vaucanson was not the first of its kind. In the beginning of the sixteenth century, the anonymous author of that well-known poem Zodiacus Vitæ, saw at Rome a figure made in the like manner by a potter. It is much to be regretted that no account is given of its construction.

Vidi ego dum Romæ, decimo regnante Leone,
Essem, opus a figulo factum, juvenisque figuram,
Efflantem angusto validum ventum oris hiatu[354].

I shall here beg leave to say a few words respecting an object of juggling, which, however old it may be, still excites astonishment, and has often imposed upon the credulity of men of learning[355]: I mean those speaking machines, which, according to appearance, answer various questions proposed to them, sometimes in different languages, sing, and even blow a huntsman's horn. The figure, or only a head, is often placed upon a box, the forepart of which, for the better deception, is filled with a pair of bellows, a sounding-board, cylinder, and pipes, supposed to represent the organs of speech. At other times the machine is only like a peruke-maker's block, hung round with a Turkish dress, furnished with a pair of arms, and placed before a table, and sometimes the puppet stands upon the table, or against a wall. The sounds are heard through a speaking-trumpet, which the figure holds in its mouth.

Many jugglers are so impudent as to assert that the voice does not proceed from a man, but is produced by machinery, in the same manner as the music of an organ. Some, like the last whom I saw, are more modest or timorous, and give evasive answers to the questions asked them respecting the cause of the voice, with as much art as those who exhibit with balls and cups. Concerning these speaking machines, however, different opinions are entertained. Some affirm that the voice issues from the machine; others, that the juggler answers himself, by speaking as ventriloquists do, or by having the power to alter his voice; and some believe that the answers are given by a man somewhere concealed. The violence with which these opinions are maintained exposes the juggler often to the danger of losing his life; for, when the illusion is detected, the populace, who in part suffer themselves willingly to be deceived, and who even pay the juggler for his deception, imagine that they have a right to avenge themselves for being imposed on. The machines are sometimes broken; and the owners of them are harshly treated as impostors. For my part, I do not see why a juggler, with a speaking machine, is a more culpable impostor than he who pretends to breathe out flames and to swallow boiling oil, or to make puppets speak, as

in the Chinese shadows. The spectators pay for the pleasure which they receive from a well-concealed deception, and with greater satisfaction the more difficult it is for them to discover it. But the person who speaks or sings through a puppet, is so well hid, that people of considerable penetration have imagined that such concealment was impossible. At present this art is well known.

Either a child or a woman is concealed in the juggler's box; or some person, placed in a neighbouring apartment, speaks into the end of a pipe which proceeds through the wall to the puppet, and which conveys the answers to the spectators. The juggler gives every necessary assistance to the person by signs previously agreed on. I was once shown, in company with M. Stock, upon promising secrecy, the assistant in another apartment, standing before the pipe, with a card in his hand on which the signs were marked; and he had been brought into the house so privately that the landlady was ignorant of the circumstance. The juggler, however, acknowledged that he did not exhibit without fear; and that he would not venture to stay long at a place like Göttingen, or to return with his Turks, though the populace were so civil as to permit him to depart peaceably with what he had gained.

The invention of causing statues to speak by this method seems so simple, that one can scarcely help conjecturing that it was employed in the earliest periods to support superstition; and many have imagined that the greater part of the oracles spoke in the same manner[356]. This, however, is false, as has been proved by the Jesuit Baltus, and the anonymous author of a Reply to Fontenelle's History of Oracles[357]. It appears that the pagan priests, like our jugglers, were afraid that their deceptions, if long practised, might be discovered. They considered it therefore as more secure to deliver the answers themselves; or cause them to be delivered by women instructed for that purpose, or by writing, or by any other means. We read, nevertheless, that idols[358] and the images of saints once spoke; for at present the latter will not venture to open their mouths. If their votaries ever really heard a voice proceed from the statue, it may have been produced in the before-mentioned manner.

Whether the head of Orpheus spoke in the island of Lesbos, or, what is more probable, the answers were conveyed to it by the priests, as was the case with the tripod at Delphi, cannot with certainty be determined. That the impostor Alexander, however, caused his Æsculapius to speak in this manner, is expressly related by Lucian[359]. He took, says that author, instead of a pipe, the gullet of a crane, and transmitted the voice through it to the mouth of the statue. In the fourth century, when bishop Theophilus broke to pieces the statues at Alexandria, he found some which were hollow, and placed in such a manner against a wall that a priest could slip unperceived behind them, and speak to the ignorant populace through their mouths[360]. I am acquainted with a passage which seems to imply that Cassiodorus, who, it is well known, constructed various pieces of mechanism, made also speaking machines; but I must confess that I do not think I understand the words perfectly[361].

That people ventured more than a hundred years ago to exhibit speaking machines for money, has been proved by Reitz in his annotations to Lucian, where he produces the instance of one Thomas Irson, an Englishman, whom he himself knew, and whose art excited much wonder in king Charles II. and his whole court. When the astonishment, however, became general, one of the pages discovered, in the adjoining chamber, a popish priest who answered in the same language, through a pipe, the questions proposed to the wooden head by whispering into its ear. This deception Irson often related himself[362].

I shall now add only a few observations respecting the Chinese shadows, which I have occasionally mentioned before. This ingenious amusement consists in moving, by pegs fastened to them, small figures cut out of pasteboard, the joints of which are all pliable, behind a piece of fine painted gauze placed before an opening in a curtain, in such a manner as to exhibit various scenes, according to pleasure; while the opening covered with gauze is illuminated, towards the apartment where the spectators sit, by means of light reflected back from a mirror; so that the shadows of the pegs are concealed. When it is requisite to cause a figure to perform a variety of movements, it is necessary to have several persons, who must be

exceedingly expert. When a snake is to be represented gliding, the figure, which consists of delicate rings, must be directed at least by three assistants.

This amusement, which one can hardly see the first time without pleasure, is really a Chinese invention. Many years ago, I have seen Chinese boxes on which such moveable figures were apparent only when the box was held against the light. In China, these shadows are used at the well-known feast of lanterns; and a description of them may be found in the works of some travellers. That they were common also in Egypt, we are informed by Prosper Alpinus[363], who admired them much; but he was not able to discover the method by which they were produced, as it was kept a secret. I was told by an Italian, who exhibited them at Göttingen some years ago, that they were first imitated, from the Chinese, at Bologna.

FOOTNOTES

[281] Essais, i. 54.

[282] The juggler mentioned in Xenophon requested the gods to allow him to remain only in places where there was much money and abundance of simpletons.

[283] Le Siècle de Louis XIV. Berlin, 1751, 12mo, i. p. 44. This horse was seen in the above-mentioned year by Casaubon, to whom the owner, an Englishman, discovered the whole art by which he had been trained. See Casauboniana, p. 56. We are assured by Jablonski, in his Lexicon der Künste und Wissenschaften, p. 547, that he was condemned to the flames at Lisbon. In the year 1739, a juggler in Poland was tortured till he confessed that he was a sorcerer, and without further proof he was hanged. The whole account of this circumstance may be found in the Schlesischen gelehrten Neuigkeiten for the year 1739.

[284] See Luciani Opera, ed. Bipont. v. pp. 388, 407.

[285] Florus, iii. 19, 4.

[286] Directions for performing this trick may be found in various works, such as Joh. Wallbergen's Zauberkünste, Stuttgard, 1754, 8vo, and Natürliches Zauberbuch, Nurnberg, 1740, 8vo.

[287] See Bayle's Diction. i. p. 450, art. Barchochebas.

[288] Philostorgii Hist. Eccles. vii. 7, p. 93.

[289] Vita Alexandri, p. 687.

[290] Galen, *l. c.*

[291] Ovid. Met. lib. ix. 160.

[292] Instances may be found collected in Huetii Alnetanæ Quæstion. lib. ii. and in Bayle's Dictionary, art. Egnatia.

[293] Journal des Sçavans, 1667, pp. 54, 222; and 1680, p. 292. Deslandes, Mémoires de Physique, ii. and Bremenscher Magazin, i. p. 665. See also Busbequii Omnia, Basil, 1740, 8vo, p. 314.

[294] [Deception might have been easily practised in this case. Fusible metal, as suggested by Sir David Brewster, Nat. Magic, p. 301, which consists of mercury, tin and bismuth, and which melts at a low temperature, might easily have been substituted in place of lead; and fluids, the boiling-point of which is lower than water, might easily have been substituted for that liquid.

A solution of spermaceti in sulphuric æther, tinged with alkanet root, which solidifies at 50° F., and melts and boils with the heat of the hand, is supposed to be the substance which is used at Naples, when the dried blood of St. Januarius melts spontaneously and boils over the vessel which contains it.

The experiments of M. Tillet, Dr. Fordyce and Sir Charles Blagden, will show the great heat which may be endured by the human body. Some of these gentlemen remained in a room where

the heat was one or two degrees above 260° F. for eight minutes; a beaf-steak was cooked in the same atmosphere, and was overdone in thirty-three minutes; when the steak was blown upon with a pair of bellows, it was found to be pretty well done in thirteen minutes. But Sir F. Chantry exposed himself to a still greater heat in the furnace used for drying his moulds. When raised to its highest temperature, the thermometer indicated 350° F., and the iron floor was red-hot. The workmen often entered it at 340°. On one occasion Sir F., accompanied by five or six of his friends, entered the furnace, and after remaining two minutes, they brought out a thermometer which indicated 320°. Some of the party experienced sharp pains in the tips of their ears, and in the septum of the nose, whilst others felt a pain in their eyes.—Brewster, *l. c.*]

295 [The peculiar property of minerals and various salts, as alum, in forming and protecting articles of dress, &c. from the effects of fire, has long been known. But the art of practically applying it, is due to the ingenuity of the Chevalier Aldini of Milan. His dress consisted of a strong cloth covering which had been steeped in a solution of alum, for the body, arms and legs; whilst the head-dress was a large cap enveloping the whole head down to the neck, with holes for the nose, eyes and mouth; the covering for the feet was composed of asbestos, or amianthus cloth. The stockings and cap were single, but the gloves were double, to enable the fireman to take burning or red-hot bodies into his hands. A metallic dress was added to this, consisting of a cap, with a mask, leaving a space between it and the asbestos cap; a cuirass; a piece of armour for the trunk and thighs; a pair of boots of double wire-gauze; and an oval shield five feet long by two and a half wide, made by stretching the wire-gauze over a slender frame of iron. All these pieces were made of wire-gauze.

It was found, that when armed with this apparatus, a man could walk upon hot iron, in the midst of high flames, keep his head over a pan of flaming fire, &c. for several minutes, and this in some cases where the heat was so intense that bystanders were obliged to stand at the distance of eight or ten yards. This was remarkably shown in 1829, in the yard of the barracks of St. Jervais. Two

towers were erected, two stories high, and were surrounded with heaps of inflamed faggots and straw. One of the firemen, with a child on his back, in a wicker basket covered with metallic gauze, and having a cap of amiantheric cloth, rushed into a narrow place, where the flames were raging eight yards high. The violence of the fire was so great that he could not be seen, while a thick black smoke spread around, throwing out a heat which was insupportable to the spectators. The man remained so long invisible that serious doubts were entertained of his safety. He at length, however, issued from the fiery gulf uninjured.]

296 The same thing was performed by Schreber in 1760.

297 Plin. vii. 11.—Virg. Æn. xi.—Silius Ital. v.—Strabo, v.

298 Strabo, xii.

299 In his work De Mirabilibus Mundi, at the end of his book De Secretis Mulierum, Amstelod. 1702, 12mo, p. 100.

300 Antigone, 270.

301 Animad. in Athen. lib. i. 15.

302 De Theatro, lib. i. 40, in Grævii Thes. Ant. Rom. ix.

303 Lib. iii. epist. 20.—Seneca, Epist. 45. Compare Suidas, Pollux, and Athenæi Deipn. 4. It is probable that Quintilian alludes to this art in his Institut. x. 7, 11.

304 Plin. vii. 20, p. 385.—Martial. v. 12.—Suidas, speaking of Theogenes Thasius.—Haller, Elem. Physiol. iv. p. 486.

305 Vopiscus, Vita Firmi. See the figure in Desaguliers, tab. xix. fig. 5. He describes the position thus:—The pretended Samson puts his shoulders (not his head, as he used to give out) upon one chair, and his heels upon another (the chairs being made fast), and supports one or two men standing on his belly, raising them up and down as

he breathes, making with his backbone, thighs and legs, an arch whose abutments are the chairs.

306 A course of Experimental Philosophy. Lond. 1745, 4to, i. p. 266. [A popular account of these extraordinary feats, with illustrations and explanations of the principles on which they depend, is given by Sir David Brewster in his interesting volume on Natural Magic, p. 246.]

307 Versuche und Abhandl. der Naturforsch. Geselsch. in Danzig.

308 A great many of these passages of the ancients have been collected by Bulenger, in his work De Theatro, i. cap. 41. See also Des Camps in a dissertation contained in Recherches Curieuses d'Antiquité, par Spon. A Lyon 1683.—Mercurialis De Arte Gymnast. and Fabricii Biblioth. Antiq. p. 995.

309 An epigram, ascribed to Petronius, at page 542 of the edition of Hadrianides, belongs to this subject.

310 Muratori Antiquit. Ital. Med. Ævi, ii. p. 846.

311 Von Stetten, Kunstgeschichte von Augsburg, ii. p. 177.

312 Claudian. de Mallii Consul. 320. In Cilano's Römischen Alterthümer, ii. fig. 8, there is a representation like what I have often seen exhibited. But the most dangerous and the most curious is that of which an engraving is given in Splendor Urbis Venetiarum, to be found in Grævii Thesaurus Antiquit. Italiæ, v. 3. p. 374.

313 Sat. xiv. 265.

314 Lib. v. 433.

315 Symposium, p. 655, edition of Basle, 1555. fol. Εἰσεφέρετο τῇ ὀρχηστρίδι τροχὸς τῶν κεραμεικῶν ἐφ' οὗ ἔμελλε θαυμασιουργήσειν. In the old edition of J. Ribittus, this passage is

thus translated: “Allata est saltatrici orbis saltatorius, in quo admiranda erat editura.” The first question that arises is, what was τροχὸς τῶν κεραμεικῶν. The last word alluded to a place at Athens where wrestling was exhibited every year; and on that account Aristophanes uses the expression πληγαὶ κεραμεικαί. This however affords no explanation. Bulenger, who quotes the same passage, translates it in the following manner: “Illata est saltatrici figularis rota, per quam se trajiceret, et miracula patraret.” He means here therefore a potter’s wheel, the invention of Anacharsis, but that was always called κεραμικὸς τροχὸς, and not τροχὸς τῶν κεραμεικῶν. But even allowing that a potter’s wheel is meant, it is wrong to add *per quam se trajiceret*; for the potter’s wheel is not like a hoop, but like a plate or dish; and when turned round revolves not vertically, but horizontally. Besides, how the performer could write or read on a wheel that she jumped through, he has not thought proper to explain. “Scribere et legere in rota dum versatur, mirabile quiddam est.” If a potter’s wheel be meant, I consider it as certainly possible for a person to stand upon it whilst it revolves with the greatest velocity, and even to read or write; but it would be necessary to lift up the legs, in turn, with the utmost quickness.

316 Nicephorus Gregor. viii. 10. p. 215. This company of rope-dancers came from Egypt. They travelled through the greater part of Asia, and all Europe, as far as the extremity of Spain. At Constantinople they extended the ropes, on which they first exhibited their art, between the masts of ships. One is almost induced to believe that stupid superstition did not then prevail so much in Europe as at the beginning of the last century. The historian says that the company at first consisted of forty persons; but that the half of them were cast away on their passage to Constantinople. He does not, however, tell us that they or their horses were anywhere burnt as conjurors, or possessed with the devil.

317 See the German translation of his Travels, ii. p. 238.

318 Journal du Règne de Henri III. p. 57.—Recueil de Pièces servant à l'Hist. de Henri III. Cologne, 1666, 12mo.

319 Epistolarum Selectarum Centuria. Antverpiæ, 1605, 4to, i. epist. 50. p. 59.—Plin. viii. 1 and 3.—Seneca, epist. 86.—Suetonii Vit. Galbæ.—Dio Cassius. A great many also may be found collected in Hartenfels Elephantographia, Erfordiæ, 1715, 4to. It appears that in the thirteenth century some ventured to ride a horse upon a rope. See the Chronicle Alberichi Monachi Trium-Fontium, inserted by Leibnitz in Accessiones Historicæ, vol. ii., where a description is given of the solemnities at the wedding of Robert, brother to the king of France, in the year 1237.

Several instances of the dexterity of the elephant may be found in Lipsii Laus Elephantis, inserted in Dissertat. Ludicrarum et Amœnitatum Scriptores varii, Lugd. Bat. 1638.—TRANS.

320 Æliani Hist. An. xvi. 23. vi. 10.—Athenæus, lib. xii.—Plinius.

321 One instance may be found in Theophanis Chronographia, which was printed at Paris 1655, fol. It occurred in the seventeenth year of the reign of Justinian, or 543.

322 Universal Magazine, 1766, October, p. 217.

323 Der entlarvte Wildman, Betrüger grosser Höfe. Berlin, 1774, 8vo. See also Göttingische Gelehrte Anzeig. 1775, p. 816. The name of *impostor* given to Wildman was, however, too harsh; for I do not think that he who performs anything extraordinary, never done by any one before, becomes an impostor when another discovers his art.

324 The voyage of Brue is in Labat's Afrique Occidentale, iv.

325 [A curious exhibition of this kind has been made public for several years in the Strand, viz. the "industrious fleas." These noxious animals are here seen to draw and drive a coach and four; fire off a small cannon; and various other performances of a similar kind.]

326 Several instances of the like kind may be found also in Monstrorum Historia Memorabilis a J. G. Schenkio a Grafenberg filio, Francof. 1609, 4to, p. 28 *et seq*. One of the most curious is that of Thomas Schweicker, born at Halle in Prussian Saxony, in the year 1586. Camerarius saw him not only write, but even make a pen with his feet.—TRANS.

327 Strabo, lib. xv. p. 1048. ed. Almel.—Dio Cassius, lib. liv. p. 739. Suetonius, Eutropius, Eusebius and Orosius, speak of this embassy, but make no mention of the presents.

328 [In modern times the idle portion of the public has been gratified by the exhibition of the Siamese twins; the diminutive monster Tom Thumb; and quite recently a child with three legs. The birth of such monsters is equivalent to a legacy or fortune to the parents, who by their exhibitions realise large sums: the morbid taste of the public, especially the weaker portion, for such sights is truly deplorable.]

329 Man. Astron. lib. v. 165.

330 Frisch derives this word from *morio*, a fool or buffoon.

331 This piece of kitchen furniture was known in the middle of the sixteenth century. Montagne saw one at Brixen, in Tyrol, in the year 1580, and wrote a description of it in his Journal, as a new invention. He says it consisted entirely of wheels; that it was kept in motion by a heavy piece of iron, as clocks are by a weight, and that when wound up in the like manner, it turned the meat for a whole hour. He had before seen, in some other place, another driven by smoke.—Reise, i. pp. 155, 249. The latter kind seem to be somewhat older. Scappi, cook to pope Pius V., gave a figure of one in his book Opera di M. Bartolomeo Scappi, printed at Venice 1570, which is exceedingly scarce. I lately saw a copy, which, instead of eighteen, had twenty-four engravings. It was printed twice afterwards at the same place, viz. in 1571 and 1605, in quarto. The third edition says, “con due aggiunte, cio é il

Trinciante et il Maestro di casa." Bayle seems to confound this book with that of Platina De Honesta Voluptate, or to think that the latter was the real author of it. This however cannot be, as there were more than a hundred years between the periods when Scappi and Platina lived. Platina died in 1481, and not in 1581, as we read in Bayle.

[332] De Mundo. cap. vi.

[333] Herodot. ii. 48. p. 127.—Lucian. de Syria Dea, 16, ed. Bipont. ix. p. 99.

[334] Recueil des Antiquit. iv. p. 259.

[335] Doppelmayer, p. 285.

[336] Iliad, xviii. 373. It deserves to be remarked, that there were also such τρίποδες αὐτόματοι at the banquet of Iarchas. See Philostrat. Opera, ed. Olearii, pp. 117, 240.

[337] Polit. i. 3.

[338] In his Menon, p. 426.—Euthyphron, pp. 8, 11.

[339] Introd. in Philos. Nat. i. p. 143.

[340] Physiologia Kircheriana, fol. p. 69.

[341] In Philostrati Opera, ed. Olearii, p. 899.

[342] In Mém. de l'Acad. des Inscr. xiii. p. 274.

[343] Ode xxvii.

[344] Aulus Gellius, x. 12.

[345] See Naudé's Apology, Bayle's Dictionary, &c. Thomas Aquinas is said to have been so frightened when he saw this head, that he

broke it to pieces, and Albertus thereupon exclaimed, “Periit opus triginta annorum!”

346 Schol. Mathemat. lib. ii. p. 65.

347 Dissertat. de Regiomontani Aquila et Musca Ferrea. Altorfi, 1709. —See Mémoires de Trevoux, 1710, Juillet, p. 1283.—Doppelmayer, p. 23.—Fabricii Bibl. Med. Ætat. iv. p. 355.—Heilbronner Hist. Math. p. 504.

348 Strada De Bello Belgico. Mogunt. 1651, 4to, p. 8. He calls the artist Jannellus Turrianus Cremonensis.

349 In the year 1738, Le Méchanisme du Fluteur Automate, par Vaucanson, was printed at Paris, in a thin 4to. It contains only a short description of the flute-player, which is copied into the Encyclopédie, i. p. 448, under the article Androide. The duck, as far as I know, has been nowhere described.

350 Vaucanson died at Paris in 1782.

351 [The publisher is in possession of an elegantly formed mechanical bird-cage, in which two artificial bullfinches wheel about on a perch, flutter their wings, and move their beaks, while emitting musical sounds in imitation of their natural note. A fountain constructed of spiral glass plays in the centre. Beneath the cage is a clock which sets the whole in motion hourly, for three or four minutes; but it may be set going independently, like a musical snuff-box. It is presumed to have been made by Vaucanson about a hundred years ago, and was at one time a principal attraction at Weeks’s celebrated Museum, where that singular piece of mechanism the Tarantula spider was first exhibited.]

352 Nicolai, Reise, i. p. 287.

353 Nouveau Voyage aux Iles de l’Amerique. A la Haye 1724, 2 vols. 4to, ii. pp. 298, 384. From his county he was called Count de Gennes.

[354] Zodiacus Vitæ, xi. 846.

[355] See a small treatise Ueber H. D. Muller's Redende Maschine, und über redende Maschinen überhaupt. Nurnberg, 1788, 8vo.—Algem. Teutsches Biblioth. vol. lxxxvii. p. 473. The Speaking Figure and the Automaton Chess-player exposed and detected. London, 1784, 8vo.—[This celebrated chess-playing automaton, invented by M. Vankempelin, was repaired and exhibited in London in 1820, by the ingenious mechanician Maelzel, with considerable success. The figure and machinery were always submitted to the inspection of the visitors, and shifted along the floor in various directions before the game commenced, and the deception was so adroitly managed as to escape the detection of the most scrutinizing. The proprietor always took care to secure the best chess-player in the town before he commenced operations, the wonder therefore was greatly increased by the superiority of the automaton's play. Mr. Lewis directed it in London. It is now generally admitted that a boy was concealed inside.]

[356] Van Dale De Oraculis. Amstelod. 1700, 4to, i. 10, p. 222.

[357] Réponse à l'Histoire des Oracles de M. de Fontenelle.

[358] A few instances are related by Livy, Valerius Maximus, and Plutarch. Among the fables of the Christian church they are more numerous.

[359] Vol. v. p. 90. editio Bipont.

[360] Theodoreti Hist. Eccles. v. 22.

[361] Cassiodori Variar. i. ep. 45.

[362] [*Speaking Automaton.*—There is a piece of mechanism now exhibiting to the public at the Egyptian Hall—the work of Professor Faber, of Vienna, and the result, as he states, of twenty-five years of labour and preparation. The name which he has given

to this product of his ingenuity is the Euphonia; and the work, as that name implies, is another of those many combinations which have attempted, by the anatomical and physiological study of the structures that contribute to the human voice, to attain to an imitation of that organ as regards both sound and articulation. As an example of inductive and mechanical skill this exhibition is well deserving of attention. The professor himself, by an arrangement of bellows-pipes, pedal and keys, which he plays somewhat like the keys of a piano, prompts the discourse of his automaton; which certainly does enunciate both sounds and words. When we entered the room we found it singing to a select society. It requires all our sense of the ingenuity and perseverance which have been bestowed on the work to induce our assent to the proposition which calls the voice human; but undoubtedly it is a remarkable result of contriving skill and scientific patience.—*Athœneum.*]

363 Historia Ægypti Natural. Lugd. Bat. 1735, 4to, p. 60.

ARTIFICIAL ICE. COOLING LIQUORS.

The art of preserving snow for cooling liquors during the summer, in warm countries, was known in the earliest ages. This practice is mentioned by Solomon[364], and proofs of it are so numerous in the works of the Greeks and the Romans, that it is unnecessary for me to quote them, especially as they have been collected by others[365]. How the repositories for keeping it were constructed, we are not expressly told; but what I know on the subject I shall here lay before the reader.

That the snow was preserved in pits or trenches, is asserted by many[366]. When Alexander the Great besieged the city of Petra, he caused thirty trenches to be dug and filled with snow, which was covered with oak branches, and which kept in that manner for a long time[367]. Plutarch says that a covering of chaff and coarse cloth is sufficient[368]; and at present a like method is pursued in Portugal. Where the snow has been collected in a deep gulf, some grass or green sods, covered with dung from the sheep-pens, is thrown over it; and under these it is so well preserved, that the whole summer through it is sent the distance of sixty Spanish miles to Lisbon[369].

When the ancients therefore wished to have cooling liquors, they either drank the melted snow or put some of it in their wine, or they placed jars filled with wine in the snow, and suffered it to cool there as long as they thought proper. It appears that in these trenches it could not remain long clean; on the contrary, it was generally so full of chaff, that the snow-water was somewhat coloured with it, and had a taste of it, and for this reason it was necessary to strain either it or the wine that had been cooled by it[370].

That ice also was preserved for the like purpose, is probable from the testimony of various authors[371]; but it appears not to have been used so much in warm countries as in the northern. Even at present snow is employed in Italy, Spain, and Portugal; but in Persia, ice[372]. I have never anywhere found an account of Grecian or Roman ice-houses. By the writers on agriculture they are not mentioned.

Mankind however soon conceived the idea of cooling water without snow or ice, from having remarked that it became cold more speedily when it had been previously boiled, or at least warmed, and then put in a vessel among snow, or in a place much exposed to the air. Pliny seems to give this as an invention of Nero[373]; and a jocular expression in Suetonius[374] makes it at any rate probable that he was fond of water cooled by this method; but it appears to be much older. It seems to have been known even to Hippocrates: at least Galen[375] believes so. And Aristotle[376] was undoubtedly acquainted with it; for he says that some were accustomed, when they wished water to become soon cold, to place it first in the sun and suffer it to grow warm. He relates also that, the fishermen near the Black Sea poured boiling water over the reeds which they used in fishing on the ice to cause them to freeze sooner. Galen[377] on this subject is still more precise. He informs us that the above practice was not so much used in Italy and Greece, where snow could be procured, as in Egypt and other warm countries, where neither snow nor cool springs were to be found. The water after it had been boiled was put into earthen vessels or jars, and exposed in the evening on the upper part of the house to the night air. In the morning these vessels were put into the earth (perhaps in a pit), moistened on the outside with water, and then bound round with fresh or green plants, by which means the water could be preserved cool throughout the whole day. Athenæus[378], who gives a like account from a book of Protagorides, remarks, that the pitchers filled with water, which had become warm by standing all day long in the sun, were kept continually wet during the night, by servants destined to that office, and in the morning were bound round with straw. In the island of Cimolus[379], water which had become warm in the day-time was put into earthen jars, and deposited in a cool cellar, where

it grew as cold as snow. It was generally believed therefore, that water which had been warmed or boiled, was soonest cooled, as well as acquired a greater degree of refrigeration; and on this account boiled water is mentioned so often in the works of the ancients[380].

The same opinion prevails at present in the southern countries of Asia, and people there still let their water boil before they expose it to the air to cool[381]. The experiments however which have been made on this subject by philosophers, have proved very different in the result. When one indeed places boiling and cold water, all other circumstances being equal, in frosty air, the latter will become ice before the former has cooled; but when one exposes to the cold, water that has been boiled, and unboiled water of equal temperatures, the former will be converted into ice somewhat sooner.

The experiments made by Mariotte[382], Perrault[383], the Academy del Cimento[384], Marian[385] and others, showed no perceptible difference in the time of freezing, between boiled and unboiled water; but the former produced ice harder and clearer, the latter ice more full of blisters. In later times, Dr. Black of Edinburgh has, from his experiments, asserted the contrary. Boiled water, he says, becomes ice sooner than unboiled, if the latter be left at perfect rest; but if the latter be stirred sometimes with a chocolate stick, it is converted into ice as soon as the former. This difference he explains in the following manner:—Some motion promotes congelation; this arises in the boiled water through its re-imbibing air; and therefore it must necessarily freeze before the unboiled, provided the latter be kept at perfect rest. Fahrenheit had before remarked that water not moved, would show a cold several degrees below the freezing-point, without becoming ice[386].

M. Lichtenberg, with whom I conversed on these contradictory results, assured me that he was not surprised at this difference in the experiments. The time of congelation is regulated by circumstances, with which philosophers are not yet sufficiently acquainted. A certain, but not every degree of stirring hastens it; so that every icy particle which is formed on the side of the vessel, or which falls from the atmosphere, may convert the water sufficiently cooled into ice instantaneously; and such unavoidable

accidents must, where all other circumstances are equal, cause a great difference in the period of freezing.

I am inclined to think that the cooling of water, in ancient times, of which I have already spoken, is not to be ascribed so much to the boiling as to the jars being kept continually wet, and to the air to which it was exposed. A false opinion seems therefore to have prevailed respecting the cause; and because it was considered to be the boiling, many have not mentioned the real cause, which appeared to them only to afford a trifling assistance, though it has been remarked both by Galen and Athenæus. We know at present that coolness is produced by evaporation. A thermometer kept wet in the open air falls as long as evaporation continues[387]. With sulphuric æther, and still better with that of nitre, which evaporates very rapidly, water may be made to freeze even in the middle of summer; and Cavallo saw in summer a Fahrenheit's thermometer, which stood at 64°, fall in two minutes, by means of æther, to +3, that is to 29° below the freezing-point[388].

On this principle depends the art of making ice at Calcutta and other parts of India, between 25° 30′ and 23° 30′ of north latitude, where natural ice is never seen unless imported. Trenches two feet deep, dug in an open plain, are strewed over with dry straw; and in these are placed small shallow unglazed earthen pans, filled with water at sunset. The ice which is produced in them is carried away before sunrise next morning, and conveyed to an ice-cellar fifteen feet deep; where it is carefully covered with straw to be preserved from the external heat and air. A great deal, in this process, depends upon the state of the atmosphere. When calm, pure and serene, it is most favourable to the congelation; but when the winds are variable, or the weather heavy and cloudy, no ice is formed; and the same is often the case when the nights are raw and cold[389].

It was once believed that this freezing was occasioned principally by the water having been boiled; but it seems to be owing much rather to evaporation[390]. It is not however said that the vessels are kept continually wet on the outside, but that they are unglazed, and so porous or little burnt, that the water oozes through them; and on that account their exterior surface

appears always moist[391]. By vessels of this kind the trouble of wetting is saved. What has been said respecting the influence of the weather serves, in some measure, to confirm my conjecture. The more it favours evaporation, the ice is not only formed more easily, but it is better; and when evaporation is prevented by the wind or the weather, no ice is produced. The latest accounts how ice is made at Benares, say expressly that boiled water is not employed; and that all those vessels, the pores of which are stopped by having been used, do not yield ice so soon or so good. In porcelain vessels none is produced; and this is the case also when the straw is wet[392].

Another method of cooling water also seems to have been known to Plutarch. It consisted in throwing into it small pebbles or plates of lead[393]. The author refers to the testimony of Aristotle; but this circumstance I cannot find in the works of that philosopher which have been preserved. It seems to be too unintelligible to admit of any opinion being formed upon it; and the explanation given by Plutarch conveys still less information than the proposition itself. This is the case, in general, with almost all the propositions of the ancients. We indeed learn from the questions that they were acquainted with many phænomena; but the answers scarcely ever repay the trouble which one must employ in order to understand them. They seldom contain any further illustration; and never a satisfactory explanation.

It appears that the practice of cooling liquors, at the tables of the great, was not usual in any country besides Italy and the neighbouring states, before the end of the sixteenth century. In the middle of that century there were no ice-cellars in France; for when Bellon relates, in the Account of his travels, in 1553, how snow and ice were preserved at Constantinople throughout the whole summer, for the purpose of cooling sherbet, he assures us that the like method might be adopted by his countrymen; because he had found ice-cellars in countries warmer than France. The word *glacière* also is not to be met with in the older dictionaries; and it does not occur even in that of Monet, printed in 1635[394]. Champier, the physician who attended Francis I. when he had a conference with the emperor Charles V. and pope Paul III. at Nice, saw the Spaniards and Italians put snow, which they caused to be brought from the neighbouring mountains, into their wine in order to cool it. That practice, which excited his astonishment,

he declared to be unhealthful; and this proves that in his time it had not been introduced at the French court[395].

Grand d'Aussy quotes an anecdote, related by Brantome, from which he forms the same conclusion. The dauphin, son of Francis I., being accustomed to drink a great deal of water at table, even when he was overheated, Donna Agnes Beatrix Pacheco, one of the ladies of the court, by way of precaution, sent to Portugal for earthen vessels, which would render the water cooler and more healthful; and from which all the water used at the court of Portugal was drunk. As these vessels are still used in Spain and Portugal, where the wine is cooled also with snow, both methods might have been followed in France. I have in my collection of curiosities, fragments of these Portuguese vessels; they are made of red bole; are not glazed, though they are smooth, and have a faint gloss on the surface like the Etruscan vases. They are so little burnt that one can easily break them with the teeth; and the bits readily dissolve to a paste in the mouth. If water be poured into such vessels, it penetrates their substance; so that, when in the least stirred, many air-bubbles are produced; and it at length oozes entirely through them[396]. The water that has stood in them acquires a taste which many consider as agreeable; and it is probable that it proceeds from the bark of the fir-tree, with which, as we read, they are burnt. When the vessels are new, they perform their service better; and they must then also have a more pleasant smell. If they really render water cold, or retain it cool, that effect, in my opinion, is to be ascribed to the evaporation. Their similarity to those in which the Indians make ice is very apparent.

Towards the end of the sixteenth century, under the reign of Henry III., the use of snow must have been well known at the French court, though it appears that it was considered by the people as a mark of excessive and effeminate luxury. In the witty and severe satire on the voluptuous life of that sovereign and his favourites, known under the title of L'Isle des Hermaphrodites[397], a work highly worthy of notice but which is exceedingly scarce, we find an order of the Hermaphrodites that large quantities of ice and snow should everywhere be preserved, in order that people might cool their liquors with them, even though they might occasion extraordinary maladies, which, it seems, were then apprehended. In the description of an entertainment we are told that snow and ice were placed

upon the table before the king; and that he threw some of them into his wine; for the art of cooling it without weakening it was not then known. The same method was practised even during the whole first quarter of the seventeenth century[398].

Towards the end of the above century this luxury must have been very common in France. At that period there were a great many who dealt in snow and ice; and this was a free trade which every person might carry on. Government, however, which could never extort from the people money enough to supply the wants of an extravagant court, farmed out, towards the end of the century, a monopoly of these cooling wares. The farmers, therefore, raised the price from time to time; but the consumption and revenue decreased so much that it was not thought worth while to continue the restriction; and the trade was again rendered free. The price immediately fell; and was never raised afterwards but by mild winters or hot summers.

The method of cooling liquors by placing them in water in which saltpetre has been dissolved, could not be known to the ancients, because they were unacquainted with that salt. They might however, have produced the same coolness by other salts which they knew, and which would have had a better effect; but this, as far as I have been able to learn, they never attempted. The above property of saltpetre was first discovered in the first half of the sixteenth century; and it was not remarked till a long period afterwards, that it belongs to other salts also.

The Italians at any rate were the first people by whom it was employed; and about the year 1550, all the water, as well as the wine, drunk at the tables of the great and rich families at Rome, was cooled in this manner. Blasius Villafranca, a Spaniard, who practised physic in that capital, and attended many of the nobility, published, in the before-mentioned year, an account of it, in which he asserts, more than once, that he was the first person who had made the discovery publicly known. In his opinion it was occasioned by the remark that salt water in summer was always cooler than fresh water. According to his directions, which are illustrated by a figure, the liquor must be put into a bottle or globular vessel with a long neck, that it may be held with more convenience; and this vessel must be immersed in another wide one filled with cold water. Saltpetre must then be thrown gradually into the water; and while it is dissolving, the bottle must be driven

round with a quick motion on its axis, in one direction. Villafranca thinks that the quantity of saltpetre should be equal to a fourth or fifth part of the water; and he assures us, that when again crystallized, it may be employed several times for the same use, though this, before that period, had by many been denied. Whether other salts would not produce the like effect, the author did not think of trying; but he attempts to explain this of saltpetre from the principles of Aristotle; and he tells his noble patrons what rules they should observe for the preservation of their health, in regard to cooling liquors.

Towards the end of the sixteenth century this method of cooling liquors was well known, though no mention is made of it by Scappi, in his book on cookery. Marcus Antonius Zimara, however, speaks of it in his Problems[399]. I do not know at what time this Appulian physician lived. In a list of the professors of Padua, his name is to be found under the year 1525, as *Explicator philosophiæ ordinariæ*; and because another is named under the year 1532, we have reason to conjecture that he died about that time. But in that case the physician Villafranca would probably have been acquainted with the Problemata of Zimara; and would not have said that no one had spoken of this use of saltpetre before him.

Levinus Lemnius[400] also mentions the art of cooling wine by this method so much, that the teeth can scarcely endure it. We are informed by Bayle that the earliest edition of his work, which has been often reprinted, was published at Antwerp, in the year 1559, in octavo. It contains only the first two books; but as the above account occurs in the second book, it must be found in this edition.

Nicolaus Monardes, a Spanish physician, who died about the year 1578, mentions this use of saltpetre likewise. It was invented, as he says, by the galley-slaves; but he condemns it as prejudicial to health. From some expressions which he uses, I am inclined to think that he was not sufficiently acquainted with it; and that he imagined that the salt itself was put into the liquor. At a later period we find some account of it in various books of receipts; such as that written by Mizaldus in 1566, and which was printed for the first time the year following[401].

In the Mineralogy of Aldrovandi, first printed in 1648, this process is described after Villafranca; but where the editor, Bartholomæus Ambrosianus, speaks of common salt, he relates that it was usual in countries where fresh water was scarce to make deep pits in the earth; to throw rock-salt into them; and to place in them vessels filled with water, in order that it might be cooled. This remark proves that the latter salt was then employed for the same purpose; but it has led the editor into a very gross error. He thinks he can conclude from it, that the intention of potters, when they mix common salt with their clay, is not only to render the vessel more compact, but also to make it more cooling for liquors. But the former only is true. The addition of salt produces in clay, otherwise difficult to be fused, the faintest commencement of vitrification; a cohesion by which the vessel becomes so solid that it can contain fluids, even when unglazed; but for this very reason it would be most improper for cooling, which is promoted by the evaporation of the water that oozes through.

The Jesuit Cabeus, who wrote a voluminous commentary on the Meteorologica of Aristotle, which were printed at Rome in 1646, assures us that with thirty-five pounds of saltpetre one can not only cool a hundred pounds of water, by quickly stirring it, but convert it also into solid ice; and for the truth of this assertion he refers to an experiment which he made. Bartholin says that for the above account he can give him full credit[402]; but the truth of it is denied by Duhamel, who suspects that this Jesuit took the shooting crystals of the salt to be ice[403].

Who first conceived the idea of mixing snow or ice with saltpetre and other salts, which increases the cold so much, that a vessel filled with water, placed in that mixture, is congealed into a solid mass of ice that may be used on the table, I cannot with certainty determine; but I shall mention the earliest account of it that I have been able to find. Latinus Tancredus, a physician and professor at Naples, whose book De Fame et Siti was published in 1607, speaks of this experiment; and assures us that the cold was so much strengthened by saltpetre, that a glass filled with water, when quickly moved in the above mixture, became solid ice[404].

In the year 1626, the well-known commentary on the works of Avicenna, by Sanct. Sanctorius, was published at Venice. The author in this

work relates, that in the presence of many spectators, he had converted wine into ice, not by a mixture of snow and saltpetre, but of snow and common salt[405]. When the salt was equal to a third part of the snow, the cold was three times as strong as when snow was used alone.

Lord Bacon, who died in 1626, says that a new method had been found out of bringing snow and ice to such a degree of cold, by means of saltpetre, as to make water freeze. This, he tells us, can be done also with common salt; by which it is probable he meant unpurified rock-salt; and, he adds, that in warm countries, where snow was not to be found, people made ice with saltpetre alone; but that he himself had never tried the experiment[406]. Boyle, who died in 1691, made experiments with various kinds of salts; and he describes how, by means of salt, a piece of ice may be frozen to another solid body[407]. Descartes says that in his time this was a well-known phænomenon, but highly worthy of attention[408].

Since that period the art of making ice has been spoken of in the writings of all philosophers where they treated on heat and cold, and with many other experiments has been introduced into various books of receipts. It was then employed merely for amusement[409]; and no one suspected that it would ever form an important item of luxury. In the like manner Fugger's first bills of exchange were said to be useful only for gambling, and gunpowder was called a trifling discovery.

In the beginning of the seventeenth century, drinking-cups made of ice and iced fruit were first brought to the table; but towards the end of that century it appears that the French began to congeal in this manner all kinds of well-tasted juices, which were served up as refreshments at the tables of the great and wealthy[410]. This was a grand invention for the art of cookery; which became common among the German cooks, both male and female, about the middle of the last century; and since that time our confectioners sell single glasses of iced articles at balls and in the theatres.

I am acquainted with no older information respecting this invention than what is contained in Barclay's Argenis, which is, indeed, a romance; but the author's account makes the possibility of its being used so clear, that we may certainly conclude it was then employed; especially as he mentions

it several times. Arsidas finds in the middle of summer, at the table of Juba, fresh apples, one-half of which was encrusted with transparent ice. A basin, made also of ice and filled with wine, was handed to him; and he was informed that to prepare all these things in summer was a new art. Snow was preserved throughout the whole year in pits lined with straw. Two cups made of copper were placed the one within the other, so as to leave a small space between them, which was filled with water; the cups were then put into a pail, amidst a mixture of snow and unpurified salt coarsely pounded, and the water in three hours was converted into a cup of solid ice, as well-formed as if it had come from the hands of a pewterer. In the like manner apples just pulled from the tree were covered with a coat of ice.

The first edition of the Argenis was printed at Paris in 1621, and in that year the author died at the age of thirty-nine.

After brandy, from being a medicine, came into general use as a liquor at table, and was drunk in common by the populace, the Italians, above all, endeavoured to render it weaker and more pleasant by various mixtures; and by raising its value to make it more respectable, and at the same time more useful to people of the first rank. That their wares might be distinguished with more certainty, they gave them the name of *liquori*; and under that appellation sold them to foreign nations. The French were the first who adopted the use of these articles; particularly after the marriage of Henry II., when duke of Orleans, with Catharine de Medici, in the year 1533. This event brought to France great numbers of Italians, who made the French acquainted with these delicacies of their native country; and who taught them to prepare and to use them. They were the first, therefore, who made and sold the fine *liqueurs* at Paris; and in order to serve those who could not bear heating liquors, or rather to serve themselves by filling their pockets with money, their successors in this business invented about the year 1630 or 1633 that beverage called *lemonade*, because the juice of lemons or oranges was its chief component part. This liquor soon came into high repute, as it not only served for cooling and refreshing people during the sultry heats of summer, but was even recommended by physicians against putrid diseases.

The *limonadiers*, or venders of lemonade, endeavoured to increase the first property, which occasioned the far greatest consumption, by the means of ice; and one of them, Procope Couteaux, an Italian from Florence, about

the year 1660, conceived the happy idea of converting such beverage entirely into ice, by a process which had been before employed only by jugglers. The ready sale which he found for his invention induced others to make articles of the like kind. His example, therefore, was followed by Le Fevre and Foi; and these three for some years enjoyed a monopoly of this new-fashioned commodity. About the year 1676, liquors cooled by, or changed into ice, must however have been the principal things sold by the *limonadiers*; for being then formed into a company, the following delicacies were mentioned in the patent which they received on that occasion: “Eaux de gelée et glaces de fruits et de fleurs, d’anis et de canelle, franchipanne, d’aigre de cetre, du sorbec,” &c. There were at that time in Paris two hundred and fifty masters in this employment. In 1690, when De la Quintiny wrote, iced liquors were extremely common[411].

People, however, long imagined that such articles could be used only during the hot months of summer. In the year 1750, Dubuisson, successor to the celebrated Procope, *au café de la rue des Fossés de S. Germain des Près*, and author of the Art du Déstillateur, began to keep ready prepared, the whole year through, ices of every kind for the use of those who were fond of them. At first they were little called for, except in the dog-days; but some physicians recommended them in certain disorders. Have the physicians then, by their opinion, done most service to the venders of *liqueurs* and to cooks, or the latter to the physicians? This would make a fine subject for an inaugural dissertation. It is, however, certain, for we are told so by Dubuisson himself, that after two cures, in which ices had been of the greatest service, the *more discerning* part of the public made use of them in every season of the year. That this part of the public might never lose their conceit, the venders of *liqueurs* always employed their thoughts upon new inventions. Among the latest is that of iced butter, which acquired its name on account of some likeness to that substance. It was first known at the Parisian coffee-house (*caveau*) in 1774. The Duke de Chartres often went thither to enjoy a glass of iced liquor; and the landlord, to his great satisfaction and surprise, having one day presented him with his arms formed of eatable ice, articles of a similar kind immediately became fashionable.

[Ice is now used extensively for a variety of œconomical purposes, such as packing salmon, cooling liquors, &c. Of late years it has become a

regular article of commerce. In September 1833, a cargo of ice, shipped at Boston, was discharged at Calcutta. It was sold at threepence per pound, while the native ice fetched sixpence. It was packed in solid masses, within chambers of double planking, with a layer of refuse tan or bark between them. The quantity shipped was 180 tons, of which about 60 wasted on the voyage, and 20 on the passage up the river to Calcutta. Thousands of tons are now annually shipped from Boston (United States) to our East Indies, to the West Indian Archipelago, and to the Continent of South America, and quite recently 'The Wenham Lake Ice Company' have erected extensive ice-houses in London and at Liverpool, and arranged for the transportation to this country of thousands of tons of ice. One surprising circumstance connected with the trade, is the fact that their ice, though transported to this country in the heat of summer, is scarcely reduced in bulk. The masses are so large that they expose a very small surface to atmospheric action in proportion to their weight, and therefore do not suffer from exposure to it, as the smaller and thinner fragments do, which are obtained in our own or other warmer climates. It appears, also, that ice frozen upon very deep water, is more hard and solid than ice of the same thickness obtained from shallow water; and even when an equal surface is exposed, melts more slowly. In this country, the collection of ice, even by those largely engaged in the trade, is an occasional and fitful undertaking; depending, both as to time and quantity, upon the accidental occurrence of severe frost; and when the process of collection is carried on, it is with very few artificial aids. In America, on the other hand, this labour can be regularly carried on through the whole winter; while the adjuncts of machinery for cutting and storing, and of steam for transporting it, are brought extensively into action.

The details connected with this trade, as carried on in America, are so novel and so interesting, that we lay them before our readers with the confident belief that the result of our labours will prove attractive to them. Wenham Lake, whence a large proportion of the ice now imported to this country is obtained, is eighteen miles from Boston, in the State of Massachusets; it occupies a very elevated position, and lies embosomed in hills of majestic height and bold rugged character. The lake has no inlet whatever, but is fed solely by the springs which issue from the rocks at its bottom, a depth of 200 feet from its surface. The ice-house, which is capable of storing 20,000 tons of ice, is built of wood, with double walls, two feet apart, all around; the space between which is filled with sawdust;

thus interposing a medium, that is a non-conductor of heat, between the ice and the external air; the consequence of which is, that the ice is scarcely affected by any condition or temperature of the external atmosphere, and can be preserved without waste for an indefinite time.

The machinery employed for cutting the ice is very curious, and was invented for that express purpose. It is worked by men and horses in the following manner:—From the time when the ice first forms, it is carefully kept free from snow until it is thick enough to be cut; that process commences when the ice is a foot thick. A surface of some two acres is then selected, which at that thickness will furnish about 2000 tons, and a straight line is then drawn through its centre from side to side each way. A small hand-plough is pushed along one of these lines, until the groove is about three inches deep and a quarter of an inch in width, when the 'Marker' is introduced. This implement is drawn by two horses, and makes two new grooves, parallel with the first, twenty-one inches apart; the gauge remaining in the original groove. The marker is then shifted to the outside groove, and makes two more. Having drawn these lines over the whole surface in one direction, the same process is repeated in a transverse direction, marking all the ice out into squares of 21 inches. In the meantime, the 'Plough,' drawn by a single horse, is following in these grooves, cutting the ice to a depth of 6 inches. One entire range of blocks is then sawn out, and the remainder are split off toward the opening thus made with an iron bar. This bar is shaped like a spade and of a wedge-like form. When it is dropped into the groove, the block splits off; a very slight blow being sufficient to produce that effect, especially in very cold weather. The labour of 'splitting' is slight or otherwise, according to the temperature of the atmosphere. 'Platforms,' or low tables of frame-work, are placed near the opening made in the ice, with iron slides extending into the water, and a man stands on each side of this slide, armed with an ice-hook. With this hook the ice is caught and by a sudden jerk thrown up the 'slide' on to the 'platform.' In a cold day everything is speedily covered with ice by the freezing of the water on the platforms, slides, &c., and the enormous blocks of ice, weighing some of them more than two cwt., are hurled along these slippery surfaces, as if they were without weight. Beside this platform, stands a 'sled' of the same height, capable of containing about three tons; which, when loaded, is drawn upon the ice to the front of the store-house, where a large stationary platform of exactly the same height, is ready to

receive its load; which, as soon as discharged, is hoisted block by block, into the house.

Forty men and twelve horses will cut and stow away 400 tons a day. In favourable weather 100 men are sometimes employed at once. When a thaw or a fall of rain occurs, it entirely unfits the ice for market, by rendering it opake and porous; and occasionally snow is immediately followed by rain, and that again by frost, forming snow-ice, which is valueless, and must be removed by the 'plane.' The operation of 'planing' is somewhat similar to that of 'cutting.' A plane gauged to run in the grooves made by the 'marker,' and which shaves the ice to the depth of three inches, is drawn by a horse, until the whole surface of the ice is planed. The chips thus produced are then scraped off; and if the clear ice is not reached, the process is repeated. If this makes the ice too thin for cutting, it is left in *statu quo*, and a few nights of hard frost will add below as much as has been taken off above. In addition to filling their ice-houses at the lake and in the large towns, the company fill a large number of private ice-houses during the winter, all the ice for these purposes being transported by railway. It will easily be believed, that the expense of providing tools, building houses, furnishing labour, and constructing and keeping up the railway, is very great; but the traffic is so extensive, and the management of the trade so good, that the ice can be furnished, even in England, at a very trifling cost[412] (it is retailed at twopence per pound).]

FOOTNOTES

[364] Proverbs, xxv. ver. 13.

[365] Bartholini de Nivis Usu Medico Observationes, Hafn. 1661.

[366] Seneca, Quæst. Natur. iv. 13.

[367] Athenæus, iii. p. 124.

[368] Sympos. vi. quæst. 6.—Augustinus De Civitate Dei, xxi. 4, p. 610.

[369] Mémoires Instructifs pour un Voyageur. How the snow repositories at Constantinople are constructed, is related by Bellon in his Observat. iii. 22.

[370] The dissipated Heliogabalus caused whole mounts of snow to be heaped up in summer in order to cool the air. See Lampridius, Vita Heliogab. cap. 23.

[371] Plin. xix. 4.—Latinus Pacatus in Panegyr. Theodos.

[372] De la Valle, iii. p. 60, where the Persian ice-pits are described, as well as in Chardin, iv. p. 195.

[373] Hist. Nat. xxxi. 3, 23, p. 552.

[374] Vita Neronis, cap. 48: Hæc est Neronis decocta.

[375] In lib. vi. Hippocrat. de Morbis Vulgar. comment. 4, 10.

[376] Meteorol. i. cap. 12.

[377] In the place before quoted.

[378] Deipnos. iii. p. 124.

[379] Ibid. p. 123.

[380] See Pitisci Lex. Antiq. Rom. under the word Decocta.

[381] Philosoph. Transact. vol. lxv. part i. p. 126.

[382] Traité du Mouvement des Eaux.

[383] Du Hamel, Hist. de l'Academ. l. i. c. 3, p. 99.

[384] Tentamina Experimentorum Acad. del Cim. p. 183.

[385] Dissertation sur la Glace. Paris, 1749, 12mo, p. 187.

386 Philosoph. Transact. vol. lxv. part i. p. 124.

387 [In India, one mode of cooling wines, is to suspend the bottle in a thick flannel bag, or folds of blotting-paper, kept constantly wetted, and placed in the sun's rays, or a current of air, or both; by which means the evaporation, and therewith intense coldness, is produced.]

388 Philosoph. Transact. vol. lxxi. part ii. p. 511. [M. Boutigny's beautiful experiment of making ice in a red-hot crucible is a striking phænomenon of this kind. It is thus performed:—A deep crucible of platinum is heated to a glowing red heat; liquid sulphurous acid, which has been preserved in the fluid state by a freezing mixture, and some water are then at the same instant poured into the crucible. The rapid evaporation of the volatile sulphurous acid, which boils below the freezing-point of water, produces such an intense degree of cold as to freeze the water, which is then thrown out of the crucible as a solid lump.]

389 Philosoph. Transact. vol. lxxi. part ii. p. 252: the process of making ice in the East Indies; by Robert Barker.

390 [There is no question that this refrigeration is caused by the evaporation of a portion of the water, whereby a very large quantity of heat becomes latent in the vapour. A clear serene sky being necessary for the success of the production of the ice, would tend to show that the further loss of heat by radiation, which always ensues to a great extent at nights, when the sky is clear, is necessary.]

391 ... a number of small, shallow, earthen pans. These are unglazed, scarce a quarter of an inch thick, about an inch and a quarter in depth, and made of an earth so porous, that it was visible from the exterior part of the pans, the water had penetrated the whole substance. [Our ordinary wine-coolers, which consist of extremely porous vessels, act from evaporation. A portion of the water, which is placed in the interior of the cooler, evaporates through its pores,

and produces cold by rendering a considerable amount of heat latent.]

392 See the account of Lloyd Williams, in the Universal Magazine, June 1793, p. 410. Thin unglazed vessels are employed at present in Egypt also for cooling water, as we are told in several books of travels.

393 Sympos. vi. 5, p. 690.

394 The word however may be found in Dictionnaire par Richelet, Genève 1680, 4to.

395 J. B. Campegii Libri xxii. de re cibaria, xvi. 9, p. 669.

396 Most vessels of this kind in Portugal are made at Estremos, in the province of Alentejo. The description given of them by Brantome is as follows:—"Cette terre étoit tannée, si subtile et si fine qu'on diroit proprement que c'est une terre sigillée; et porte telle vertu, que quelque eau froide que vous y mettiez dedans, vous la verrez bouillis et faire de petits bouillons, comme si elle estoit sur le feu; et si pourtant elle n'en perd sa froideur, mais l'entretient, et jamais l'eau ne fait mal à qui la boit, quelque chaud qu'il fasse, ou quelque exercice violent qu'il fasse." This clay seems to be the same as that which the ladies in Spain and Portugal chew for the sake of its pleasant taste, though to the prejudice of their health. They are so fond of it that their confessors make them abstain from the use of it some days by way of penance for their transgressions. See Madame D'Aunoi, Voy. en Espagne, ii. pp. 92, 109. Mémoires Instructifs pour un Voyageur. A vessel of the above kind is called *bucaro* and *barro*. See Diccion. de la Lengua Castellana, Madrid, 1783, fol.

397 This curious work contains so much valuable information respecting the French manners in the sixteenth century, that some account of it may not prove unacceptable to my readers. The title is, Déscription de L'Isle des Hermaphrodites, nouvellement découverte ... pour servir de Supplement au Journal de Henri III.

The preface, to which there is no signature, says that the book was printed for the first time in 1605. In the first editions neither date nor place is mentioned; but one edition is dated 1612. It appears to have been written in the reign of Henry IV., after the peace of Vervins, concluded in 1598, which the author mentions in the beginning. Henry IV. would not suffer any inquiry to be made respecting the author that he might be punished, because, he said, though he had taken great liberty in his writing, he had written truth. He is not therefore known. Some have conjectured that it was the production of cardinal Perron, and others of sieur d'Emery, Thomas Artus. But the former would not have chosen to lash vices such as those mentioned in this satire, with so much wit and severity; and the latter could not have done it. The one was too vicious, and the other too vehement. The cardinal must have delineated his own picture; and Artus have exceeded what he was capable of. The same opinion respecting Artus is entertained by Marchand, in his Dict. Historique. The frontispiece, which in many editions is wanting, represents an effeminate voluptuary with a womanish face, dressed half in men's and half in women's clothing. Marchand says the inscription is Les Hermaphrodites. In some editions however it is much more cutting: "Pars est una patris; cætera matris habet." This pentameter is taken from Martial, lib. xiv. ep. 174. The whole work is inserted also in Journal de Henri III., par Pierre de l'Estoiles, à la Haye 1744, 8vo, iv. p. 1. For further information on this subject see Le Long, Bibliothèque Historique de la France, ii. p. 326, n. 19128.

398 In the Contes de Gaillard, printed in 1620, it is said, "Il alla un jour d'esté souper chez un voluptueux, qui lui fit mettre de la glace en son vin."

399 Problema 102. These Problemata are often printed with the Problemata Aristotelis, Alexandri Aphrodis. and others. The collection which I have was printed at Amsterdam, 1685, 12mo.

400 De Miraculis, libri iv. Colon. 1581, 8vo, p. 288.

401 Centuriæ ix Memorabilium. Francof. 1599, 12mo, p. 67.

402 De Nive, p. 38.

403 J. B. Du Hamel, Opera Philosophica, Norimb. 1681, 4to.

404 L. Tancredi de Fame et Siti libri tres. Ven. 1607, 4to, lib. iii.

405 When snow or ice is mixed with salt, both begin to be liquid. This process is employed in Russia to clean windows covered with frost. They are rubbed with a sponge dipped in salt, and by these means they become immediately transparent. [The *rationale* of this appears to consist in the salt absorbing water and deliquescing, and in this fluid the snow subsequently dissolves, the mixture requiring a much lower temperature for its assuming the solid state.]

406 Historia Vitæ et Mortis, § 44.—De Augmentis Scient. v. 2.—Silva Silvarum, cent. i.

407 History of Cold, title i. 17; title v. 3; title xv. 7. [The method of making one or two freezing or cooling mixtures will not perhaps be without interest here. Where snow is not at hand, a mixture of 5 parts of powdered nitre and 5 of powdered sal-ammoniac may be mixed with 16 parts of water. This reduces the thermometer from +50° to about +10° F., or, 9 parts of phosphate of soda, 6 of nitrate of ammonia, and 4 of dilute nitric acid, reduce the thermometer from +50° to -21°; 5 parts of common salt, 5 of nitrate of ammonia and 12 of snow, reduce it from the ordinary temperature to -28°. The most intense degree of cold, probably known, has been produced by Dr. Faraday in his experiments upon the liquefaction of gases. This was effected by placing solid carbonic acid mixed with æther, under the air-pump, and exhausting.]

408 Des Cartes Specimina Philosophiæ. Amst. 1650, 4to, p. 216.

409 Von Hohberg says, in his Adliches Landleben, “The following, which serves more for amusement than use, is well-known to

children. If one put snow and saltpetre into a jug, and place it on a table, over which water has been poured, and stir the snow and salt well round in the jug with a stick, the jug will be soon frozen to the table." This baron, therefore, who, after he had sold his property in Austria on account of the persecution against the Protestants, wrote at Regensburg (Ratisbon), where he died in 1688, at the age of seventy-six, was not acquainted with iced delicacies. Had they been known to him, he would have certainly mentioned them where, in his Book of Cookery, he gives ample directions for laying out a table of the first rank.

410 [The application of ice to the purposes of confectionary, has, within the last few years, become much more extensive; encouraged, no doubt, by the facility with which it is now procurable at all seasons of the year, and in any quantity. Imitations of peaches, nectarines, apricots, and other fruits, are now produced in ice paste in such perfection, as at first sight to deceive the most practised eye; and such elegances are no longer confined to the tables of the wealthy.]

411 Instruction pour les Jardins. Paris, 1730, 4to, i. p. 263. The author says that ice in summer is indeed useful; but, as a gardener, he wishes that frost could be prevented; and that ice might be imported from the North, as olives and oranges are from the South. Some years ago, as no ice could be procured on account of the great mildness of the preceding winter, the merchants at Hamburg sent a ship to Greenland for a load of it, by which they acquired considerable profit.

412 For the above account of the mode of collecting the ice at Wenham Lake, we are indebted to the 'Illustrated London News' for May 17, 1845.

HYDROMETER.

This instrument, called in Latin *hydrometrum*, *hygroscopium*, *hygrobaroscopium*, *hydroscopium*, *areometrum*, and *baryllion*, serves to determine the weight or specific gravity of different fluid masses, by the depth to which it sinks in them.

The laws respecting the comparative specific gravity of fluids and solid bodies immersed in them were discovered by Archimedes, when he tried the well-known experiment, by order of Hiero king of Sicily, to find the content of a golden crown, made for that sovereign. Upon these is founded the construction of the hydrometer; and it is not improbable that Archimedes, who was killed in the year 212 before the Christian æra, was the inventor of it, though no proofs to warrant this conjecture are to be found in the writings of that great man, or in those of any other author.

The oldest mention of the hydrometer occurs in the fifth century, and may be found in the letters of Synesius to Hypatia. Of the lives of these two persons I must here give some anecdotes, as they deserve to be known on account of the singular fate which attended them. Hypatia was the daughter of Theon, a well-known mathematician of Alexandria, some of whose writings are still extant. By her father she was instructed in mathematics, and from other great men, who at that time abounded in Alexandria, she learned the Platonic and Aristotelian philosophy, and acquired such a complete knowledge of these sciences, that she taught them publicly with the greatest applause. She was young and beautiful, had a personable figure, was sprightly and agreeable in conversation, though at the same time modest; and she possessed the most rigid virtue, which was proof against every temptation. She conducted herself with so much propriety towards her lovers, that they never could obtain more than the pleasure of her company and of hearing her discourse; and with this, which they considered as an honour, they were contented. Those who wished to intrude further were dismissed; and she destroyed the appetite of one who would not suffer

her to philosophise, by means of some strong preparation, which, as far as I know, remained a secret. She was not baptized, and with all her knowledge, adopted the blind superstition of paganism. Had she been a Christian, and suffered a cruel death from heathen persecution, she would have merited a place in the martyrology of the saints: but the case was reversed; for, by the conduct of the Christians towards her, she became entitled to have her name enrolled in the martyrology of the philosophers.

The patriarch of Alexandria, at the time when she lived, was Cyril, whose family for a hundred years before had produced bishops, who were of more service to their relations than to the church. This prelate was a proud, litigious, vindictive and intolerant man, who thought every thing lawful which he conceived to be for the glory of God; and who, as prosecutor and judge, condemned Nestorius without hearing his defence. In the city of Alexandria, which was then very flourishing on account of its commerce, the emperor allowed greater toleration than he imagined could be justified to the clergy in any other place; and it contained a great many Jews, who carried on an extensive trade, as well as a number of pagan families who were of service to the city, or at least did it no harm. This, in the eyes of Cyril, was not proper; he would have the sheep-fold clean, and the Jews must be banished. Orestes, however, the governor, who was a man of prudence, and better acquainted with the interests of the city, opposed a measure that was likely to be attended with mischief, and he even caused to be condemned to death a Christian profligate, who had done some injury to the Jews. This malefactor was, by the order of Cyril, buried in the church as a martyr; and he immediately collected five hundred monks, who ill-treated Orestes in the streets, and excited an insurrection among the people, who plundered the unfortunate Jews, and expelled them from a city in which they had lived since the time of Alexander the Great.

Cyril, observing one day a great number of horses and servants belonging to persons of the first rank, before a certain house in the city, inquired the cause of their being assembled in that manner. He was informed that the house was the habitation of the celebrated female philosopher Hypatia, who, on account of her extensive learning and eminent talents, was visited not only by people of the highest distinction, but even by the governor himself. This was sufficient to excite the bishop’s jealousy against the unbelieving Hypatia, and he resolved to effect her ruin.

As he had instigated the people against the Jews, he in like manner encouraged them to attack Hypatia. They seized her in the street, hurried her to the church, stripped off her clothes, tore her flesh to pieces with potsherds, dragged her mangled limbs about through the city, and at length burned them. This bloody tragedy, which took place in the year 415, could tend only to inspire the heathens with a greater hatred to Christianity, and to make sensible Christians ashamed of the conduct of their brethren. To Cyril, however, it occasioned no shame; on the contrary, he endeavoured to divert the emperor from punishing those who had been guilty of so gross a violation of the principles of justice, and in this he was assisted by his numerous adherents and friends. In some circumstances of this relation historians are not agreed, but they all concur in bestowing praise on Hypatia, whose memory was honoured and preserved by her grateful and affectionate scholars[413].

Among these was Synesius, of a noble pagan family, who cultivated philosophy and the mathematics with the utmost ardour, and who had been one of her most intimate friends and followers. On account of his learning, talents, and open disposition, he was universally esteemed, and he had been employed with great success on public occasions of importance. The church at Ptolemais at length wished to have him for their bishop. After much reluctance he accepted the office, but on condition that they should not require him to acknowledge the resurrection of the dead, which he doubted. The people having consented to allow him this indulgence, he suffered himself to be baptized, and became their bishop. He was confirmed by the orthodox patriarch Theophilus, the predecessor of Cyril, to whose jurisdiction Ptolemais belonged; and he afterwards renounced his errors, and declared himself convinced of the truth of the resurrection. This learned man showed his gratitude to Hypatia, by the honourable mention which he made of her in some letters that are still preserved among his writings.

In his fifteenth letter, he tells Hypatia that he was so unfortunate, or found himself so ill, that he wished to use a *hydroscopium*, and he requests that she would cause one to be constructed for him. “It is a cylindrical tube,” adds he, “of the size of a reed or pipe. A line is drawn upon it lengthwise, which is intersected by others, and these point out the weight of water. At the end of the tube is a cone, the base of which is joined to that of the tube, so that they have both only one base. This part of the instrument is

called *baryllion*. If it be placed in water, it remains in a perpendicular direction, so that one can discover by it the weight of the fluid."

Petavius, who published the works of Synesius in the year 1640, acknowledges in his annotations, that this passage he did not understand. An old scholiast, he says, who had added some illegible words, seemed to think that it referred to a water-clock; but this he considers improbable, as a clepsydra was not immersed in water, but filled with it. He conjectures, therefore, that it may allude to some such instrument as that which Vitruvius calls *chorobates*. The latter however was employed for leveling; and it appears that Synesius, who complains of the bad state of his health, could not think of leveling. Besides, no part of the description in Vitruvius agrees with that which is given in so clear a manner by Synesius.

Petau published his edition of the works of this philosopher in the time of Peter de Fermat, conseiller au parlement de Toulouse, a man of great learning, who was an excellent mathematician, and well-acquainted with antiquities and the works of the ancients. We have by the latter a commentary upon some obscure passages of Athenæus, annotations on the writings of Theon of Smyrna, and emendations from a manuscript to the Stratagemata of Polyænus, which may be found also in his Miscellanies. Mursinna, in his edition of the same author, has added them to the end of the preface. As Fermat was often consulted respecting difficult passages of the ancients, he could not be unacquainted with that in the new edition of Synesius. He drew up an explanation of it, and gave it to a friend who was then about to publish a French translation of Bened. Castelli's book, Della Misura dell'Acque Correnti, and who caused it to be printed along with that work. Fermat died in the year 1665. After his death his son published some of his writings under the title of Varia Opera Mathematica[414]; and in this collection is inserted his short treatise on the *hydroscopium*, from which I have extracted the following explanation.

It is impossible, says he, that the *hydroscopium* could be the level or *chorobates* of Vitruvius, for the lines on the latter were perpendicular to the horizon, whereas the lines on the former were parallel to it. The *hydroscopium* was undoubtedly a hydrometer of the simplest construction. The tube may be made of copper, and open at the top; but at the other end, which, when used, is the lowest, it must terminate with a cone, the base of

which is soldered to that of the tube. Lengthwise, along the tube, are drawn two lines, which are intersected by others, and the more numerous these divisions are, the instrument will be so much more correct. When placed in water, it sinks to a certain depth, which will be marked by the cross lines, and which will be greater in proportion to the lightness of the water. A figure, which is added, illustrates this explanation more than was necessary. When a common friend of Fermat and Petavius showed it to the latter, he considered it to be so just, that he wished to have an opportunity of introducing it in a new edition.

Mersenne, on the other hand, entertains some doubt[415] respecting this instrument, though he does not mention Fermat, with whom he was well-acquainted; for in the dispute which the latter had with Descartes, Mersenne was the bearer of the letters that passed between them, as we learn from the Life of Descartes, by Baillet. His objections however are of little weight. Why should Synesius, asks Mersenne, consider himself unfortunate, because he had not a hydrometer? It may be here replied, that he was in an infirm state, and that the physicians seem to have ordered him to drink no water but what was pure and light. We know that in former times, when so many artificial liquors were not in use, people were accustomed, more than at present, to good water. We read in the works of the ancient physicians, such as Galen and Celsus, directions how to examine the lightness and purity of water. He might have tried it, says Mersenne, with a common balance. He indeed might, but not so conveniently. That Synesius was in a bad state of health is apparent from several of his letters; otherwise one might say that in a letter many expressions may be only jocular, respecting some circumstance known to the friend to whom one writes; and that every expression is not to be taken according to its literal meaning. One might confess also, without weakening a received explanation, not to know what Synesius alludes to in the first line of his letter. But even if we allow that the instrument was not a hydrometer, but a water-clock, or a level; it may be asked how the want of these could make him unfortunate? Mersenne thinks further, that the cone, added to the end of the tube, would have been unnecessary in a hydrometer; but it serves to keep the instrument with more ease in a perpendicular direction in the water. Such is the opinion of H. Klugel, whom I shall soon have occasion to quote.

For the explanation of Fermat one may produce a still stronger testimony, with which he seems not to have been acquainted. It can be proved that this instrument was used in the next, or at least in the sixth century. Of that period, we have a Latin poem on weights and measures, which contains a very just description of a hydrometer. The author, in manuscripts, is called sometimes *Priscianus*, and sometimes *Rhemnius Fannius Palæmon*; but we know, from grounds which do not belong to this subject, that the former was his real name. Two persons of that name are known at present. The one, Theodore Priscian, was a physician, and lived in the time of the emperor Valentinian, towards the end of the fourth century. As more physicians have written on weights and measures, with which it is indispensably necessary they should be acquainted, one might conjecture that this Priscian was the author of the above poem. The rest of his writings, however, still preserved, are in so coarse and heavy a style, that one can scarcely ascribe to him a work which is far from being ill-written; especially as it is nowhere said that he was a poet. With much more probability may we consider as the author the well-known grammarian Priscian, who died about the year 528.

This poem has been often printed, and not unfrequently at the end of Q. Sereni Samonici De Medicina Præcepta. The best edition is that inserted by Wernsdorf in the fifth part of the first volume of his Poetæ Minores, where an account may be found of the other editions.

Be the author who he may, this much is evident, that he was acquainted with the hydrometer of Synesius, and has described it in a very clear manner.

“Fluids,” says he, “are different in weight, as may be proved by the specific gravity of oil and honey compared with that of pure water;” and the given proportion agrees almost with that found by modern experiments. “This,” adds he, “may be discovered by an instrument,” which he thus describes:—“It consists of a thin metallic cylinder made of silver or copper, about as large as the joint of a reed between two knots, to the end of which is added a cone. This cone makes the lower end so heavy, that the instrument, without sinking or floating on the surface, remains suspended perpendicularly in the water. Lengthwise, upon the cylinder, is drawn a line, which is divided by cross lines into as many parts as are equal to the weight of the instrument in *scripla*. If placed in light fluids, more of the divisions

will be covered than when put into heavy fluids; or it sinks deeper into those which are light than into those which are heavy. This difference of gravity may be found also," continues he, "by filling vessels of equal size with the fluids and weighing them; for the heavier must then weigh most; but when one takes an equal weight of two fluids, the lighter will occupy more space than the heavier. If twenty-one divisions of the instrument are covered in water, and twenty-four in oil, and if one take twenty-four *scripla* of water, twenty-one *scripla* of oil only can be contained in the space occupied by the water." Such is the manner in which Professor Klugel has conjectured the meaning of the author from hydrostatic principles; though neither he nor Wernsdorf has ventured to give a literal translation of the words which ought to convey this explanation. But however obscure they may be, it evidently appears that they allude to a hydrometer.

This poem was once published together with Celsus De Re Medica, in 1566, by Robert Constantin, who died at an advanced age in 1605, and who added a few, but excellent notes, which have been inserted by Wernsdorf in his edition. This Constantin seems to have known that the instrument of Priscian and the *hydroscopium* of Synesius were the same; and that they were used for determining the weight of fluids. He explains the use of them very properly; but is mistaken in supposing the cone to have been of wood, though it served to render the lower part of the instrument heavier, as the poet himself says: "cui cono interius modico pars ima gravatur." I am almost induced to think that *interius* implies that additional weight was given to the cone by throwing some small heavy bodies into it, through the opening above; and at present grains of leaden shot are employed for that purpose. It appears therefore that the honour of having first given a good explanation of the before-quoted passage of Synesius belongs rather to Constantin than to Fermat; but I can readily believe that the latter was not acquainted with the observations made on it by the former. Before I conclude the history of this instrument among the ancients, I shall add two remarks further. It is evidently wrong when one, with Muschenbroek and others, whose opinion I adopted before I engaged in this research, considers Hypatia as the inventress of the hydrometer. It was known at her time, and was made at Alexandria; but it seems not to have been very common, as Synesius wrote to Hypatia to procure him one, and even thought it necessary to give her a description of it.

Those are mistaken likewise, who say that this instrument was called also *baryllium*. That word, as far as I have been able to learn, occurs only in Synesius, who expressly tells us that the small heavy cone alone was meant by it. In the same manner has it been understood by Constantin. In the Dictionary of Basle it is said to be *hydroscopii pars*; and in Stephen's Dictionary it is explained by *ponducsulum*, as well as in that of Ernest, where it is given as the diminutive of *baros*. It signified therefore the heavy part of the hydrometer only.

It is equally erroneous when one says, with Muschenbroek and others, that those who among the Romans made it their employment to examine the quality of water with the hydrometer, were called *baryllistæ* or *barynilæ*. These words do not occur in the works of the ancient Latin authors, nor in any of the completest dictionaries. We read only the following passage in some editions of the Commentary of Servius upon Virgil: "Scrutatores et repertores aquarum (aquilices dicuntur) barinulas dixerunt[416]." If these words were really written by Servius, who lived in the fifth century, he either confounded the water-searchers, *aquilices*, those who sought for springs, with those who examined the nature of water when found, as the hydrometer was of no service to the former in their business; or both employments must at that time have been followed by the same people, and these must have acquired their name from a part only of one instrument they used, which is not at all probable.

I think we may with certainty believe that the hydrometer was not known to Seneca, Pliny, or Galen, who died about the end of the second century. Were not this the case, it would certainly have been mentioned by the first, where he speaks so minutely of the specific gravity of hard and fluid bodies[417]; by the second, where he says that the weight of water was ascertained by a common balance[418]; and by the last, where he gives directions how to discover its lightness. Galen adds, that in his time a method had been invented of determining the quality of salt-lye by placing an egg in it, and observing whether it floated[419]. Have we not reason to think that on this occasion the hydrometer must have occurred to him had it been then used?

But however well-known it may have been in the fifth century, it seems that it was afterwards entirely forgotten, and that towards the end of the sixteenth it was again for the first time revived or invented anew. To George Agricola it was scarcely known; for where he speaks of the weight of different kinds of water, and particularly of that of salt springs[420], he does not mention it. Constantin, however, who lived at the same time, must have been acquainted with it, else he could not have explained the before-mentioned passages of Synesius and Priscian.

I am inclined to think that the first account of the hydrometer being again brought into use must be found in the oldest German books on salt-works. It is at any rate certain that from these the modern philosophers became first acquainted with it. One of the earliest who has described it is the Jesuit Cabeus, who wrote about the year 1644[421]; but he confesses that he acquired his information from a German treatise by Tholden, whom Kircher[422] calls a German artist. He was however not properly an artist. He was a native of Hesse; a good chemist for his time; and resided about the year 1600 or 1614 as overseer of the salt-works at Frankenhausen in Thuringia. His treatise, which Cabeus had in his possession, was entitled Tholden's Haligraphia, printed at Leipsic in 1603. Another edition, printed at the same place in 1613, is mentioned by Draudius; but at present I have not been able to find it; and can say only from Cabeus and Leupold, that Tholden's hydrometer had a weight suspended to it; and that he speaks of the instrument not as a new but a well-known invention, and on that account has described it only imperfectly.

Kircher, whose works were generally read, seems to have principally contributed towards making it publicly known; and Schott[423], Sturm[424] and others, in their account of it, refer to his writings. The artists at Nuremberg, who worked in glass, and who constructed a great many hydrometers which were everywhere sold, assisted in this likewise. One, above all, made by Michael Sigismund Hack, was highly valued about the beginning of the last century, as we are told by J. Henry Muller, professor at Altorf. Of this artist, often mentioned by Sturm and other philosophers, an account has been given by Doppelmayer. He died in 1724.

Many improvements, or perhaps only alterations, have been made in this instrument in later times by a variety of artists. The task of collecting these completely in chronological order with explanations, I shall leave to others; and only mention a few of them. One of the first who endeavoured to adapt the hydrometer for determining the specific gravity and purity of metals was Monconys. Almost about the same period Cornelius Mayer and Boyle seem to have conceived the idea of facilitating the weighing of solid bodies by a weighing-scale added to the instrument. The former affirms that this improvement was invented by him as early as the year 1668[425]; whereas Boyle did not make his known till 1675[426]. Besides these the following also are worthy of notice: Feuille[427], Fahrenheit, Clark[428], and Leutmann[429], whose improvements have been described by Wolf[430], Leupold[431], Gesner, Weigel and others.

[The principal hydrometer now in use is that of Sykes, this is adopted in estimating excise duties on liquids. That of Baumé is principally employed abroad. Those of Beck or Cartier are but rarely used. These instruments differ merely in their graduation. Sykes's plan of increasing the extent of the indications without enlarging the instrument is ingenious. It is effected by means of a number of weights which may be appended as collars to the stem of the instrument.

A useful method of ascertaining specific gravities for commercial purposes, consists in using a series of glass beads, previously adjusted and numbered. When thrown into any liquid, the heavier ones sink and the lighter float on the surface; but the one which has the same density as the liquid will remain indifferent, or perhaps slightly below the surface. The specific gravity is then found by the number with which it is marked.]

FOOTNOTES

[413] A fuller account of Hypatia may be found in Menagii Histor. Mulier. Philosoph. Lugd. 1690; Bruckeri Hist. Crit. Philos. ii. p.

351; and Wolfii Fragmenta Mulierum Græc. Gott. 1739, 4to.

414 Varia Opera Mathematica D. Petri de Fermat, Tolosæ, 1679, folio.

415 Cogitata Physico-Mathem. Par., 1644, and in Phænomena Hydraulica.

416 On Georg. i. 109. These words are quoted by Emmenessius, the editor of the Variorum edition of Virgil, but in the edition of Servius, Venetiis, 1562, fol., they are not to be found. The Commentary of Servius may at present be no longer indispensable for explaining Virgil; but it deserves to be printed once more as completely and accurately as possible. It contains much useful information, as well as many fragments of works now lost; and on this account cannot well be entirely dispensed with.

417 Quæst. Nat. iii. 25, p. 726.

418 Hist. Nat. xxxi. 3, sect. 23, p. 552.—Athen. ii. p. 46.—Plutarchi Quæst. Nat. 7.

419 De Simplic. Med. Facultatibus, iv. 20.

420 De Natura eorum quæ effluunt ex Terra, lib. ii. p. 124.

421 Philosophia Experimentalis, sive Commentaria in Aristotelis Meteorolog. lib. ii. textus 26, quæst. 2, tom. ii. p. 158, b.

422 Mundus Subterraneus, vol. i. p. 254.

423 Cursus Mathemat. p. 455, icon. 20.

424 Collegii Experiment. pars ii. Norimb. 1715, 4to.

425 Nuovi Ritrovamenti. Roma, 1696, fol.

426 Philosoph. Transact. 1675: where an engraving is given of all the parts.

[427] Journal des Observations Physiques et Math. Par. 1714, 4to.

[428] Philosoph. Transact. No. 384, p. 140; and No. 413, p. 277.

[429] Comment. Acad. Petrop. v. p. 274.

[430] In his Versuchen. Halle, 1737, 8vo, i. p. 556.

[431] Theatrum Hydrostaticum.

LIGHTING OF STREETS.

The lighting of streets, while it greatly contributes to ornament our principal cities, adds considerably also to the convenience and security of the inhabitants. But of whatever benefit it may be, it is generally considered as a modern invention. M. St. Evremond says, “The invention of lighting the streets of Paris during the night, by a multitude of lamps, deserves that the most distant nations should go to see what neither the Greeks nor the Romans ever thought of for the police of their republics.” This opinion appears to be well-founded; for I have never yet met with any information which proves that the streets of Rome were lighted. Some passages, indeed, in ancient authors rather indicate the contrary; and according to my ideas, the Romans would not have considered the use of flambeaux and lanterns so necessary on their return from their nocturnal visits, as they seem to have done, had their streets been lighted; though I will allow that the public lighting of the streets in our cities does not render links or lanterns altogether superfluous. Whoever walked the streets of Rome at night without a lantern, was under the necessity of creeping home in perfect darkness, and in great danger[432], like Alexis in Athenæus. Meursius endeavours to make it appear that the streets of Rome were lighted; and in support of this opinion quotes Ammianus Marcellinus, and the Life of Julius Cæsar in Suetonius; but his arguments to me are far from being convincing[433]. That Naples was not lighted, appears from the return of Gito in the night-time, mentioned by Petronius[434]. Some circumstances however related by ancient authors make it probable that Antioch, Rome and a few other cities had public lanterns, if not in all the streets, at least in those which were most frequented.

Libanius, who lived in the beginning of the fourth century, says in his Panegyric[435], where he praises his native city Antioch, “The light of the sun is succeeded by other lights, which are far superior to the lamps lighted by

the Egyptians on the festival of Minerva of Sais. The night with us differs from the day only in the appearance of the light: with regard to labour and employment everything goes on well. Some work continually; but others laugh and amuse themselves with singing." I cannot allow myself to imagine that the sophist here considers it as a subject of praise to his native city, that the inhabitants after sun-set did not sit in darkness, but used lights to work by. It appears, therefore, that he alludes to the lighting of the streets.

In another passage, in the oration to Ellebichus[436], the same author tells us, that the ropes from which the lamps that ornamented the city were suspended, had been cut by some riotous soldiers, not far from a bath. "Proceeding," says he, "to a bath not far off, they cut with their swords the ropes from which were suspended the lamps that afforded light in the night-time, to show that the ornaments of the city ought to give way to them." This quotation indicates, at any rate, that there were lamps suspended from ropes near the baths and places of greatest resort. The following passage of Jerome, however, seems to make it probable, or rather certain, that the streets of Antioch were lighted. In the altercation between a Luciferan and an Orthodox, he relates that an adherent of the schismatic Lucifer disputed in the street with a true believer till the streets were lighted, when the listening crowd departed; and that they then spat in each other's face, and retired.

In the elegant edition of the works of that father, by Dominicus Vallarsius, we have a short dissertation on the time when this unmannerly dispute took place; and the editor shows that it happened at Antioch in the year 378[437].

Basilius the Great, in a letter to Martinianus, giving an account of the miserable situation of his native city Cæsarea, in Cappadocia, in the year 371, says they had nights without lights (*noctes non illustratas*). Most commentators explain this passage as if it meant that the lamps in the streets had not been lighted[438].

That the streets, not only of Antioch, but also of Edessa, in Syria, were lighted in the fifth century, seems proved by a passage in the History of Jesue Stylites. It is there expressly said, that Eulogius, governor of Edessa,

about the year 505, ordered lamps to be kept burning in the streets during the night; and that he employed for that purpose a part of the oil which was before given to the churches and monasteries[439].

With regard to the public lighting of whole cities on festivals, and particularly on joyful occasions, which we call illuminations, that practice seems to be of great antiquity. Of this kind was a particular festival of the Egyptians[440], during which lamps were placed before all the houses throughout the country, and kept burning the whole night[441]. During that festival of the Jews, called *festum encæniorum*, the feast of the Dedication of the Temple, which, according to common opinion, was celebrated in December, and continued eight days, a number of lamps were lighted before each of their houses. A passage in Æschylus shows that such illuminations were used also in Greece. At Rome, the forum was lighted when games were exhibited in the night-time; and Caligula, on a like occasion, caused the whole city to be lighted[442]. As Cicero was returning home late at night, after Catiline's conspiracy had been defeated, lamps and torches were lighted in all the streets in honour of that great orator. The emperor Constantine caused the whole city of Constantinople to be illuminated with lamps and wax candles on Easter eve[443]. The fathers of the first century frequently inveigh against the Christians, because, to please the heathens, they often illuminated their houses, on idolatrous festivals, in a more elegant manner than they. This they considered as a species of idolatry[444]. That the houses of the ancients were illuminated on birth-days, by suspending lamps from chains, is too well known to require any proof[445].

Of modern cities, Paris, as far as I have been able to learn, was the first that followed the example of the ancients by lighting its streets. As this city, in the beginning of the sixteenth century, was much infested with street robbers and incendiaries, the inhabitants were, from time to time, ordered to keep lights burning, after nine in the evening, before the windows of all the houses which fronted the street. This order was issued in the year 1524, and renewed in 1526 and 1553[446]; but in the month of October 1558, *falots* were erected at the corners of the streets, or, when the street was so long that it could not be lighted by one, three were erected in three different parts

of it. These lights had, in a certain measure, a resemblance to those used in some mines; for we are told, in the Grand Vocabulaire François[447], that *falot* is a large vase filled with pitch, rosin, and other combustibles, employed in the king's palace and houses of princes to light the courts. At that period there were in Paris 912 streets; so that the number of lights then used must have been less than 2736.

In the month of November, the same year, these lights were changed for lanterns of the like kind as those used at present. The lighting of the streets of Paris continued, however, for a long time to be very imperfect, till the abbé Laudati, an Italian of the Caraffa family, conceived the idea of letting out torches and lanterns for hire. In the month of March 1662, he obtained an exclusive privilege to this establishment for twenty years; and he undertook to erect, at certain places, not only in Paris, but also in other cities of the kingdom, booths or posts where any person might hire a link or lantern, or, on paying a certain sum, might be attended through the streets by a man bearing a light. He was authorised to receive from every one who hired a lantern to a coach, five sous for a quarter of an hour; and from every foot-passenger, three sous. To prevent all disputes in regard to time, it was ordered that a regulated hour-glass should be carried along with each lantern.

In 1667, however, the lighting of the city of Paris was put on that footing on which it is at present. At the same time the police was greatly improved, and it afterwards served as a pattern to most of the other cities in Europe. Affairs of judicature, and those respecting the public police, instead of being committed, as before, to one magistrate, called the "Lieutenant civil du prevost de Paris," were by a royal edict, of the month of March in the above year, divided between two persons. One of them, who had the management of judicial affairs, retained the old title; and the other, who superintended the police, had that of "Lieutenant du prevost de Paris pour la police," or "Lieutenant général de police." The first lieutenant of police was Nicholas de Reynie, a man who, according to the praises bestowed on him by French writers, formed an epoch in the history of modern police. In the History of Paris, so often already quoted, he is called an enlightened, upright, and vigilant magistrate, as zealous for the service of the king as for the good of the public, and who succeeded so well in this new office, that we may say, adds the author, it is to him, more than to any other, that we are

indebted for the good order which prevails at present in Paris. The first useful regulation by which La Reynie rendered a service to the police, was that for improving the (*guet*) night-watch, and the lighting of the streets. I can find no complete account of the changes he introduced; but four years after, that is, on the 23rd of May 1671, an order was made that the lanterns every year should be lighted from the 20th of October till the end of March in the year following, and even during moonlight; because the latter was of little use in bad weather, and even in fine weather was not sufficient to light some of the most dangerous streets.

Before this period the streets were lighted only during the four winter months; and on account of the numberless atrocities committed in the night-time, when there were no lights, the Parisians offered to contribute as much money as should be sufficient to defray the expense of keeping the lamps lighted throughout the whole winter. The lamps employed by La Reynie were, on account of their likeness to a bucket, called *lanternes à seau*, and succeeded those invented by one Herault, called *lanternes à cul-de-lampe*.

When De Sartines held the office of lieutenant de police, a premium was offered to whoever should discover the most advantageous means of improving the lighting of the streets; and the Academy of Sciences were to decide on the different plans that might be proposed. In consequence of this offer, a journeyman glazier, named Goujon, received a premium of 200 livres, and Messrs. Bailly, Le Roy, and Bourgeois de Chateaublanc 2000 livres. To the last-mentioned gentleman is ascribed the invention of the present reverberating lamps, described by La Vieil, which were introduced in 1766.

In a small work, called an Essay on Lanterns, by a society of literary men[448], which, though written to ridicule antiquarian researches and certain persons at Paris, contains some authentic information respecting the lighting of the streets, we are told that reverberating lamps were invented by an abbé P., who therefore, says the author humorously, is the second abbé who can boast of having enlightened the first city in the world. The superiority of these lamps cannot be denied; but, besides their expense, they are attended with this disadvantage when they hang in the middle of the street, that they throw a shade over it, so that one cannot be known by those who pass. In cities also, where people walk principally in the middle of the

streets, or where the streets are broad, they are not very convenient, and they occasion a stoppage when it is necessary to clean them.

In the year 1721, the lamps in Paris are said to have amounted to 5772; but in the Tableau de Paris, printed in 1760, the number is reckoned to be only 5694, and in the Curiosités de Paris, 1771, they are stated to be 6232.

In 1777, the road between Paris and Versailles, which is about nine miles in length, was lighted at the yearly expense of 15,000 livres by the same contractors who lighted Paris. The city of Nantes was lighted the same year; and in 1780 had 500 lamps. Strasburg began to be lighted in 1779.

If what Maitland says in his history[449] be true, that in the year 1414 an order was issued for hanging out lanterns to light the streets, and if that regulation was continued after the above period, which I very much doubt, then must it be allowed that London preceded Paris in this useful establishment. Maitland refers for his authority to Stow's Survey of London; but in the edition of that work published in 1633, I find only, where a list of the magistrates is given, the following information:—"1417, Mayor, Sir Henry Barton, skinner. This Henry Barton ordained lanthorns with lights to bee hanged out on the winter evenings, betwixt Hallontide and Candlemasse." Nothing more occurs in the edition by Strype, published in 1720.

In the year 1668, when several regulations were made for improving the streets, the Londoners were reminded that they should hang out lanterns duly at the accustomed time[450]. In the year 1690 this order was renewed, and every housekeeper was required to hang out a light or lamp every night as soon as it was dark, between Michaelmas and Lady-day; and to keep it burning till the hour of twelve at night. In the year 1716 it was ordained by an act of common council, that all housekeepers, whose houses fronted any street, lane, or public passage, should, in every dark night, that is, every night between the second night after every full moon till the seventh night after every new moon, set or hang out one or more lights, with sufficient cotton wicks, that should continue to burn from six o'clock at night till eleven o'clock of the same night, under the penalty of one shilling. All these regulations, however, seem to have been ineffectual, owing to bad management. The city was lighted by contract, and the contractors for

liberty to light it were obliged to pay annually to the city the sum of six hundred pounds. Besides, the contractors received only six shillings per annum from every housekeeper whose rent exceeded ten pounds; and all persons who hung out a lantern and candle before their houses were exempted from paying towards the public lamps. The streets were lighted no more than one hundred and seventeen nights; and as this gave great opportunity to thieves and robbers to commit depredations in the night-time, the lord mayor and common council judged it proper, in the year 1736, to apply to parliament for power to enable them to light the streets of the city in a better manner; and an act was accordingly passed, by which they were empowered to erect a sufficient number of such sort of glass lamps as they should judge proper, and to keep them burning from the setting to the rising of the sun throughout the year. Instead therefore of a thousand lamps, the number was now increased to 4679; but as these even were not sufficient, several of the wards made a considerable augmentation, so that the whole could amount to no less than 5000. This, however, was not the amount of all the lamps in London, but of those in what is properly called the city and liberties. As this division forms only a fifth part of London, Maitland reckons the whole number of public and private lamps to have been, even at that period, upwards of 15,000. The time of lighting also, which before had been only 750 hours annually, was increased to 5000. In our cities of Lower Saxony, the streets of which are not so dark as those of London, the lighting continues 1519 hours.

In the year 1744, owing to the great number of robberies committed in the streets during the night, it was found necessary to apply for another act of parliament to regulate still farther the lighting of the city; and at that period this establishment was placed upon that footing on which it now stands.

The lamps of London, at present (1786), are all of crystal glass; each is furnished with three wicks; and they are affixed to posts placed at the distance of a certain number of paces from each other. They are lighted every day in the year at sunset. Oxford-street alone is said to contain more lamps than all Paris. The roads, even, seven or eight miles round London, are lighted by such lamps; and as these roads from the city to different parts are very numerous, the lamps seen from a little distance, particularly in the county of Surrey, where a great many roads cross each other, have a

beautiful and noble effect. Birmingham was lighted, for the first time, in 1733, with 700 lamps.

It appears that the streets of Amsterdam were lighted by lanterns as early as 1669; for in the month of February that year, the magistrates, who in 1665 had forbidden the use of torches, issued an order against destroying the lamp-posts, to which it was customary to fasten horses. This order, as well as the instructions given to the lamp-lighters in 1669, may be found in a work called the Privileges of the city of Amsterdam. The lanterns were not of glass, but of horn; for the lamp-lighters were ordered, in their instructions, to wipe off every day the smoke of the train-oil which adhered to the horn of the lanterns.

At the Hague an order was issued in the month of October 1553, that the inhabitants should place lights before their doors during dark nights; and afterwards small stone buildings were erected at the corners of the principal streets, in which lights were kept burning; but in the year 1678 lamps were fixed up in all the streets.

The streets of Copenhagen were first lighted by lamps in 1681; and on the 16th of July 1683 new regulations were made, by which the plan was much improved, as well as that of the night-watch.

The streets of Rome are not yet lighted. Sixtus V. was desirous to introduce this improvement in the police, but he met with insurmountable obstacles. That the benefit of lighting might be enjoyed in some measure, he ordered the number of the lights placed before the images of saints to be augmented. De la Lande says, in his Travels, that Venice had been lighted for some years before the period when he wrote, by 3000 lamps. Messina and Palermo, in Sicily, are both lighted.

Madrid, which till lately was the dirtiest of all the capital cities of Europe, is at present as well lighted as London[451]. Valencia in Spain was some years ago indebted for this improvement to Joachim Manuel Fos, then inspector of the manufactories. Barcelona is lighted also[452]. Lisbon however has no lights.

The streets of Philadelphia are lighted, and on each side there is a foot-pavement.

In the year 1672 the council of Hamburg made a proposal to the citizens for lighting the streets. The year following this proposal was accepted, but the lamps were not fixed up till two years after, that is to say in 1675.

In the year 1679, Berlin had advanced so far towards this improvement, that the inhabitants were obliged in turns to hang out a lantern with a light at every third house. In 1682, the Elector Frederick William caused lamp-posts with lamps to be erected, notwithstanding the opposition made by the inhabitants on account of the expense. In a petition which they presented in 1680, they stated that the lamps cost 5000 dollars, and that 3000 were required yearly to keep them lighted. At present Berlin has 2354 lamps, which are kept lighted from September till May, and at the king's expense. Potsdam has 590[453].

Vienna began to be lighted in the year 1687. The lights were hung out in the evening on a signal given by the fire-bell. In 1704 lamps were introduced; but at first the light which they afforded was very imperfect, as the lamps burned badly, and because, to save the expense of lamp-lighters, every housekeeper was obliged daily to remove the empty lamps, to carry them to the lamp-office to be filled, and to light them again on a signal given with a bell. In 1776, the lamps, which before amounted to 2000, were increased to 3000, and a contract was entered into for lighting them at the rate of 30,000 florins. These lamps were invented by counsellor Sonnenfels, and amounted in 1779 to 3445. They are made of white glass, in a globular form, and have a covering of tin-plate, painted red on the outside and polished within. They are supported by lamp-irons, fixed in the houses at the height of fifteen feet from the earth. Each lantern is only sixteen paces distant from the other, so that the streets are completely illuminated. They are kept lighted both summer and winter, whether the moon shines or not; and this is more necessary at Vienna than anywhere else, on account of the height of the houses and the narrowness and crookedness of the streets. The lamp-lighters wear an uniform, and are under military discipline. In 1783 the yearly expense of the lamps was estimated at only 17,000 florins[454].

Leipzig was lighted in 1702, and Dresden in 1705. In 1766, the number of lamps at the latter amounted only to 728, for the lighting of which oil of rape-seed was employed.

In Cassel the streets began to be lighted under the Landgrave Charles, in 1721; but as regulations were not made sufficient to support this improvement, it was at length dropped. It was however revived in 1748, and in 1778 the number of the lamps was increased to 1013, besides those at the landgrave's palace.

Hanover was lighted in 1696, Halle in 1728, and Göttingen in 1735. Brunswick since 1765 has had 1565 lamps. Zurich has been lighted since 1778, but the lamps are very few in number.

[Such was the state of street-lighting towards the end of the last century, and many of the readers of this work will remember the round glass lamps and their dismal oil-light, which long after the streets of London were illuminated with gas, still continued to be employed in the outskirts of this immense metropolis. How changed is all this now, and how surprising must it appear, that a thing so simple as the employment of the combustible gases produced in the distillation of coal and other bodies of organic origin should date from so recent a period! But such is the case with most of the improvements which tend to the comfort and happiness of the human race; slow and by degrees they progress towards perfection,—a fact most admirably illustrated by numerous articles contained in these volumes.

The first idea of applying coal-gas to œconomical purposes is generally attributed to Mr. William Murdoch, who in 1792 employed coal-gas for lighting his house and offices at Redruth in Cornwall, and in 1798 constructed the apparatus for the purpose of lighting Boulton and Watt's celebrated manufactory at Soho, near Birmingham, which on the occasion of the peace in 1802 was publicly illuminated by the same means. This display vastly attracted public attention to the subject, and soon after several manufacturers whose works required light and heat adopted the use of gas; a button manufactory at Birmingham used it largely for soldering; Halifax, Manchester and other towns soon followed. A single cotton-mill in Manchester used above 900 burners, and had several miles of pipe laid down to supply them. Mr. Murdoch, who erected the apparatus used in this mill, sent a detailed account of his operations to the Royal Society in 1808, and received the gold medal of that body. It appears, however, from an interesting paper by R. C. Taylor on the coal-fields of China[455], that the Chinese, if not manufacturers, are nevertheless gas consumers and

employers on a grand scale, and have evidently been so ages before the knowledge of its application was acquired by Europeans. Beds of coal are frequently pierced by the borers for salt water; and the inflammable gas is forced up in jets twenty or thirty feet in height. From these fountains the vapour has been conveyed to the salt-works in pipes, and there used for the boiling and evaporation of the salt; other tubes convey the gas intended for lighting the streets and the larger apartments and kitchens. As there is still more gas than required, the excess is conducted beyond the limits of the salt-works, and there forms separate chimneys or columns of flame. But this, like many other discoveries of the Chinese, remained, owing to their exclusive habits, unknown to us till within a recent period, and the world may fairly be said to be indebted to Mr. Winsor, for the vast benefit conferred upon it by gas-illumination. After several experiments, this gentleman in 1803–1804 lighted the Lyceum theatre, and shortly afterwards, in 1807, one side of Pall-Mall with gas distilled from coal. Soon after that period companies were formed for carrying on the manufacture of gas upon an extensive scale, oil-lamps were banished from all the great thoroughfares of the metropolis, and in the course of fifteen years not only was every street and alley illuminated from the same source, but it was generally introduced into shops and houses, was carried into the suburbs, and has now become general in every town and city of the empire.

It would lead us too far to enter into minute details concerning the structure, uses and arrangement of the various apparatus employed in the production of gas; it will suffice to observe that when coal is heated to redness in a close vessel, it yields a variety of products which may be classed under three heads, as,—1st, permanent gases; 2ndly, vapours condensable into the liquid or solid state by cooling; and 3rdly, the residuary matter, coke, which remains in the retort. The object of gas manufacture is to separate these from each other, and to purify the gaseous products by washing and other means, so as to render them fit for combustion.

The following particulars, taken from Brande's Dictionary of Science, may serve to give an idea of the quantity of gas annually consumed in London. The oldest of the London gas-works is the establishment belonging to the original chartered company. They have three stations; the largest situated in Peter-street, Westminster; the second in Brick-lane, St. Luke's,

and the third in the Curtain-road, Shoreditch. This company consumes 50,000 chaldrons of coals annually, the produce of which in gas may be estimated at about six hundred million cubic feet, or about eighteen million seven hundred and fifty thousand pounds *weight* of gas. It may be assumed that each chaldron of coals weighs 2880 lbs., and yields an average produce of 12,000 cubic feet of purified gas. The prime cost of gas is about four or five shillings per 1000 cubic feet; the usual retail price is from seven to ten shillings per 1000 cubic feet.

The chartered company probably supplies about a fifth part of the whole of the gas consumed in London and the suburbs; so that the total annual consumption of coal employed for this important manufacture in the London district only, probably exceeds two hundred and fifty thousand chaldrons, and the quantity of gas produced for the supply of this district amounts annually to three thousand million cubic feet. The *weight* of this quantity of gas exceeds seventy-five millions of pounds; and the *light* produced by its combustion may be considered as equivalent to that which would be obtained by the combustion of one hundred and sixty millions of pounds of mould-candles of six to the pound.

The operations of the London Gas-light Company, which was established in the year 1833, are also on a scale of great magnitude. Their works, situated at Vauxhall, are not only the most powerful, but the most complete in arrangement of any in the world. From this point their mains ramify to a prodigious extent in Middlesex as well as Surrey, and by the admirable mode in which they are laid, aided by the power of their works, they are enabled to supply gas at Highgate Hill (seven miles distance) with the same precision and in the same abundance as at Vauxhall. The extent of their pipes exceeds one hundred and fifty miles.

The cost of light equivalent to that of seven mould candles (six to the pound) is in coal-gas three farthings per hour, in an Argand oil-lamp 3*d.* per hour, in mould candles 3½*d.* per hour, and in wax candles 1*s.* 2*d.* per hour.

Gas has also been manufactured from oil, rosin and other substances. Oil-gas is procured abundantly by the decomposition of oil, trickled into a red-hot retort, half-filled with coke or brick. It contains no sulphuretted hydrogen, requires no purification, and is much richer in carburetted

hydrogen than coal-gas. Its expense has however led nearly to the entire disuse of this kind of gas.

In London there are eighteen public gas establishments and twelve companies; the capital invested in works and apparatus is estimated at 3,000,000*l.*]

FOOTNOTES

[432] Athen. Deipn. vi. 8. p. 236.

[433] Joh. Meursii Opera, ex recensione Joannis Lami. Florent. 1745, fol. v. p. 635.

[434] Pet. cap. lxxix. That the author here speaks of Naples, I conclude from cap. lxxxi., where the city is called *Græca urbs*. Others, however, with less probability, are of opinion that *Capua* is meant.

[435] Libanii Opera, Lutet. 1627, fol. ii. p. 387.

[436] Ib. 526.

[437] See vol. ii. p. 170.

[438] Valesius informs us, in his observations on Ammianus Marcellinus, that to denote public sorrow, on occasions of great misfortune, it was customary not to light the streets; and in proof of this assertion he quotes a passage of Libanius, where it is said that the people of Antioch, in order to mitigate the anger of the emperor, bethought themselves of lighting either no lamps or a very small number.

[439] Assemani Bibliotheca Orientalis. Romæ, 1719, fol. i. p. 281.

[440] It was called by the Greeks λυχνοκαία.

[441] Herodot. lib. ii. cap. 62.

[442] Suet. Vita Calig. c. 18.

[443] Euseb. lib. iv. De Vita Constantini, cap. 22. Compare with the above Greg. Naz. Orat. 19, and Orat. 2, where the author alludes to the festival of Easter.

[444] Tertuliian. de Idololatria, cap. xv. p. 523. See also his Apologet. cap. 35, p. 178. In both places La Cerda quotes similar passages from other writers. In Concilio Eliberitano, cap. 37, it was decreed "prohibendum etiam ne lucernas publice accendant." See also Joh. Ciampini Vetera Monumenta, in quibus musiva opera illustrantur. Romæ, 1690, 2 vols. fol. i. p. 90, where, on a piece of mosaic work, said to be of the fifth century, some lamps are represented hanging over a door.

[445] J. Lipsii Electa, lib. ii. cap. 3.

[446] This order may be seen in that large and elegant work, entitled Histoire de la Ville de Paris, Felibien, revue, augmentée par Lobineau, Paris, 1725, 5 vols. folio. See vol. ii. pp. 951, 977, and vol. iv. pp. 648, 676, 764.

[447] Paris, 1770, x. p. 265.

[448] Essai sur les Lanternes. A Dole, 1775.

[449] History of London. London, 1756, 2 vols. fol. i. p. 186.

[450] Noorthouck's History of London. Lond. 1773, 4to, p. 233. For the safety and peace of the city, all inhabitants were ordered to hang out candles duly at the accustomed hour.

[451] See Twiss and Dalrymple's Travels.

[452] Swinburne's Travels through Spain, 1779, 4to.

[453] Nicolai Beschreibung von Berlin und Potsdam, pp. 308, 971.

[454] Nicolai Beschreibung einer Reise, iii. pp. 212, 214.

[455] Philosophical Magazine for March, 1846.

NIGHT-WATCH.

The establishment of those people who are obliged to keep watch in the streets of cities during the night, belongs to the oldest regulations of police. Such watchmen are mentioned in the Song of Solomon, and they occur also in the book of Psalms. Athens and other cities of Greece had at least sentinels posted in various parts; and some of the *thesmothetæ* were obliged to visit them from time to time, in order to keep them to their duty[456]. At Rome there were *triumviri nocturni*, *cohortes vigilum*, &c.

The object of all these institutions seems to have been rather the prevention of fires than the guarding against nocturnal alarms or danger; though in the course of time attention was paid to these also. When Augustus wished to strengthen the night-watch, for the purpose of suppressing nocturnal commotions, he used as a pretext the apprehension of fires only. The regulations respecting these watchmen, and the discipline to which they were subjected, were almost the same as those for night-sentinels in camps during the time of war; but it does not appear that the night-watchmen in cities were obliged to prove their presence and vigilance by singing, calling out, or by any other means. Signals were made by the patroles alone, with bells, when the watchmen wished to say anything to each other. Singing by sentinels in time of war was customary, at least among some nations; but in all probability that practice was not common in the time of peace[457].

Calling out the hours seems to have been first practised after the erection of city gates, and, in my opinion, to have taken its rise in Germany; though indeed it must be allowed that such a regulation would have been very useful in ancient Rome, where there were no clocks, and where people had nothing in their houses to announce the hours in the night-time. During the day people could know the hours after water-clocks had been constructed at the public expense, and placed in open buildings erected in

various parts of the city. The case seems to have been the same in Greece; and rich families kept particular servants both male and female, whose business it was to announce to their masters and mistresses certain periods of the day, as pointed out by the city clocks. These servants consisted principally of boys and young girls, the latter being destined to attend on the ladies. It appears, however, that in the course of time water-clocks were kept also in the palaces of the great: at any rate Trimalchio, the celebrated voluptuary mentioned in Petronius, had one in his dining-room, and a servant stationed near it to proclaim the progress of the hours, that his master might know how much of his lifetime was spent; for he did not wish to lose a single moment without enjoying pleasure.

I have not read everything that has been written by others on the division of time among the ancients; but after the researches I have made, I must confess that I do not know whether the hours were announced in the night-time to those who wished and had occasion to know them. There were then no clocks which struck the hours, as has been already said; and as water-clocks were both scarce and expensive, they could not be procured by labouring people, to whom it was of most importance to be acquainted with the progress of time[458]. It would therefore have been a useful and necessary regulation to have caused the watchmen in the streets to proclaim the hours, which they could have known from the public water-clocks, by blowing a horn, or by calling out.

It appears, however, that people must have been soon led to such an institution, because the above methods had been long practised in war. The periods for mounting guard were determined by water-clocks; at each watch a horn was blown, and every one could by this signal know the hour of the night[459]; but I have met with no proof that these regulations were established in cities during the time of peace, though many modern writers have not hesitated to refer to the night-watch in cities what alludes only to nocturnal guards in the time of war. On the contrary, I am still more strongly inclined to think that ancient Rome was entirely destitute of such a police establishment. The bells borne by the night watchmen were used only by the patroles, as we are expressly told, or to give signals upon extraordinary occasions, such as that of a fire, or when any violence had been committed. Cicero, comparing the life of a civil with that of a military

officer, says, “The former is awaked by the crowing of the cock, and the latter by the sound of the trumpet.” The former therefore had no other means of knowing the hours of the night but by attending to the noise made by that animal[460]. An ancient poet says that the cock is the trumpeter which awakens people in the time of peace[461]. The ancients indeed understood much better than the vulgar at present, who are already too much accustomed to clocks, how to determine the periods of the night by observing the stars; but here I am speaking of capital cities, and in these people are not very fond of quitting their beds to look at the stars, which are not always to be seen.

Without entering into further researches respecting watchmen among the ancient Greeks and Romans, I shall prove, by such testimonies as I am acquainted with, that the police establishment of which I speak is more modern in our cities than one might suppose. But I must except Paris; for it appears that night-watching was established there, as at Rome, in the commencement of its monarchy. De la Mare[462] quotes the ordinances on this subject of Clothaire II., in the year 595, of Charlemagne, and of the following periods. At first the citizens were obliged to keep watch in turns, under the command of a *miles gueti*, who was called also *chevalier*. The French writers remark on this circumstance, that the term *guet*, which occurs in the oldest ordinances, was formed from the German words *wache*, *wacht*, the guard, or watch; and in like manner several other ancient German military terms, such as *bivouac*, *landsquenet*, &c.[463] have been retained in the French language. In the course of time, when general tranquillity prevailed, a custom was gradually introduced of avoiding the duty of watching by paying a certain sum of money, until at length permanent *compagnies de guet* were established in Paris, Lyons, Orleans, and afterwards in other cities.

If I am not mistaken, the establishment of single watchmen, who go through the streets and call out the hours, is peculiar to Germany, and was copied only in modern times by our neighbours. The antiquity of it however I will not venture to determine[464]. At Berlin, the elector John George appointed watchmen in the year 1588[465]; but in 1677 there were none in

that capital, and the city officers were obliged to call out the hours[466]. Montagne, during his travels in 1580, thought the calling out of the night-watch in the German cities a very singular custom. “The watchmen,” says he, “went about the houses in the night-time, not so much on account of thieves as on account of fires and other alarms. When the clocks struck, the one was obliged to call out aloud to the other, and to ask what it was o’clock, and then to wish him a good night[467].” This circumstance he remarks also when speaking of Inspruck. Mabillon likewise, who made a literary tour through Germany, describes calling out the hours as a practice altogether peculiar to that country.

The horn of our watchmen seems to be the *buccina* of the ancients, which, as we know, was at first an ox’s horn, though it was afterwards made of metal[468]. Rattles, which are most proper for cities, as horns are for villages, seem to be of later invention[469]. The common form, “Hear, my masters, and let me tell you,” is very old. I am not the only person to whom this question has occurred, why it should not rather be, “Ye people, or citizens.” The chancellor von Ludwig deduces it from the Romans, who, as he says, were more liberal with the word Master, like our neighbours with Messieurs, than the old Germans; but the Roman watchmen did not call out, nor yet do the French at present. If I may be allowed a conjecture on so trifling an object, I should say that the city servants or beadles were the first persons appointed to call out the hours, as was the case at Berlin. These therefore called out to their masters, and “Our masters” is still the usual appellation given to the magistrates in old cities, particularly in the central and southern portions of Germany, and in Switzerland. At Göttingen the ancient form was abolished in the year 1791, and the watchmen call out now, “The clock has struck ten, it is ten o’clock.”

Watchmen who were stationed on steeples by day as well as by night, and who, every time the clock struck, were obliged to give a proof of their vigilance by blowing a horn, seem to have been first established on a permanent footing in Germany, and perhaps before watchmen in the streets. In England there are none of these watchmen; and in general they are very rare beyond the boundaries of Germany. That watchmen were posted on the tops of towers, in the earliest ages, to look out for the approach of an

enemy, is well known. In the times of feudal dissension, when one chief, if he called in any assistance, could often do a great deal of hurt to a large city, either by plundering and burning the suburbs and neighbouring villages, or by driving away the cattle of the citizens, and attacking single travellers, such precaution was more necessary than at present. The nobility therefore kept in their strong castles watchmen, stationed on towers; and this practice prevailed in other countries besides Ireland and Burgundy[470]. It appears by the laws of Wales, that a watchman with a horn was kept in the king's palace[471]. The German princes had in their castles, at any rate in the sixteenth century, tower-watchmen, who were obliged to blow a horn every morning and evening.

At first, the citizens themselves were obliged to keep watch in turns on the church-steeples, as well as at the town-gates; as may be seen in a police ordinance of the city of Einbeck[472], in the year 1573. It was the duty of these watchmen, especially where there were no town clocks, to announce certain periods, such as those of opening and shutting the city-gates. The idea of giving orders to these watchmen to attend not only to danger from the enemy but from fire also, and, after the introduction of public clocks, to prove their vigilance by making a signal with their horn, must have naturally occurred; and the utility of this regulation was so important, that watchmen on steeples were retained, even when cities, by the prevalence of peace, had no occasion to be apprehensive of hostile incursions.

After this period persons were appointed for the particular purpose of watching; and small apartments were constructed for them in the steeples. At first they were allowed to have their wives with them; but this was sometimes prohibited, because a profanation of the church was apprehended. In most, if not in all cities, the town-piper, or as we say at present, town-musician, was appointed steeple-watchman; and lodgings were assigned to him in the steeple; but in the course of time, as these were too high and too inconvenient, a house was given him near the church, and he was allowed to send one of his servants or domestics to keep watch in his stead. This is the case still at Göttingen. The city musician was called formerly the *Hausmann*, which name is still retained here as well as at the Hartz, in Halle, and several other places; and the steeple in which he used to

dwell and keep watch was called the *Hausmann's Thurm*[473]. These establishments, however, were not general; and were not everywhere formed at a period equally early, as will be shown by the proofs which I shall here adduce.

If we can credit an Arabian author, whose Travels were published by Renaudot, the Chinese were accustomed, so early as the ninth century, to have watchmen posted on towers, who announced the hours of the day as well as of the night, by striking or beating upon a suspended board. Marco Paulo, who, in the thirteenth century, travelled through Tartary and China, confirms this account; at least in regard to a city which he calls Quinsai, though he says that signals were given only in cases of fire and disturbance. Such boards are used in China even at present[474]; and in Petersburg the watchmen who are stationed at single houses or in certain parts of the city, are accustomed to announce the hours by beating on a suspended plate of iron. Such boards are still used by the Christians in the Levant to assemble people to divine service, either because they dare not ring bells or are unable to purchase them. The former is related by Tournefort of the inhabitants of the Grecian islands, and the latter by Chardin of the Mingrelians. The like means were employed in monasteries, at the earliest periods, to give notice of the hours of prayer, and to awaken the monks[475]. Mahomet, who in his form of worship borrowed many things from the Christians of Syria and Arabia, adopted the same method of assembling the people to prayers; but when he remarked that it appeared to his followers to savour too much of Christianity, he again introduced the practice of calling out.

The steeple-watchmen in Germany are often mentioned in the fourteenth and fifteenth centuries. In the year 1351, when the council of Erfurt renewed that police ordinance which was called the *Zuchtbrief*, letter of discipline, because it kept the people in proper subjection, it was ordered, besides other regulations in regard to fire, that two watchmen should be posted on every steeple. A watchman of this kind was appointed at Merseburg and Leisnig so early as the year 1400. In the beginning of the seventeenth century the town-piper of Leisnig lived still in apartments in the steeple. In the year 1563, a church-steeple was erected in that place, and

an apartment built in it for a permanent watchman, who was obliged to announce the hours every time the clock struck.

In the fifteenth century the city of Ulm kept permanent watchmen in many of the steeples. In the year 1452 a bell was suspended in the tower of the cathedral of Frankfort-on-the-Maine, which was to be rung in times of feudal alarm, and all the watchmen on the steeples were then to blow their horns and hoist their banners. In the year 1476, a room for the watchman was constructed in the steeple of the church of St. Nicholas. In the year 1509, watchmen were kept both on the watch-towers and steeples, who gave notice by firing a musket when strangers approached. The watchman on the tower of the cathedral immediately announced, by blowing a trumpet, whether the strangers were on foot or on horseback; and at the same time hung out a red flag towards the quarter in which he observed them advancing. The same watchman was obliged, likewise, to blow his horn on an alarm of fire; and that these people might be vigilant day and night, both in winter and summer, the council supplied them with fur-cloaks, seven of which, in the above-mentioned year, were purchased for ten florins and a half.

In the year 1496, the large clock was put up in the steeple of Oettingen, and a person appointed to keep watch on it[476]. In 1580, Montagne was much surprised to find on the steeple at Constance a man who kept watch there continually; and who, on no account, was permitted to come down from his station.

[One of the greatest improvements of modern times, in this country, is the establishment of that highly efficient body, the new police. The first introduction of the police was made by the magistrates of Cheshire in 1829, under an authority from parliament (Act 10 Geo. IV. c. 97). The first metropolitan establishment was also made in 1829. Before this time the total old force of the metropolitan watchmen consisted of 797 parochial day officers, 2785 night-watch, and upward of 100 private watchmen; including the Bow-street day and night patrol, there were about 4000 men employed in the district stretching from Brentford Bridge on the west to the river Lea on the east, and from Highgate on the north to Streatham on the south, excluding the city of London. The act of parliament creating the new police force (10 Geo. IV. c. 44) placed the control of the whole body in the hands

of two commissioners, who devote their whole time to their duties. The total number of the metropolitan police in January 1840 consisted of 3486 men. These are arranged in divisions, each of which is employed in a distinct district. The metropolis is divided into "beats" and is watched day and night. Since August 1839, the horse-patrol, consisting of seventy-one mounted men, who are employed within a distance of several miles around London, has been incorporated with the metropolitan police. The Thames police consists of twenty-one surveyors, each of whom has charge of three men and a boat when on duty. The establishment is under the immediate direction of the magistrates of the Thames police-office.

The police affairs of the city of London are still under its own management. In 1833, the number of persons employed in the several wards of the city was,—ordinary watchmen, 500; superintending watchmen, 65; patrolling watchmen, 91; beadles, 54; total, 710. There are about 400 men doing duty in the city at midnight. In addition to the paid watchmen, about 400 ward-constables are appointed. The expense of the day-police, consisting of about 120 men, amounts to about £9000 a year, and is defrayed by the corporation: and the sum levied on the wards for the support of the night-watch averages about £42,000 per annum.

The police of the metropolis and the district within fifteen miles of Charing Cross (exclusive of the city) is regulated by the acts 10 Geo. IV. c. 44, and 2 and 3 Vict. c. 47. In nearly all the boroughs constituted under the Municipal Reform Act, a paid police force has been established on the same footing as the metropolitan police.]

FOOTNOTES

456 They were called bell-bearers or bellmen, because while going the rounds they gave a signal with their bells, which the sentinels were obliged immediately to answer. See the Scholiasts on the *Aves* of Aristophanes, ver. 841. Dio Cassius, lib. liv. 4, p. 773, says, "The watchmen in the different quarters of the city have small bells, that they may make signals to each other when they think proper." The

bells therefore did not serve for announcing the hours, as some have imagined.

457 The Persian sentinels sung in this manner when they were surprised in the city by the Romans.—Ammianus Marcell. xxiv. 15.

458 That the servants in many houses were wakened by the ringing of a bell, appears from what Lucian says in his treatise, De iis qui mercede conducti in divitum familiis vivunt, cap. xxiv. p. 245, and cap. xxxi. p. 254, Bipont edition, vol. iii. It does not however follow that there were then striking or alarm-clocks, as some have thence concluded. See Magius De Tintinnabulis, cap. 6, in Sallengre, Thesaurus Antiquit. ii. p. 1177.

459 Vegetius De Re Milit. iii. 8. That Cæsar had such clocks may be concluded from the observation which he makes in his Commentaries, on the length of the day in the islands near Ireland, lib. v. 13. Maternus, in Romische Alterthümer, iii. p. 47, endeavours to prove by what Suetonius relates of Domitian, cap. 16, that this prince had in his palace neither a sun-dial nor a water-clock. But what kind of a proof! Domitian asked what the hour was, and some one answered, the sixth. Such insignificant *dicta probantia* have been banished from philosophy by the moderns, and ought they not to be banished from antiquities likewise? The often-quoted passage also of Valerius Maximus, viii. 7, 5, proves nothing, unless we first adopt the amendment of Green. Carneades, it is said, was so engaged in the study of philosophy, that he would have forgot his meals had not Melissa put him in mind of them. Green reads *monitrix domestica*; but Valerius says, "Melissa, quam uxoris loco habebat." See Sallengre, Thes. Antiq. Rom. i. p. 721. A passage likewise in Pliny's Epistles, iii. 1, p. 181, "ubi hora balinei nunciata est," does not properly prove that it alludes to one of those boys who announced the hours. That such servants however were kept, is evident from the undoubted testimony of various authors. Martial, viii. ep. 67.—Juven. Sat. x. 216.—Seneca De

Brevit. Vitæ, c. 12.—Alciphron, Epist. lib. iii. p. 282.—Sidon. Apollin. ii. ep. 9, p. 120.

460 Cic. Orat. pro Muræna, cap. 22.

461 Sil. Ital. vii. 155.

462 Traité de la Police, vol. i. in the Index under the word *Guet*.

463 *Bivouac*, from the German *beiwacht*, is an additional night-guard during a siege, or when an army is encamped near the enemy. *Lansquenets* were German soldiers added by Charles VIII. of France to his infantry, and who were continued in the French army till Francis I. introduced his legions.—TRANS.

464 [With respect to the institution of night-watch in this country, Stow says, "For a full remedy of enormities in the night, I read, that in the year 1253 Henry III. commanded watches in the cities and borough towns to be kept, for the better observing of peace and quietness among his people.... And further, by the advice of them of Savoy, he ordained, that if any man chanced to be robbed, or by any means damnified by any thief or robber, he to whom the charge of keeping that country, city, or borough, chiefly appertained, where the robbery was done, should competently restore the loss. And this was after the use of Savoy, but yet thought more hard to be observed here than in those parts; and therefore, leaving those laborious watches, I will speak of our pleasures and pastimes in watching by night." (Survey of London, Thoms's edition, 1842, p. 39.) He then describes the marching watches which were instituted in the months of June and July, on the vigils and evenings of festival days; with the cresset lights, &c. But he does not state whether these watches were continued in his time; nor does he state the author of the information which he gives us from his reading. The statute of Winchester, 13 Edward I. c. 4, enforces a continuation of the watches as they had previously been made, from Ascension-day to Michaelmas-day; the night-watch from sun-set to sunrise, in every city by six men at each

gate, in every borough by twelve men, in every open town by six or four men.]

465 Nicolai Beschreib. von Berlin, i, p. 38.

466 Ib. p. 49.

467 Iter Germanicum. Hamburgi, 1717, 8vo, p. 26.

468 Lipsius De Milit. Rom. iv. 10, p. 198.—Bochart. Hierozoic. i.

469 From the name of this instrument, called in some places of Germany a *ratel*, arose the appellation of *ratelwache*, which was established at Hamburg in 1671. In the Dutch language the words *ratel*, *ratelaar*, *ratelen*, *ratelmann*, *ratelwagter* (a night-watchman), are quite common.

470 Stanihurst De Rebus in Hibernia Gestis, lib. i. p. 33.

471 Leges Walliæ. Lond. 1730, fol.

472 The person whose turn it was to watch at the gates, was obliged to perform the duty himself, or to cause it to be performed by a fit and proper young citizen. Those who attended to trade and neglected the watch, paid for every omission one mark to the council. The case was the same with the watch on the tower in the market-place.

473 In the Berlin police ordinance of the year 1580, it was ordered that the *Raths-thurn oder Hausmann*, steeple-watchman or city-musician, should attend at weddings with music for the accustomed pay, but only till the hour of nine at night, in order that he might then blow his horn on the steeple, and place the night-watch.

474 Martini Atlas Sinens. p. 17. Matches or links, to which alarums are sometimes added, are employed in China to point out the hours; and these are announced by watchmen placed on towers who beat

a drum. See Kæmpfer's Japan, where the mention of matches is omitted. Thunberg says, "Time is measured here not by clocks or hour-glasses, but by burning matches, which are plaited like ropes, and have knots on them. When the match burns to a knot, which marks a particular lapse of time, the hour is announced, during the day, by a certain number of strokes on the bells in the temples; and in the night by watchmen who go round and give a like signal with two pieces of board, which they knock against each other."

475 A great deal of important information, which is as yet too little known, has been collected on this subject by Reiske, on Constantini Lib. de Ceremoniis Aulæ Byzant. ii. p. 74.

476 This is related in the Oettingisches Geschichts-almanach, p. 7, on the authority of an account in the parish books of Oettingen, said to be extracted from an ancient chronicle of that town. The author of this almanac, which is now little known, was, as I have been told, Schablen, superintendant at Oettingen.

PLANT-SKELETONS.

Plants, as well as animals, are organised bodies, and like them their parts may be dissected and decomposed by art; but the anatomy of the former has not been cultivated so long and with so much zeal and success as that of animals. Some naturalists, about the beginning of the last century, first began to make it an object of attention, to compare the structure of plants with that of animals; and for that purpose to employ the microscope. Among these, two distinguished themselves in a particular manner; Marcellus Malpighi, an Italian; and Nehemiah Grew, an Englishman; who both undertook almost the same experiments and made them known at the same time; so that it is impossible to determine which of them was the earlier. It appears, however, that Grew published some of his observations a little sooner; but Malpighi was prior in making his known in a complete manner. But even allowing that the one had received hints of the processes of the other, they are both entitled to praise that each made experiments of his own, and from these prepared figures, which are always more correct the nearer they correspond with each other.

Among the various helps towards acquiring a knowledge of the anatomy of plants, one of the principal is the art of reducing to skeletons leaves, fruit and roots; that is, of freeing them from their soft, tender and pulpy substance, in such a manner, that one can survey alone their internal, harder vessels in their entire connexion. This may be done by exposing the leaves to decay for some time soaked in water, by which means the softer parts will be dissolved, or at least separated from the internal harder parts, so that one, by carefully wiping, pressing and rinsing them, can obtain the latter alone perfectly entire. One will possess then a tissue composed of innumerable woody threads or filaments, which, in a multiplicity of ways, run through and intersect each other. By sufficient practice and caution one may detach, from each side of a leaf, a very thin covering, between which lies a delicate web of exceedingly tender vessels. These form a woody net-work, between the meshes of which fine glandules are distributed. This net

is double, or at least can be divided lengthwise into halves, between which may be observed a substance that appears as it were to be the marrow of the plant. Persons who are expert often succeed so far, with many leaves, as to separate the external covering on both sides from the woody net, and to split the latter into two, so that the whole leaf seems to be divided into four.

One might conjecture that this method of reducing leaves to skeletons must have been long known, as one frequently finds in ponds leaves which have dropped from the neighbouring trees, and which by decomposition, without the assistance of art, have been converted into such a woody net-work, quite perfect and entire. It is however certain that a naturalist, about the year 1645, first conceived the idea of employing decomposition for the purpose of making leaf-skeletons, and of assisting it by ingenious operations of art.

This naturalist, Marcus Aurelius Severinus, professor of anatomy and surgery at Naples, was born in 1580, and died of the plague in 1656. In his Zootomia Democritæa, printed in 1645, he gave the figure, with a description of a leaf of the *Ficus Opuntia* reduced to a skeleton. Of the particular process employed to prepare this leaf, the figure of which is very coarse and indistinct, he gives no account. He says only that the soft substance was so dissolved that the vessels or nerves alone remained; and that he had been equally successful with a leaf of the palm-tree. A piece of a leaf of the like kind he sent by Thomas Bartholin to Olaus Wormius, who caused it to be engraved on copper, in a much neater manner, without saying anything of the method in which it had been prepared[477]. The process Severin kept secret; but he communicated it to Bartholin, in a letter, on the 25th of February 1645, on condition that he would not disclose it to any one. At that period, however, it excited very little attention, and was soon forgotten, though in the year 1685 one Gabriel Clauder made known that he had reduced vine-leaves, the calyx of the winter cherry, and a root of hemlock, to a net or tissue by burying them in sand during the heat of summer, and hanging them up some months in the open air till they were completely dried.

This art was considered to be of much more importance when it was again revived by the well-known Dutchman, Frederick Ruysch. That naturalist found means to conduct all his undertakings and labours in such a

manner as to excite great wonder; but we must allow him the merit of having brought the greater part of them to a degree of perfection which no one had attained before. By the anatomy of animals, in which he was eminently skilled, he was led to the dissection of plants; and as it seemed impossible to fill their tender vessels, like those of animals, with a coloured solid substance[478], he fell upon a method of separating the hard parts from the soft, and of preserving them in that manner.

For this purpose he first tried a method which he had employed with uncommon success, in regard to the parts of animals. He covered the leaves and fruit with insects, which ate up the soft or pulpy parts, and left only those that were hard. But however well these insects, which he called his little assistants, may have executed their task, they did not abstain altogether from the solid parts, so that they never produced a complete skeleton. He dismissed them, therefore, and endeavoured to execute with his own fingers what he had before caused the insects to perform, after he had separated the soft parts from the hard by decomposition. In this he succeeded so perfectly, that all who saw his skeletons of leaves or fruit were astonished at the fineness of the work and wished to imitate them.

I cannot exactly determine the year in which Ruysch began to prepare these skeletons. Trew thinks that it must have been when he was in a very advanced age, or at any rate after the year 1718; for when he was admitted to Ruysch's collection in that year, he observed none of these curiosities. Rundmann, however, saw some of them in his possession in the year 1708[479]. At first Ruysch endeavoured to keep the process a secret, and to evade giving direct answers to the questions of the curious. We are informed by Rundmann, that he attempted to imitate his art by burying leaves at the end of harvest in the earth, and leaving them there till the spring, by which their soft parts became so tender that he could strip them off with the greatest ease. He produced also the same effect by boiling them.

The first account which Ruysch himself published of his process, was, as far as I know, in the year 1723. After he had sufficiently excited the general curiosity, he gave figures of some of his vegetable skeletons, related the whole method of preparing them, and acknowledged that he had accidentally met with an imperfect engraving of a leaf-skeleton in the

Museum of Wormius, which had at one time occasioned much wonder[480]. It is not improbable that he knew how the Italian, whom he does not mention, though he is mentioned by Wormius, and though he must certainly have been acquainted with his Zootomia, prepared his skeletons. I must however observe, that it is remarked by those who knew Ruysch, that he had read few books, and was very little versed in the literature of his profession.

In the year following, Ruysch described more articles of the like kind, and gave figures of some pears prepared in this manner. In 1726, when Vater, professor at Wittenberg, expressed great astonishment at the fineness of his works, he replied, in a letter written in 1727, that he had at first caused them to be executed by insects, but that he then made them himself with his fingers[481]. He repeated the same thing also in 1728, when he described and gave engravings of more of these curious objects[482]. The progress of this invention is related in the same manner by Schreiber, in his Life of Ruysch.

When the method of producing these skeletons became publicly known, they were soon prepared by others; some of whom made observations, which were contrary to those of Ruysch. Among these in particular were J. Bapt. Du Hamel, who, so early as the year 1727, described and illustrated with elegant engravings the interior construction of a pear[483]; Trew[484], in whose possession Keysler saw such skeletons in 1730; P. H. G. Mohring[485]; Seba[486]; Francis Nicholls[487], an Englishman; Professor Hollmann[488] at Göttingen, Ludwig[489], Walther[490], Gesner[491] and others. Nicholls seems to have been the first who split the net of an apple- or a pear-tree leaf into two equal parts, though Ruysch split a leaf of the opuntia into three, four, and even five layers, as he himself says.

In the year 1748, Seligmann, an engraver, began to publish, in folio plates, figures of several leaves which he had reduced to skeletons[492]. As he thought it impossible to make drawings sufficiently correct, he took impressions from the leaves or nets themselves, with red ink, and in a manner which may be seen described in various books on the arts. Of the greater part he gave two figures, one of the upper and another of the under side. He promised also to give figures of the objects as magnified by a solar

microscope; and two plates were to be delivered monthly. Seligmann however died soon after, if I am not mistaken; and a lawsuit took place between his heirs, by which the whole of the copies printed were arrested, and for this reason the work was never completed, and is to be found only in a very few libraries.

Cobres says that eight pages of text, with two black and twenty-nine red copper-plates, were completed. The copy which is in the library of our university has only eight pages of text, consisting partly of a preface by C. Trew, and partly of an account of the author, printed in Latin and German opposite to each other. Trew gives a history of the physiology of plants and of leaf-skeletons; and Seligmann treats on the methods of preparing the latter. The number of the plates however is greater than that assigned by Cobres. The copy which is now before me contains thirty-three plates, printed in red; and besides these, two plates in black, with figures of the objects magnified. Of the second plate in red, there is a duplicate with this title, “Leaves of a bergamot pear-tree, the fruit of which is mild;” but the figures in both are not the same; and it appears that the author considered one of the plates as defective, and therefore gave another. The leaves represented in the plates are those of the orange-tree, lemon-tree, shaddock-tree, butcher’s-broom, walnut-tree, pear-tree, laurel, lime-tree, ivy, medlar, chestnut-tree, maple-tree, holly, willow, white hawthorn, &c.

I shall take this opportunity of inserting here the history of the art of raising trees from leaves. The first who made this art known was Agostino Mandirola, doctor of theology, an Italian minorite of the Franciscan order. In a small work upon Gardening, which, as I think, was printed for the first time at Vicenza, in duodecimo, in the year 1652, and which was reprinted afterwards in various places, he gave an account of his having produced trees from the leaves of the cedar- and lemon-tree[493]; but he does not relate this circumstance as if he considered it to be a great discovery. On the contrary, he appears rather to think it a matter of very little importance. His book was soon translated into German; and his account copied by other writers, such as Böckler[494] and Hohberg[495], who were at that time much read. A gardener of Augsburg, as we are told by Agricola, was the first who imitated this experiment, and proved the possibility of it to others. He is

said to have tried it with good success in the garden of count de Wratislau, ambassador at Ratisbon from the elector of Bohemia.

But never was this experiment so often and so successfully repeated as in the garden of baron de Munchhausen, at Swobber. A young tree was obtained there from a leaf of the *Limon a Rivo*, which produced fruit the second year. It was sent to M. Volkamer, at Nuremberg, who caused a drawing to be made from it, which was afterwards engraved, in order that it might be published in the third volume of his Hesperides; but as the author died too early, it was not printed. The exact drawing, as it was then executed at Nuremberg, and an account of the whole process employed in the experiment at Swobber, have been published by the baron de Munchhausen himself, from authentic papers in his grandfather's own writing[496].

No one, however, excited so much attention to this circumstance as the well-known George Andrew Agricola, physician at Ratisbon, who, with that confidence and prolixity which were peculiar to him, ventured to assert that trees could be propagated in the speediest manner by planting the leaves, after being steeped in a liquor which he had invented; and for the truth of his assertion he referred to his own experiments[497]. Among the naturalists of that period none took more trouble to examine the possibility of this effect than Thummig[498], who endeavoured to prove that not only leaves with eyes left to them, could, in well-moistened earth, throw out roots which would produce a stem, but that leaves also without eyes would grow up to be trees. Baron Munchhausen, on the other hand, assures us, that according to the many experiments made in his garden, one can only expect young plants from the leaves of those trees which do not bring forth buds; that experiments made with the leaves of the lemon-tree had alone succeeded, but never those made with the leaves of the orange- or lime-tree; and that Agricola and Thummig had erroneously imagined that the leaves themselves shot up into trees, their middle fibre (*rachis*) becoming the stem, and the collateral fibres the branches. But the leaf decays as soon as it has resigned all its sap to the young tree, which is springing up below it.

To conclude: It is probable that the well-known multiplication of the Indian fig, or *Opuntia*, gave the first idea of this experiment; for every joint

of that plant, stuck into the earth, and properly nurtured, throws out roots and grows. As these joints were commonly considered to be leaves, people tried whether other leaves would not grow in the like manner. Luckily, those of the lemon-tree were chosen for this purpose; and what was expected took place. Thus from a false hypothesis have new truths often been derived; and thus was Kepler, by a false and even improbable opinion, led to an assertion, afterwards confirmed, that the periodical revolutions of the planets were in proportion to their distance from the sun. But the raising of trees from leaves was too rashly declared to be a method that might be generally employed; for it is certain that it now seldom succeeds.

[Beckmann certainly overrates the value of these plant-skeletons in assisting the acquirement of a knowledge of the anatomy of plants. By macerating plants in water, all but the woody fibres are decomposed by the putrefactive fermentation which ensues. From an examination of these, a knowledge of structure merely is attainable, which may be now truly said to be thoroughly understood. It gives us no insight into its functions. The modern microscope has revealed to us the structure of all the components of vegetable tissues, and has most materially assisted in developing the functions of several; many, however, remain in the hands of the physiologist. Nevertheless, these plant-skeletons exhibit the true course and arrangement of the woody fibres, and form most beautiful objects. The leaves are not the only parts which can be thus prepared; the petals of many plants are even more delicate and beautiful in their ligneous structure, as evidenced in the hydrangea and several others. Their preparation is exceedingly simple, but tedious, and can only be well effected by maceration in water, which frequently requires to be considerably prolonged. The pulpy half-decomposed portions are gradually removed by a camel-hair pencil, or other means, with great delicacy and care; they are finally washed and bleached, if necessary, with chloride of lime or soda. By washing in considerably diluted muriatic acid and water, all traces of this reagent are removed; they are then dried, and will keep for an indefinite period.]

FOOTNOTES

[477] Museum Wormianum. Lugd. Bat. 1655, fol. p. 149.

[478] The well-known Sir John Hill, an Englishman, has proved, however, in later times, the possibility of injecting a substance into the vessels of plants also. He dissolved sugar of lead in water, suspended in it bits of the finest wood, so that one-half of them was under water and the other above it, and covered the vessel in which they were placed with an inverted glass. At the end of two days he took the bits of wood out, cut off the parts which had been immersed in the water, dipped them in a warm lye made of unslaked lime and orpiment, like what was used formerly for proving wine; and by these means the finest vessels, which had been before filled with sugar of lead, acquired a dark colour, and their apertures became much more distinct. This process he describes himself in his work on the Construction of Timber.

[479] Rariora Naturæ et Artis. Breslau and Leipsic, 1737, fol. p. 421.

[480] Adversariorum decas iii. in Ruyschii Opera Omnia Anat. Med.

[481] A. Vateri Epist. ad Ruyschium de Musculo Orbiculari, 1727. Of employing different kinds of insects, particularly the *dermestes*, as they are called, for reducing animal and vegetable bodies to skeletons, Hebenstreit has treated in Program. de Vermibus Anatomicorum administris. Lips. 1741. Figures of the insects and of some of their preparations are added.

[482] Acta Eruditorum, 1729, Febr. p. 63.

[483] Mémoires de l'Acad. des Sciences, ann. 1730, 1731, 1732.

[484] Commerc. Litter. Norim. 1732, p. 73.

[485] Ib.

[486] Phil. Transact. 1730, ccccxvi. p. 441.

[487] Ib. ccccxiv. p. 371.

488 Ib. cccclxi. p. 789, and cccclxiii. p. 796.—Commerc. Litter. Norimb. 1735, p. 353.

489 Institutiones Regni Vegetabil. In the part on Leaves.

490 Programma de Plantarum Structura. Lips. 1740, 4to, § 5, 6.

491 Dissertat. Phys. de Vegetabilibus, printed with Linnæi Orat. de Necessitate Peregrinat. intra Patriam. Lugd. B. 1743.

492 Die Nahrungs-Gefässe in den Blättern der Bäume. Nurnb. 1748.

493 Many editions of this book may be found mentioned in Halleri Bibl. Botan. i. p. 484; Böhmeri Bibl. Hist. Nat. iii. p. 679.

494 Haus- und Feld-Schule, i. 26.

495 Georgica Curiosa, i. p. 787.

496 Hausvater, vol. v. p. 662.

497 Versuch der Universal-vermehrung aller Bäume. Regensb. 1716, fol., or the edition by Brauser. Regensb. 1772.

498 Thummigii Meletemata. Brunsw. 1727, 8vo, p. 5.

BILLS OF EXCHANGE.

I shall not here repeat what has been collected by many learned men respecting the important history of this noble invention, but only lay before my readers an ordinance of the year 1394, concerning the acceptance of bills of exchange, and also two bills of the year 1404, as they may serve to illustrate further what has been before said on the subject by others. These documents are, indeed, more modern than those found by Raphael de Turre[499] in the writings of the jurist Baldus[500], which are dated March 9, 1328; but they are attended with such circumstances as sufficiently prove that the method of transacting business by bills of exchange was fully established so early as the fourteenth century; and that the present form and terms were even then used. For this important information I am indebted to Von Martens, who found it in a History, written in Spanish, of the maritime trade and other branches of commerce at Barcelona, taken entirely from the archives of that city, and accompanied with documents from the same source, which abound with matter highly interesting[501].

Among these is an ordinance issued by the city of Barcelona in the year 1394, that bills of exchange should be accepted within twenty-four hours after they were presented; and that the acceptance should be written on the back of the bill[502].

In the year 1404, the magistrates of Bruges, in Flanders, requested the magistrates of Barcelona to inform them what was the common practice, in regard to bills of exchange, when the person who presented a bill raised money on it in an unusual manner, in the case of its not being paid, and by these means increased the expenses so much that the drawer would not consent to sustain the loss. The bill which gave occasion to this question is inserted in the memorial. It is written in the short form still used, which certainly seems to imply great antiquity. It speaks of usance; and it appears

that first and second bills were at that time drawn, and that when bills were not accepted, it was customary to protest them.

[It may not, perhaps, be uninteresting to the reader to give a short account of the present mode of conducting transactions of bills of exchange; this we condense from Waterston's Encyclopædia of Commerce, which contains the most recent and practical account.

The individual who issues the bill is called the drawer, the person to whom it is addressed the drawee, until he consent to honour the draft or obey the order or bill, by writing his name on the face of it, after which he is called the acceptor. The bill may be passed from hand to hand by delivery or *indorsation*, and in the latter case the person who makes over is called the indorser, and the person who receives the indorsee. The indorser commonly puts his name on the back, with or without a direction to pay to a particular person. He who is in legal possession of the bill and the obligation contained in it, is called the holder or the payee. There is no particular form for a bill of exchange required by law, further than that the mandate to pay in money be distinct, and the person who is to pay, the person who is to receive, and the time of payment shall be ascertainable beyond a doubt. By special statute in England, all bills under 20*s.* are void; and those between that sum and £5 must be made payable within twenty-one days after date, contain the name and description of the payee, and bear date at the time of making. Bills of exchange must be on a proper stamp.

Bills, though they are of the nature of a "chose in action," which is not strictly assignable, may be transferred from hand to hand or negociated. To allow of this, there must be negotiable words, as "or order" or "bearer." The various parties upon a bill, besides the acceptors, indorsers, drawers and others, become liable for its payment on failure of the acceptor.

Bills of exchange cease in England to be documents of debt on the expiration of six years from the time named for payment.

In foreign bills, the term "usance" is sometimes employed to express the period of running in foreign bills. It means a certain time fixed by custom, as between any two places. An usance between this kingdom and Rotterdam, Hamburg, Altona, or Paris, or any place in France, is *one* calendar month from the date of the bill; an usance between us and Cadiz,

Madrid or Bilboa, *two*; an usance between us and Leghorn, Genoa, or Venice, *three*.]

FOOTNOTES

499 Disp. i. quæst. 4. n. 23.

500 Consil. 348.

501 Memorias Historicas sobre la Marina Commercio, etc. de Barcelona, por D. Ant. de Capmany. Madrid, 1779, 2 vols. 4to. The following important articles will be found in this work:—A custom-house tariff, written in Latin, of the year 1221, in which occur a great number of remarkable names and articles of merchandise not explained. Another of the like kind, of the year 1252. Letters of power to appoint consuls in distant countries, such as Syria, Egypt, &c., dated in the years 1266, 1268, and 1321. An ordinance of the year 1458, respecting insurance, which required that under-writing should be done in the presence of a notary, and declared *polices o scriptures privades* to be null and void. A *privilegium* of the emperor Andronicus II. to the merchants of Barcelona, written in Greek and Spanish, in 1290. Account of the oldest Spanish trade with wool, silk, salt, and saffron; and of the oldest guilds or incorporated societies of tradesmen at Barcelona, &c.

502 Vol. ii. p. 382.

TIN. TINNING.

It is generally believed that the metal called at present tin was known and employed in the arts, not only in the time of Pliny, but as early as that of Herodotus, Homer, and Moses. This I will not venture to deny; but I can only admit that it is probable, or that the great antiquity of this metal cannot be so fully proved as that of gold, silver, copper, iron, lead, and quicksilver.

Tin is one of those minerals which hitherto have been found in quantity only in a few countries, none of which ever belonged to the Greeks or the Romans[503], or were visited, at an early period, by their merchants. As it never occurs in a native state[504], the discovery of it supposes some accident more extraordinary than that of those metals which are commonly, or at any rate, often found native. I cannot, however, attach much importance to this circumstance, as the ancients became acquainted with iron at an early period, though not so early as with copper. I must also admit that tin might have been more easily discovered, because it is frequently found near the surface of the earth; does not require a strong heat or artificial apparatus for fusing it, and therefore can be more easily won than copper.

But if tin was known so early as has hitherto been believed, it must, on account of the circumstance here first remarked, have been scarce and therefore exceedingly dear. In this manner the aurichalcum or Corinthian brass, according to the expression of Plautus, was “auro contra carum.” The metal of the ancients, however, which is believed to have been tin, was not so rare and costly. Vessels of it are not often mentioned, in general; but they never occur among valuable articles. The circumstance also, that vessels of tin have never or very seldom been found among Greek or Roman antiquities, and that when discovered the nature of the metal has been very doubtful, though tin is not apt to change from the action of the air, water, or earth, and at any rate far surpasses in durability copper and lead, ancient articles made of which are frequently found, appears to me worthy of

attention. It possesses also so many excellent properties, that it might be expected that the people of every age, to whom it was known, would have employed it in a great variety of ways. It recommends itself by its superior silvery colour; its ready fusion; the ease with which it can be hammered and twisted; its lightness, and its durability. It is not soon tarnished; it is still less liable to rust or to become oxidized; it retains its splendour a long time, and when it is lost easily recovers it again. It is not so soon attacked by salts as many other metals; and this till lately has been considered a proof of its being less pernicious than it possibly may be. After an accurate investigation, should everything said by the ancients of their supposed tin be as applicable to a metallic mixture as to our tin, my assertion, that it is probable, but by no means certain, that the ancients were acquainted with our tin, will be fully justified.

The oldest mention of this metal, as generally believed, is to be found in the sacred scriptures. In the book of Numbers, chap. xxxi. ver. 22, Moses seems to name all the metals then known; and, besides gold, silver, brass (properly copper), iron, and lead, he mentions also *bedil*, which all commentators and dictionaries make to be tin. When Ezekiel, chap. xxvii. ver. 12, gives an account of the commerce of Tyre, he names, among the commodities, silver, iron, copper, and *bedil*. In Zechariah, chap. iv. ver. 10, the plummet of the builder or architect is said to be made of the *bedil* stone. In Isaiah, chap. i. ver. 25, the word occurs in the plural number, and appears there to denote either scoriæ, or all those inferior metallic substances which must be separated from the noble metals. In the old Greek versions of these Hebrew books, *bedil* is always translated by *cassiteros*, except in the passage of Isaiah, where no metal is mentioned. In Zechariah, the translator calls the *bedil* stone τὸν λίθον κασσιτέρινον. There can hardly be a doubt, that for the purpose here mentioned, people would employ, not the lighter metal tin, but lead, and that the plummet was called the lead-stone, because at first a stone was used.

It seems, however, probable that in the first-quoted passage *bedil* is our tin; but must it not appear astonishing that the Midianites, in the time of Moses, should have possessed this metal? Is it not possible that the Hebrew word denoted a metallic mixture or artificial metal, which formerly was an article of commerce, as our brass is at present[505]?

The Greek translators considered *bedil* to be what they called *cassiteros*; and as the moderns translated this by *stannum*, these words have thus found their way into the Latin, German, and other versions of the Hebrew scriptures, which therefore can contribute very little towards the history of this metal. The examination of the word *cassiteros* would be of more importance; but before I proceed to it, I shall make some observations on what the ancients called *stannum*.

This, at present, is the general name of our tin; and from it seem to be formed the *estain* of the French, the *tin* of the Low German and English, and the *zinn* of the High German. It can, however, be fully proved that the *stannum* of the ancients was no peculiar metal; at any rate not our tin, but rather a mixture of two other metals, which, like our brass, was made into various articles and employed for different purposes, on which account a great trade was carried on with it. This, at least, may with great certainty be concluded from a well-known passage of Pliny[506]; though to us, because we are not fully acquainted with the metallurgic operations of the ancients, it is not sufficiently intelligible. What I have been able to collect, however, towards illustrating the passage, with the assistance of my predecessors, and by comparing myself the account of the Roman with our works, I shall here lay before the reader; and perhaps it may induce others to improve and enlarge it.

But I must first observe, that there can be no doubt that the *nigrum plumbum* of the ancients was our lead. This metal, according to Pliny's account, they obtained in two ways. First, from their own lead mines or lead ore, which immediately on its fusion gave pure or saleable lead. To comprehend this, it is necessary to know that most kinds of lead ore contain also silver, and many of them in such quantity that they might with more propriety be called silver ores, or rather argentiferous lead ores or plumbiferous silver ores. Those which contain no silver are so scarce, that I am ignorant whether any other has yet been found, except that of Bleyberg, not far from Villach, in Carinthia. As Villach lead, according to some experiments made on a large scale, is entirely free from silver, it is well-known, and particularly useful for assaying.

It may therefore appear singular that the ancients had lead of this kind in such abundance that Pliny was able to make of it a particular division.

But it is to be observed, that in ancient times people paid little attention to a small admixture of silver; and that they were accustomed to separate this metal only when it was capable, by the old imperfect process of smelting, to defray the expenses, which certainly would not be the case, when a quintal of ore contained only a few ounces, or even a pound of silver. Strabo says this expressly of some Spanish ores. Such poor ores were then used merely for lead; and our silver refiners, without doubt, would separate silver with considerable advantage from the lead of the ancients. Hence has arisen the common opinion, that lead and also copper, with which some of the oldest buildings are covered, had in the course of time become argentiferous. This is impossible; but it is possible for us to separate from them the noble metal, which the ancients either could not do, or did not think it worth the trouble to attempt.

Secondly, the ancients obtained, as we do, a great deal of lead from argentiferous ores, from which they separated the silver and revived the lead. The ore was pounded very fine, or, as we say, stamped; it was then washed and roasted, and formed into a powder or paste. This was then put into the furnace, and by the first fusion gave a regulus consisting of silver and lead, which was called *stannum*, and was the same substance as that known to our metallurgists by the name of *werk*. If it was required to separate the silver, it was again fused, not in the first furnace, but in a particular refining furnace with a hearth of lixiviated ashes. This circumstance Pliny has not mentioned; perhaps it appeared to him unnecessary; perhaps he did not fully understand every part of the process; and were one inclined to say anything in his defence, modern travels and other works might be quoted, in which metallurgic operations are described in a manner no less imperfect. The produce obtained by the second fusion, called in German *treiben* or *abtreiben*, was silver, and besides that half-vitrified lead, *glätte*, which in part falls into the hearth. This substance, called by Pliny *galena*, a word which denotes also *molybdæna*[507], was once more fused or revived, and then gave lead. In this manner were obtained three different productions, which were all used in commerce, namely, *stannum*, *argentum* and *galena*, or revived lead, *plumbum nigrum*. These Pliny seems to have considered as component parts of lead ore; but not indeed according to the present signification[508].

Though it must be confessed that this passage of Pliny cannot be fully understood by any explanation, it proves to conviction that the *stannum* of the ancients was neither our tin nor a peculiar metal, but the *werk* of our smelting-houses. This was long ago remarked by those writers who were acquainted with metallurgy, of whom I shall here mention Agricola[509], Encelius[510], Fallopius[511], Savot[512], Bernia[513], and Jung[514].

The ancients used, as a peculiar metal, a mixture of gold and silver, because they were not acquainted with the art of separating them, and afterwards gave it the name of *electrum*. In the like manner they employed *werk* or *stannum*, which was obtained almost in the same manner in the fusion of silver. In all probability it was employed before people became acquainted with the art of separating these two metals, and continued in use through habit, even after a method of separating them was discovered. If the ore subjected to fusion was abundant in silver, this mixture approached near to the noble metals; if poor in silver, it consisted chiefly of lead. When it consisted of silver and lead only, it was soft and ductile; but if other metals, difficult of fusion, such as copper, iron, or zinc, were intermixed, it was harder and more brittle, and in that case approached nearer to what the German silver refiners call *abzug* and *abstrich*.

That this *stannum* was employed as an article of commerce, and that the ancients made of it vessels of various kinds, cannot be doubted. The *vasa stannea* however may be considered as vessels which were covered with tin only in the inside; for that this was customary I shall prove hereafter. In general, these *vasa stannea* are named where mention is made of saline or oily things, or such as would readily acquire a taste and smell from other metals, were they boiled or preserved in them for any length of time[515].

It has been long ago remarked that most of the Roman vessels were made of copper, and that these people were acquainted with the art of tinning or silvering them; but that tinned vessels have never been found, and silvered ones very rarely. Hence so many things appear to have been made of what is called *bronze*, which is less liable to acquire that dangerous rust or oxide, known under the name of verdigris, than pure copper. This bronze is sometimes given out as Corinthian and sometimes Syracusan

brass, as the gold-coloured coins of the first size were considered to be Corinthian brass also. But in my opinion, a great and perhaps the greater part of all these things were made of *stannum*, properly so called, which by the admixture of the noble metals, and some difficult of fusion, was rendered fitter for use than pure copper. We are told by Suetonius, that the emperor Vitellius took away all the gold and silver from the temples and substituted in their stead *aurichalcum* and *stannum*[516].

Whether the Greeks worked *stannum*, and under what name, I do not know: perhaps we ought to class here the κασσιτέρινα of the oldest times, of which I shall speak hereafter.

What I have already said in regard to *werk* will be rendered more certain by the circumstance, that even two centuries ago, vessels of all kinds called *halbwerk* were made of it in Germany. This we are told by Encelius[517] as a thing well-known in his time, which however I should wish to see further examined. I have searched in vain for this name in a great many works of the sixteenth century; but I have long entertained an idea, which I shall take this opportunity of mentioning:—Among the oldest church vessels I have seen some articles which I considered to be *vasa stannea*, I mean such as when newly scoured and polished had a silvery brightness, and when they remained long without being cleaned acquired a dull gray colour, and a greater weight than bronze. Those who show these things commonly say that the method of composing the metal is lost; but that it contains silver, and according to the assertion of many, even gold. Such articles deserve, undoubtedly, to be examined by our chemists.

I shall further remark, on this subject, that the *abstrich*, as it is called, which in many respects has a resemblance to *stannum*, and contains also lead and silver, but at the same time metals difficult of fusion, is employed in the arts, and collected for the use of the letter-founders[518]. For this purpose it is well-adapted, on account of its hardness and durability; and in want of it lead must be mixed with regulus of antimony. At the Lower Harze the workmen began so early as 1688 to revive this *abstrich* in particular; and as the lead thence obtained, on account of its hardness, could not be disposed of like common lead, it was sold to the letter-founders at Brunswick, at first at the rate of a hundred weight for two and a half dollars,

and in the year 1689 for three dollars. But in Schlüter's time a small quantity of it only was made annually, because the *abstrich* could be used with more advantage for other purposes. This lead, says Schlüter, had the appearance of bronze, and was so brittle, that a piece of it broke into fragments when struck[519].

Speise also, which is obtained at the blue colour-works, can be employed in the same manner. Under this term is understood a metallic mixture deposited during the preparation of blue glass, and which is composed of various metals combined with cobalt, but particularly nickel, iron, copper, arsenic, and perhaps also bismuth. It is hard, brittle, sonorous, and assumes a good polish, though it is not always of the same quality in all manufactories. As it contains some colouring particles, it is in general again added to the glass residuum. But when I lately paid a visit to the colour-mill at Carlshafen, M. Birnstein the inspector told me, that the *speise* was manufactured at Halle into buttons of every kind. This probably is the case there in those button-manufactories established by G. H. Schier, in which buttons of all patterns are made annually to the value of 30,000 dollars[520]. The ancients, in my opinion, employed in a similar manner the *werk* of their silver smelting-houses.

I shall now proceed to examine that metal which the Greeks named κασσίτερος, or, as Pliny says, *Cassiteron*, and which he expressly adds was called by the Latins *plumbum candidum* (white lead). I have no new hypothesis to recommend; my sole object is truth. I wish for certainty, and, when that is not to be obtained, probability; at the same time, however, I cannot rest satisfied with the judgement given by the compilers of dictionaries, and the translators and commentators of ancient authors, because I firmly believe that they never made any researches themselves on the subject.

That the ancients were acquainted with our tin as early as we find the word *cassiteros* mentioned by them, I am not able to prove, and I doubt whether it is possible to do so; the contrary seems to me to be more probable. In my opinion, it was impossible for the Phœnicians, at so early a period, to obtain this metal from Portugal, Spain, and England, in such quantity that it could be spread all over the old world. The carriage of merchandise was not then so easy. If all the *cassiteron* was procured from

the north-west parts of Europe, it appears to me that it must have been much dearer than it seems to have been in the oldest times, to judge from the information that has been preserved.

In my opinion, the oldest *cassiteron* was nothing else than the *stannum* of the Romans, the *werk* of our smelting-houses, that is, a mixture of lead, silver, and some other accidental metals. That this has not been expressly remarked by any Greek writer, is to me not at all surprising. The works of those who might be supposed to have possessed knowledge of this kind have not been handed down to us. We should not have known what *stannum* was, had not the only passage of Pliny which informs us been preserved. I am as little surprised that Herodotus should say he did not know where *cassiteron* was obtained. How many modern historians are ignorant of the place from which zinc, bismuth, and tombac are brought! and however easy it might be for our historians to acquire knowledge of this kind if they chose, it was in the same degree difficult for Herodotus, in whose time there were not works on mineralogy, technology, and commerce, to furnish such information. At the period when he lived, *cassiteron* perhaps was no metallurgic production of any neighbouring mines, but a foreign commodity, a knowledge of which, mercantile people endeavoured in those early ages, much more than is the case in modern times, to conceal, and which also could be better concealed than at present.

That real tin was afterwards known to the Greeks, I readily believe; but I find no proof of it, nor can I determine the time at which they first became acquainted with this metal. It is not improbable that they considered it only as a variety of their old *cassiteron*, or the *stannum* of the Romans, as the latter declared both to be a variety of lead. It might be expected that the Greeks would have given a peculiar name to the new tin, in order to distinguish it from the old, as the Romans really did; but this appears not to have been the case. I think, however, to have remarked that, so early as the time of Aristotle, real foreign tin was called the Tyrian or Celtic, because Tyre undoubtedly was, at that period, the market for this commodity.

According to the conjectural accounts hitherto given, there is no necessity for believing the word *cassiteron* to be Phœnician or Celtic. The Greeks seem to have used it before they had Phœnician tin; and because they afterwards considered the Phœnician ware as a kind of their *cassiteron*, and at the same time heard of islands from which it was brought, they

named these islands the *Cassiterian*, as Herodotus has done, though he expressly says that he did not know where they were situated. This ancient historian seems to have entertained nearly the same opinion in regard to the origin of the name, for he adds, "At any rate the name Eridanus is not foreign, but originally Greek[521]." It is, however, very possible that every thing said of these islands, in the time of Herodotus, was merely a fabrication of the Greek merchants, none of whom had the least knowledge of the Phœnician trade to England[522]. In this case the *bedil* of the Hebrews might be only *stannum*, and thus would be removed the wonder of Michaelis, how the Midianites could have obtained tin so early[523]. I will not, however, deny that the contrary of what has been here stated is equally possible. The Greeks might have obtained real tin at a very early period by trade, and along with it the foreign name, from which was formed *cassiteros*. The art of preparing *stannum* may not have been known among them, and therefore under the *cassiteron* of the Greeks we must undoubtedly understand tin. In this case one could comprehend why *stannum* is not mentioned in the works of the Greeks; and if the *plumbum album* of Pliny be our tin, of which there can be scarcely a doubt, his testimony that the *cassiteron* of Homer was the same belongs to this place.

In regard to the question, which opinion seems the most probable, I will not enter into any dispute; but I must maintain that, in regard to the periods of Homer and Herodotus, no certainty can be obtained. To justify this assertion, I shall here point out everything I have found relating to *cassiteron*, and, as far as possible, in the original words, quoting the different works in the manner in which all the words for dictionaries of natural history ought to be arranged.

I. Vocatur Latinis *plumbum candidum*[a] sive *album*[a b], et Græcis jam Iliacis temporibus teste Homero *cassiteron*[a].

II. *Mineræ* (calculi) coloris nigri, quibus eadem gravitas quæ auro[a].

III. Non nascitur cum argento, quod ex nigro fit[a].

IV. Nascitur summa tellure arenosa[a]; sed etiam ex profunda effoditur[h].

V. Arenæ istæ lavantur a metallicis, conflatæque in album plumbum resolvuntur[a].

VI. Plumbum candidum est pretiosius nigro[a].

VII. Facile in igne fluit, ita ut plumbi albi experimentum in charta sit, ut liquefactum pondere videatur, non calore rupisse[a c]. *Celticum* citius quam plumbum fluit, atque adeo in aqua; colore inficit, quæcunque tangat[c].

VIII. Nulli rei sine mixtura utile[a].

IX. Adulteratur plumbo nigro[d].

X. Stannum adulteratur addita æris candidi tertia portione in plumbum album[a].

XI. Incoquitur æris operibus, Galliarum invento, ita ut vix discerni possit ab argento, eaque *incoctilia* vocant[a].

XII. Adhibetur ad ocreas heroum[p]; ad thoraces exornandos[q r]; ad scuta ornanda[s t]; ad specula[y].

XIII. Ex eo nummos percussit Dionysius tyrannus Syrac.[u v].

XIV. Secum jungi nequit sine plumbo nigro, nec plumbum nigrum inter se jungi potest sinealbo[a x].

XV. Gignitur in *Hispania*[h]; Lusitania[a h] Gallæcia[a], in Iberia[k l], apud Artabros[h], in *Britannia*[j]: in insulis quæ Cassiterides dictæ sunt Græcis[e f h k w], in insula quam Mictim vocat Timæus, et a Britannia sex dierum navigatione abesse refert[g]; in insulis Hesperidibus[m n o] apud *Drangas* populos Persicos regionis Arianæ[i 524].

To this I shall add the following illustration. The name *cassiteron* is supposed, in general, to be derived from the Phœnician or Chaldaic[525]; but

on this point I am not able to decide. Mela, where he explains the name of the Cassiterian islands, calls it only *plumbum*, without the addition of any epithet, unless it has been lost in transcribing. But Pliny himself says[526], "Cassiterides dictæ Græcis a fertilitate plumbi." It is possible, therefore, that the leaden vessels, which are often mentioned in the works of the ancients, were in part tin; but I cannot possibly agree with Millin[527], who makes the *cyanos* of Homer to be tin. This word evidently denotes mountain-green, or some species of stone coloured by it, which in former times, like the lapis lazuli at present, was employed for making various kinds of ornaments. Besides, *cyanos* and *cassiteros* are mentioned in the Iliad[528] as two different things[529].

What Pliny says of the colour and weight of those minerals that produced tin, corresponds exceedingly well with tin ore, which, as is well known, is among the heaviest of minerals, though the specific gravity of the metal itself is but small. It is also true that lead is seldom found without silver; and tin perhaps has never been found with the latter. What we read in regard to the obtaining of tin ore, agrees very well with our washing-works. Even at present the greater part of the tin ores are found in fragments and washed.

The smelting of this metal, even when all the rules of art are not employed, is attended with little difficulty, though Goguet is of a different opinion. As of all metals it melts easiest in the fire, it requires only a small degree of heat and no artificial furnace; but as it is readily calcined, and after repeated reduction loses its malleability, care must be taken that the reduced metal can immediately flow off; and on that account our furnaces have an aperture always kept open. It is probable that the ancients, in their small furnaces, could easily make a similar arrangement.

Tin at all times must have been dearer than lead, as the latter was found in abundance, but the former in small quantities. In England at present tin costs about four times as much as lead. At Hamburg, in 1794, a pound of English block tin cost eleven schillings and a half, and tin in bars thirteen schillings; but a hundred pounds of English lead were worth at that time only fourteen marks, and Goslar lead eleven and a half marks ready money.

That tin melts easier than lead is very true. According to the latest experiments the former fuses at 442°, whereas lead requires 612° of Fahrenheit's thermometer. Both metals can be fused in paper when it is closely wrapped round them. Aristotle and Pliny meant to say the same thing of their paper; and the latter adds that the paper, even when it became torn, was not burnt. What the first says of melting in water, some have too inconsiderately declared to be a fable; but it is not entirely false. Tin, when mixed with lead and bismuth in certain proportions, is so fusible that it melts in boiling water, because it requires less heat to be fused than water does to be brought to a state of ebullition. That the Celtic tin contained a great deal of lead, appears from the observation, that when rubbed it made the fingers black; an effect which would not have been produced by pure tin.

That tin in the time of Pliny was mixed with lead, and in various proportions, we are told by himself. At that period a mixture of equal parts tin and lead was called *argentarium*; and that of two parts lead and one part tin, *tertiarium*. Others mixed the latter composition with an equal quantity of tin, and named the mixture also *argentarium*, and this was commonly used for tinning.

I must, however, acknowledge that the last words of Pliny I do not fully comprehend. They have not indeed been noticed by any commentator; but I do not on that account believe that I am the only person to whom they have been in part unintelligible. Savot and Watson[530], who were undoubtedly capable of giving some decisive opinion on them, have purposely left that part, which to me appears obscure, untranslated and without any explanation. Pliny says, "Improbiores ad tertiarium additis æquis partibus albi, argentarium vocant, et eo quæ volunt, incoquunt." He seems here to throw out a reproach against those who melted together equal quantities of *tertiarium* and pure tin, and then gave it the name of *argentarium*, as if it had been of an inferior quality to the *argentarium* first named. But equal quantities of *tertiarium* and pure tin produced a mixture, in which for *one* part of lead there were *two* of tin. How then could those who made this mixture be called *improbiores*? To answer this question I shall venture to give my conjecture. Pliny perhaps meant to say, that tinning properly ought to be done with pure tin, but that unprincipled artists employed for that purpose tin mixed with lead. If this be the true meaning, his reproach was

not unfounded. On the same account, because all tin was then adulterated with lead, Galen gives cautions against the use of tinned vessels, and advises people to preserve medicines rather in glass or in golden vessels. But why does Pliny add, “ideo album nulli rei sine mixtura utile?” In using these words, it is possible he may have alluded, not to tinning, but to things cast of tin, which, according to the ideas of that time or the nature of the tin, if of that metal alone, would be too brittle. This seems to be said by the preceding words, to which the *ideo* refers: “albi natura plus aridi habet, contraque nigri tota humida est, ideo album....” I hope the reader will forgive me for entering so deeply into criticism; but if Pliny’s valuable work is ever to become intelligible, occasional contributions of this kind must not be despised.

Of the process employed in tinning in ancient times, we have no account; but the words of Pliny *incoquere* and *incoctilia* seem almost to denote that it was performed, as in tinning our iron wares, by immersing the vessels in melted tin. It appears also to have been done at an early period in a very perfect manner, both because the tinned articles, as Pliny says, could scarcely be distinguished from silver, and because the tinning, as he adds, with an expression of wonder, did not increase the weight of the vessels. The metal, therefore, was applied so thin that it could make no perceptible addition to the weight. This is the case still, when the work has been skilfully executed; and it affords a remarkable proof of the astonishing divisibility of metal. Dr. Watson caused a vessel, the surface of which contained 254 square inches, and which weighed twenty-six ounces, to be tinned, and found that the weight was increased only half an ounce; consequently half an ounce of tin was spread over 254 square inches.

But, notwithstanding all this dexterity, which must be allowed to the Romans, they appear to have employed tinning at any rate for kitchen utensils and household furniture very seldom. It is scarcely ever mentioned, and never where one might expect it, that is to say, in works on cookery and domestic œconomy, where the authors give directions for preparing and preserving salt provisions. When they speak of the choice of vessels, they merely say that new earthen ones should be employed. Some of the physicians only have had the foresight to recommend tinned vessels. It does not appear indeed that the Romans, though copper vessels were in general use among them, employed any precautions to prevent them from being

injurious to the health. Pliny only says that a coating of *stannum* improved the taste of food, and guarded against verdigris. The former part is to be thus understood; that the bad taste occasioned by copper was prevented; but he does not say that the health was secured by it. The term also *incoctilia*, usual in the time of Pliny, is found in his works alone. It is likewise remarkable, that among the numerous vessels found at Herculaneum, as I have already remarked, the greater part of them were of copper or *stannum*, few of which were silvered, and none tinned. Had tinning been then as much used as at present, some tinned vessels must have been found.

I shall further remark, that Pliny ascribes the invention of tinning to the Gauls; and that he extols in particular the work of the Bituriges, the old inhabitants of the province of Berry, and those articles made at Alexia or Alegia, which is considered to have been Alise in Auxois; that he speaks of tinning copper and not iron, and that according to his account not only tin was used for that purpose, but also *stannum*. By the passages already quoted, it is proved that in the time of Homer *cassiteron* was employed for ornamenting shields and certain kinds of dresses; but the further illustration of them I shall leave to others. The shields perhaps were inlaid with tin; and it is not improbable that threads were then made of this metal, and used for embroidering. That this art was at that period known may be readily believed, since the women of Lapland embroider their dresses, and particularly their fur cloaks, in so delicate and ingenious a manner, with tin threads drawn out by themselves, as to excite astonishment[531].

What Pliny says is true, that lead cannot be soldered without tin, or tin without lead. For this operation a mixture of both metals, which fuses more readily than each of them singly, is employed. Instead of oil, mentioned by Pliny, workmen use at present in this process colophonium, or some other resin.

That vessels were made of cast tin at an early period is highly probable; but I do not remember to have seen any of them in collections of antiquities. I am acquainted only with two instances of their being found, both of which occurred in England. In the beginning of the last century some pieces of tin were discovered in Yorkshire, together with other Roman antiquities[532]; and

in 1756 some tin vessels of Roman workmanship with Roman inscriptions were dug up in Cornwall[533].

I shall pass over the history of the tin trade of the Phœnicians, the Greeks, the Gauls and the Romans, respecting which only scanty and doubtful information is to be found in the works of the ancients, but in those of the moderns a greater number of hypotheses. The situation even of the Cassiterides islands cannot with certainty be determined, though it is supposed in general, and not without probability, that they were the Scilly islands, which lie at the distance of about thirty miles from the most western part of the English coast; that is, the extremity of Cornwall, or, as it is called, the Land's End. At the same time we must adopt the opinion of Ortelius, that under that appellation were included the coasts of Cornwall and Devonshire[534]. To those who are on the Scilly islands, Cornwall, as Borlase remarks, appears to be an island; and as it is impossible that the Scilly islands, which were called also *Silures*, could furnish tin sufficient for the ancient trade, especially as few and very small traces of old works are observed in them, it is more probable that the greater part of the metal was obtained from Cornwall. That the Phœnicians themselves worked mines there, cannot be proved; it is rather to be supposed that they procured the metal from the inhabitants by barter; but, on the other hand, there is reason to believe, from various antiquities, that the Romans dug up the ore themselves from the mine, and had works for extracting the metal.

The island Ictis of Diodorus Siculus, to which the ancient Britons carried tin, and from which it was conveyed by the Gallic merchants, is generally considered as the Isle of Wight; but Borlase remarks very properly[535], that Ictis, according to the account of the ancients, must have been much nearer to the coast of Cornwall. He conjectures therefore, and with great probability, that this word was the general appellation of a peninsula, or bay, or a place of depôt for merchandise[536]. If the Mictis of Timæus and the Vectis of Pliny are not this island Ictis, it will be difficult to find them. It is very singular, that Dionysius, a later writer, and his follower Priscian, and Avienus, call the *Cassiterides* islands the *Hesperides*[537].

That the Drangians had tin mines appears to me highly improbable; Strabo is the only writer who says so, in a few words; and nothing of the kind is to be found in any other author. If Drangiana be considered as a part of Persia, to which that district belongs at present, it is stated by all modern travellers that tin is not to be found anywhere in the Persian empire[538]. If we reckon it a part of India, Pliny asserts that no tin-works were then known in that country. In his time, this metal was sent thither as an article of commerce, and was purchased with precious stones and pearls. This last circumstance has by some been considered as a proof of the high price of the metal at that period; but he says nothing further than that tin was among the imports of India at that time, and that jewels and pearls formed a part of the exports. It may be said that the inhabitants of the Spanish colonies in America gave their silver for our linen, but we cannot thence prove that it bears a high price.

That the word *stannum*, in the time of Pliny, did not signify tin but a compounded metal, is as certain as that in later times it became the common name of tin. Hence arises the question, Since what time has our tin been known under the appellation of *stannum*?

This question, as far as I know, has never yet been examined; and this, I hope, will be a sufficient excuse if I should not be able to give an answer completely satisfactory. The first author in whom I find the Greek word *cassiteros* translated by *stannum* is Avienus, in the free translation of Dionysius; who, as proved by Wernsdorf, lived about the middle of the fourth century. The next who translates the Greek word in the same manner, is Priscian; who, according to the grounds alleged by Wernsdorf, must have lived in the beginning of the sixth century.

From what I already know, I suspect that the long and improper name *plumbum candidum* began in the fourth century to be exchanged for *stannum*; and it is probable that, at that time, tin was so abundant that it banished the old *stannum*, to which it might have a resemblance. In later centuries, then, *stannum* always signified tin; and in the middle ages various words were arbitrarily formed from it which do not occur in the Latin authors. The *stannea tecta*, or roof of the church at Agen, on the Garonne, in Guienne, described by the ecclesiastical poet Fortunatus[539], about the end of the sixth century, consisted undoubtedly of tinned plates of copper.

Stagnare occurs often for tinning, as *stagnator* does for a tin-founder. In the thirteenth century, Henry III. of England gave as a present a *stagnarium* or a *stannaria*, a tin mine or tin work, or as others say, *fodina stanni*. In the fourteenth century, there was in England, under Edward III., a *stannaria curia*; and in the same century, besides various other ornaments, *lunulæ stanneatæ* were forbidden to the clergy. In a catalogue of the year 1379, the following articles occur: "tria parva stanna modici valoris ... item unum stannum parvum ... item duo magna stanna[540]."

In regard to the tin trade of the Spaniards, I can unfortunately say nothing: the tin-works in Spain, we are told, were abandoned under the government of the Moors. England, as is generally asserted, enjoyed an exclusive trade in this metal till the thirteenth century, when the tin mines were discovered and worked in Bohemia. But the exact time when this took place I am not able to determine. The Bohemian works, in all probability, are older than the Saxon; but it is still more certain that the account given by Hagec, that they were known so early as the year 798, is entirely void of foundation[541].

When the English writers[542] treat on the history of this metal, they seldom fail to repeat what has been said on the subject by Matthew Paris. This Benedictine monk, who was by birth an Englishman, and died in 1259, relates, in his History of England, that a Cornish-man having fled to Germany, on account of a murder, first discovered tin there in the year 1241. He adds, that the Germans soon after furnished this metal at so cheap a rate, that they could sell it in England, on which the price there fell, very much to the loss of Richard Earl of Cornwall, so well known by his having been elected king of the Romans[543]. Since Matthew relates this as an event which took place in his time, it would perhaps be improper to doubt it; but it still appears strange that no mention is to be found of this circumstance in the Bohemian or German Annals. Gmelin also must not have met with any account of it, else he would have announced it. Peithner likewise is silent respecting it: on the contrary, he says that the tin mines in the neighbourhood of the town of Grauppen were discovered as early as the year 1146, by a peasant named Wnadec, belonging to the village of Chodicze. Of the antiquity of the Saxon mines I can give no account: had

any information on that subject existed, it would certainly have been noticed by Gmelin.

Brusch, who was murdered by two noblemen in 1559, seems to place the discovery of the tin mines at Schlackenwalde, which he says are younger than those of Schönfeld, in the thirteenth or twelfth century[544]. Albertus Magnus, who died in 1280, says that in his time a great deal of tin was dug up in various parts of Germany. At present the principal tin works are at Geyer, Ehrenfriedersdorf and Altenberg.

The art of tinning plate-iron was invented either in Bohemia or Germany, and introduced at a later period into England, France, and other countries. But as the whole history of the German mines is very defective and uncertain, the period when this useful and highly profitable branch of business was begun is not known. Yarranton, an English writer, of whom I shall speak more hereafter, relates that the first tinning of this kind was made in Bohemia; that a Catholic clergyman, who embraced the Lutheran religion, brought the art, about the year 1620, to Saxony, and that since that time all Europe has been furnished with tin-plate from Germany.

This much, however, is certain, that the tinning of iron is more modern than the tinning of copper. The first articles made by the bottle-makers were flasks of copper tinned, which in old times were used in war and on journeys, like the *stagnone*, still employed in Spain and Portugal, in which all kinds of distilled waters are sent from Malta[545].

Among the English, who formerly had a monopoly of the tin trade, and who still possess the best and richest tin mines, the introduction of this art of employing their native production did not at first succeed; and this circumstance afforded Becher a subject for raillery[546]. But about the year 1670, a company sent to Saxony, at their expense, an ingenious man named Andrew Yarranton, in order to learn the process of tinning. Having acquired there the necessary knowledge, he returned to England with some German workmen, and manufactured tin-plate, which met with general approbation. Before the company, however, could carry on business on an extensive scale, a man of some distinction, having made himself acquainted with Yarranton's process, obtained a patent for this art; and the first undertakers

were obliged to give up their enterprise, which had cost them a great deal of money, and yet no use was made of the patent which had been obtained[547].

About the year 1720, which, on account of the many new schemes and the deceptive trade carried on in consequence of them, will ever be memorable in the history of English folly, among the many *bubbles*, as they were then called, was an establishment for making tin-plate; and this was one of the few speculations of that period which were attended with advantage. The first manufactory of this kind was established in Monmouthshire, perhaps at the village of Pontypool, where tin-plate was at any rate made so early as 1730[548]. In France, the first experiment to introduce this branch of manufacture was made under Colbert, who procured workmen, some of whom were established at Chenesey, in Franche-Comté, and others at Beaumont-la-Ferriere in the Nivernois. But the want of skill and proper support rendered this expensive undertaking fruitless. Some manufactories, however, were brought to be productive in the last century; the oldest of which was established at Mansvaux in Alsace, in the year 1726. This was followed, in 1733, by another at Bain in Lorraine, which obtained its privilege from Duke Francis III., and this was confirmed by Stanislaus in 1745[549].

That tin, in modern times, has been brought from the East Indies to Europe is well-known; but I have never been so fortunate as to discover when this trade began. It is, however, known, that at the commencement of the sixteenth century a good deal of information had been obtained in Europe in regard to East Indian tin. Louis Barthema, who was then in India, speaks of Malacca tin[550], as does also F. Mendez Pinto, who was there in 1537, and Odoard Barbosa mentions that which was carried from Caranguor to Malacca. Barbosa wrote in 1516[551]. Munster, Mercator, and other old geographers relate, that before the establishment of the Portuguese dominion in India, large tin coins were in circulation in the island of Sumatra.

The greater part of the East-Indian tin comes from Siam, Malacca, and Banca. In the last-mentioned place, which is an island near the south-east coast of Sumatra, the mines are said to have been discovered in 1711. In

1776 there were ten pits, which were worked by Chinese, on account of the king of Palimbang. One hundred and twenty-five pounds cost him only five rix dollars; and for this quantity he received from the Dutch East-India company, to whose government he was subject, from thirteen to fifteen dollars. The greater part went to China, or was used in India; but in the year 1778 the company sent 700,000 pounds to Europe, which was sold at the rate of a hundred pounds for forty-two florins. Malacca furnishes yearly about three or four hundred thousand pounds; but the principal part of it remains in India. In the year 1778 the company sold 100,000 pounds in Amsterdam. A great deal of tin is sold also in its factory at Siam. All the tin sold by it at Amsterdam between the years 1775 and 1779 amounted to 2,421,597 pounds.

[Tin occurs native in two forms, as peroxide and as sulphuret of tin and copper. The last is rare; the former constitutes the great source of tin, and in its native state mixed with arsenic, copper, zinc and tungsten, is called tin-stone; but when occurring in rounded masses, grains, or sand in alluvial soil, is called stream-tin. The metal reduced from the tin-stone forms block-tin; whilst that from the stream-tin, and which is the purest, is called grain-tin.

The annual produce of the tin mines and works of Cornwall is estimated at 4000 tons, worth from £65 to £80 a ton. About 30,000 cwt. of unwrought tin are annually exported from Britain, chiefly to France, Italy and Russia; which is, exclusive of tin and pewter wares and tin-plates, in declared value nearly £400,000, sent to the United States, Italy, Germany, France, the colonies, &c. Moreover, from 10,000 to 30,000 cwt. of Banca and Malay tin are imported for re-exportation to the continent and the United States.

An important enamel has lately been patented for lining the interior of cast iron vessels and utensils used in cooking, chemical operations, &c., which will probably replace tinned articles in a great degree. To apply the process, the vessels are cleansed with weak sulphuric acid, then washed and dipped into a thin paste made with quartz first melted with borax, felspar and clay free from iron, then reduced to an impalpable powder, and sufficient water added to form thinnish paste. The vessels are then powdered inside with a linen bag, containing a very finely powdered mixture of felspar, carbonate of soda, borax, and a little oxide of tin. The

articles are then dried and heated in an enamelling furnace. The coating is very white, bears the action of fire without cracking, and completely resists acid or alkaline solutions.]

FOOTNOTES

503 [Tin-stone however occurs in Spain and Portugal; and Watson, in his Chemical Essays, states that Spain furnished the ancients with considerable quantities of tin.]

504 Native tin never, or at any rate, very rarely occurs. In the year 1765 a piece was supposed to be found, of which an account may be seen in the Phil. Trans. vol. lvi. p. 35, and vol. lix. p. 47. But the truth of this was denied by most mineralogists, such for example as Jars in Mémoires de l'Acad. à Paris, année 1770, p. 540. Soon after the above-mentioned piece of tin was found in Cornwall, some dealers in minerals sold similar pieces to amateurs at a very dear rate; but all these had been taken from roasting-places, where the tin exudes; and very often what is supposed to be tin is only exuded bismuth, as is proved by some specimens in my collection.

I shall here observe, that it may not be improper, in the history of tin, to show that it was believed more than two hundred years ago that this metal was found in a native state.

505 Having requested Professor Tychsen, to whose profound knowledge of Oriental history, languages, and literature I have been already indebted for much assistance, to point out the grounds on which *bedil* is considered to be our tin, I received the following answer, with permission to insert it in this place.

"*Bedil*, בדיל, according to the most probable derivation, means *the separated*. It may therefore, consistent with etymology, be what Pliny calls *stannum*, not tin, but lead from which the silver has not been sufficiently separated. The passage in Isaiah, chap. i. ver. 25, appears to afford a confirmation, because the word there is

put in the plural, equivalent to scoriæ, as something separated by fusion.

"Others derive *bedil* from the meaning of the Arabic word بدل *badal*, that is, *substitutum*, *succedaneum*. In this case indeed it might mean tin, which may be readily confounded with silver.

"The questions, why *bedil* has been translated tin, and how old this explanation may be, are answered by another: Is κασσίτερος tin? If this be admitted, the explanation is as old as the Greek version of the seventy interpreters, who in most passages, Ezekiel, chap. xxii. ver. 18 and 20, and chap. xxvii. ver. 12, express it by the word κασσίτερος. In the last-mentioned passage, tin and iron have exchanged places. The Targumists also call it tin; and some, with the Samaritan translation, use the Greek word, but corrupted into *kasteron*, *kastira*. It is also the usual Jewish explanation, that *bedil* means tin, as *oferet* does lead.

"In the oldest passage, however, where *bedil* occurs, that is in Numbers, chap. xxxi. ver. 22, the Seventy translate it by μόλιβος, lead, and the Vulgate by *plumbum*, and *vice versâ*, the Seventy for *oferet* put κασσίτερος, and the Vulgate *stannum*. This, as the oldest explanation which the Latin translator found already in the Septuagint, is particularly worthy of notice. According to it, one might take בדיל, μόλιβος, *stannum*, for the *stannum* of Pliny, lead with silver; the gradation of the metals still remains; the κασσίτερος of the Seventy may be tin or real lead. It may have denoted tin and lead together, and perhaps the Seventy placed here κασσίτερος, in order that they might have one metal more for the Hebrew *oferet*. But from this explanation it would follow that Moses was not acquainted with tin.

"The East has still another name for lead and tin, אנך, *anac*, which occurs only in Amos, chap. vii. ver. 7 and 8, but is abundant in the Syriac, Chaldaic, and Armenian, and comprehends *plumbum*, *nigrum*, and *candidum*.

"In the Persian tin is named *kalai*, *resâs*, *arziz*, which are all of Arabic, or, like *kalai*, of Turkish extraction. None of these have any affinity to κασσίτερος and *bedil*.

"As tin is brought from India, it occurred to me whether the oldest name, like *tombak*, might not be Malayan. But in the Malayan, *tima* is the name for tin and lead. Relandi Dissertat. Miscell. iii. p. 65. It would indeed be in vain to look for Asiatic etymologies in regard to κασσίτερος, since, according to the express assertion of Herodotus, the Greeks did not procure tin from Asia, but from the Cassiterides islands. The name may be Phœnician; and though Bochart has not ventured to give any etymology of it, one, in case of necessity, might have been found equally probable as that which he has given of Britannia. But it appears to me more probable that the word is of Celtic extraction, because similar names are found in Britain, such as *Cassi*, an old British family; *Cassivelaunus*, a British leader opposed to Cæsar; *Cassibelanus*, in all probability, the same name in the time of Claudius. *Cassi-ter*, with the Greek termination ος, seems to be a Celtic compound, the meaning of which might perhaps be found in Pelletier, Bullet, &c."

506 Plin. lib. xxxiv. cap. 16, § 47, p. 669.

507 The last meaning is found in Pliny, xxxiii. 6, § 31, and xxxiv. 18, § 53:—"Est et molybdæna, quam alio loco galenam vocavimus, vena argenti plumbique communis. Adhærescit et auri et argenti fornacibus; et hanc metallicam vocant." Here then there are both the significations, first *bleyglanz*, secondly *ofenbruch*. The name *galena* seems to have been borrowed from foreign metallurgic works, perhaps from the Spanish, as was conjectured by Agricola in Bermannus, p. 434. This, at any rate, is more probable than the derivation of Vossius from γέλειν, *splendere*, especially as the Greeks have not the word *galena*.

508 I explain the passage in this manner, but I acknowledge that difficulties still remain. I have however thought that it might perhaps be thus understood; that in the process of fusion, as then used, the *galena* formed the third part of the weight of the ore or paste, and lead a third part of the *galena*; though I doubt whether the products of metallic works were then so accurately weighed. I

shall leave the reader to determine whether the two explanations of Savot are better. He supposes either that Pliny gives three ways of obtaining lead, namely, from lead ore, argentiferous ore, and *galena*; or that he says that silver forms a third, lead a third, and slag the remaining third. But if the first opinion be correct, why did Pliny say "Plumbi origo duplex?"

509 Bermannus, pp. 450, 485.

510 De Re Metallica, lib. iii. Franc. (1551), 8vo.

511 De Metallis, cap. 22. Franc. 1606, fol. i. p. 322.

512 Discours sur les médailles antiques par Louis Savot. Paris, 1627, 4to, ii. 2, p. 48. This work contains valuable information in regard to the mineralogy of the ancients.

513 In Aldrovandi Musæum Metallicum. Bonon. 1648, fol. p. 181.

514 J. Jungii Doxoscopia, Hamb. 1662, cap. 5, *de metalli speciebus*.

515 I shall here point out a few passages where such vessels are mentioned. Dioscorides, ii. 84, p. 109.—Plin. xxix. 2, § 20; xxx. 5, § 12, and xxx. 7, § 19.—Columella, xii. 41.—Vegetius, i. 16.—Scribonius Largus Composit. Med. Patavii, 1655, 4to, § 230.

516 Sueton. Vitell. 6, p. 192; where it is said tin, which was of a white colour, was to serve instead of silver.

517 In the work already quoted, i. cap. 32, p. 64: "Vides stannum Plinio esse quiddam de plumbo nigro, nempe primum fluorem plumbi nigri;" so that when our lead ore is fused, the first part that flows would be the *stannum* of Pliny. "Et hoc docet Plinius adulterari plumbo candido;" with our tin, and properly considered the *stannum* of Pliny is merely our *halbwerk*, of which those cans called *halbwerk* are made.

Entzel deserves that I should here revive the remembrance of him. He was a native of Salfeld; preacher, *pastor Osterhusensis*,

and a friend of Melancthon, who recommended the book for publication to Egenholf, a bookseller of Frankfort, in a letter dated 1551, in which year it was first printed. It was reprinted at the same place in 1557, and at Basle in 1555, 8vo.

518 The French letter-founders take four-fifths of lead and one-fifth regulus of antimony; those of Berlin use eleven pounds of antimony, twenty-five of lead, and five of iron. Many add also tin, copper, and brass. [Those of England use three parts of lead and one of antimony.]

519 Von Hutten-werken, p. 376.

520 A good account of this manufactory may be found in the Journal für Fabrik, Manufact. Handlung und Mode, 1793. We are told there that the buttons were made of a composition which had a white silver-like colour, and was susceptible of a fine polish. [This was probably some alloy of nickel, one of the principal constituents of German silver.]

521 Lib. iii. p. 254.

522 That the merchants, in the oldest periods, endeavoured by false information to conceal the sources of their trade, might be proved by various instances.

523 Supplementa in Lexica Hebraica p. 151.

524 The authors here quoted, corresponding to the above letters, are as follows:—

a Plinius, xxxiv. 16, p. 668.

b Cæsar De Bello Gallico, v. 12.

c Aristot. Auscult. Mirab. cap. 51, p. 100.

d Galenus De Antidot. i. 8. p. 209. ed. gr. Basil. vol. ii. p. 431.

e Plin. iv. 22. p. 630.

f Herodot. lib. iii. p. 254. edit. Wess.

g Plin. iv. 16, p. 223.

h Strabo, lib. iii. p. 219. ed. Almel.

i Strabo, lib. xv. p. 1055.

j Diodor. Sic. lib. v. p. 347. ed. Wess.

k Diod. Sic. lib. v. p. 361.

l Stephan. Byzant. v. Tartessus, p. 639.

m Dionys. Periegesis, v. 563.

n Prisciani Perieg. v. 575.

o Avienus Descript. Urbis, v. 743.

p Homeri Iliad. xviii. 612.

q Iliad. xi. 25.

r Iliad. xxiii. 561.

s Iliad. xviii. 565, 574.

t Hesiod. Scut. Herculis, v. 208.

u Aristot. Œconom. lib. ii. p. 594.

v Pollux Onomast. p. 1055.

w Pomp. Mela, iii. 6, 24, p. 275.

x Plin. xxxiii. 5, p. 621.

y Plin. xxxiv. 17, § 48, p. 669; and lib. xxxiii. § 45: Optima specula apud majores fuerant Brundisiana stanno et ære mixtis. From a similar mixture the best

metallic specula are cast at present.

525 Borlase's Antiquities of Cornwall. Ox. 1754, fol. p. 29.

526 Lib. iv. cap. 22, p. 230.

527 Minéralogie Homerique, Par. 1790, 8vo. A small treatise much esteemed.

528 Lib. xi. 24, 25.

529 See what I have already said, vol. i. p. 472.

530 Savot, p. 53.—Watson's Chemical Essays, iv. p. 187.

531 Schefferi Lapponia, Francof. 1673, 4to, pp. 210, 261, where a figure is given of a Lapland woman drawing threads.

532 Phil. Trans. 1702, 1703, vol. xxiii. p. 1129.

533 Phil. Trans. 1759, vol. li. p. 13, where figures of the vessels are given. Whitaker's Hist. of Manchester, i. p. 306.

534 Borlase's Cornwall, p. 30; and his Observations on the Islands of Scilly. Oxf. 1756, 4to.

535 Natural Hist. of Cornwall, p. 177.

536 In the Antiquities of Cornwall, p. 394: *Ik*, *yk*, *ick*, a common termination of creeks in Cornwall, as *Pordinik*, *Pradnik*.

537 Dionysii Orbis Descriptio. Londini, 1679, 8vo, p. 220, where Hill's observations deserve to be read.

538 Voyages de Chardin. Rouen, 1723, 12mo, iv. 65, where it is expressly said that Persia has no tin, but that it obtains it from India. The same thing is confirmed by Tavernier.

539 Fortunati Opera. Romæ, 1786, 4to, i. p. 14, lib. i. cap. 8.

[540] Proofs may be found in Dufresne.

[541] Wencesl. Hagec Böhmische Chronik. Nürnb. 1697, fol. p. 53.

[542] For example, Borlase in Natur. Hist.—Speed's Theatre of Great Britain.—Camden's Britannia.—Anderson's Hist. of Commerce, &c.

[543] This metal, however, must have remained long dear; for it is remarked in the Archæologia, vol. iii. p. 154, from an expense-book of the Earls of Northumberland, that vessels of tin, about the year 1500, in consequence of their dearness, had not become common. This is confirmed also by a regulation respecting the household of Henry VIII., printed also in the Archæologia, where it is said, "Officers of the squillery to see all the vessels, as well silver as pewter, be kept and saved from stealing."

[544] C. Bruschii redivivi Beschreib. des Fichtelberges. Nürnb. 1683.

[545] See Gegenwärtiger Staat von England, Portugal, und Spanien (by Theodore King of Corsica), ii. p. 25.

[546] Narrisch Weisheit, p. 51.

[547] Yarranton's England's Improvement by Sea and Land, 1698.

[548] Watson's Chem. Essays, iv. p. 203.—Anderson's Commerce.

[549] This is related by Diderot in his article *Fer-blanc* in the Encyclopédie. That the *Fer-blanc* of the French is tin plate every one knows; but what are we to understand by *ferrum candidum*, a hundred talents of which were given as a present to Alexander in India? No commentator has noticed this appellation. In the index, however, to Snakenburg's Curtius, I find the conjecture that it may mean the *ferrum Indicum*, which, lib. xvi. § 7. *ff* de Publicanis, or Digest. xxxix. 4, § 16, 7, is named among the articles liable to pay duty; but some editions in this passage have *ebenum Indicum*. The reader is referred also to Photii Biblioth. p. 145, where Ctesias

relates a fable in regard to Indian iron. Pliny, xxxiv. 14, p. 667, mentions *ferrum Sericum*, which in his time was considered as the best; but still it may be asked, why is the epithet white applied in particular to the Indian iron? Compare Aristot. de Mirab. Auscult. pp. 96, 426.

550 Ramusio, fol. i. p. 166. c.

551 Ib. i. p. m. 317. d.

SOWING-MACHINES.

That under the terms sowing-machine, *semoir*, drill-plough, *macchine per seminare*, are understood implements by which the seeds of those plants cultivated on a large scale, and particularly the different species of corn, can be regularly deposited in the earth, and at any distance from each other, at pleasure, is at present generally known. The principal part of the machine consists of a box, having within it a cylinder furnished with cogs, which forms the axes of two wheels, and which, as it revolves, assists the seed put into the box to escape through holes formed at a proper distance from each other in the bottom.

At first, these machines were exceedingly simple, and had only in the fore-part a ploughshare; but afterwards a harrow was applied behind, so that with such an apparatus one could plough, sow, and harrow at the same time. It was attended, however, with the common fault of all very complex machines; it was too artificial, too expensive, and too easily deranged. The greater part, therefore, of those lately made have only a harrow behind them.

Since the beginning of the last century so many machines of this kind have been invented, that to give a complete catalogue of them would be difficult. The invention, however, does not belong either to our period or to the English, who have hitherto paid the greatest attention to the improvement and employment of it. I have somewhere read that a proposal for a machine of this kind occurs in Theophrastus; but I have not yet been able to discover the passage. I am much rather inclined, from the information I have hitherto obtained, to place this invention in the sixteenth century, and to ascribe the merit of it to the Italians. By our oldest writers on agriculture, Heresbach, Colerus, Florinus, Hohberg and others, it is not mentioned.

Joseph Locatelli, of whom, however, very little is known, is commonly considered as the inventor. That he was a nobleman of Carinthia, but not a

count, as he is called in Iöcher's Dictionary of Learned Men, is proved by a small work consisting of two sheets in quarto, now in my possession[552]. It is there stated, that experiments were made with a machine of this kind by the emperor's order, at the imperial palace and market of Laxenburg, in the presence of a commissioner, named Pietro Bonaventura von Crollolanza, appointed for that purpose. These experiments succeeded so well, that a crop of sixty for one was obtained from land not manured, and subject to frequent inundation. On this account the emperor rewarded the inventor, and sent him with letters of recommendation to the king of Spain.

In this small work no date is mentioned but on the title-page; and if that be correct, the invention must be placed in the last year of the sixteenth or the first of the seventeenth century, consequently in the reign of the emperor Rudolphus II., who had a great fondness for mechanical inventions. This treatise is certainly the same which, as Reinman says, was printed in 1690 without any place being mentioned, and according to Haller, at Jena, 1690; but the author of it cannot have been the inventor, as asserted by Iöcher, who adds, that the tract in question was printed at Vienna in the year above-mentioned.

The date 1603, however, can hardly be correct; it ought rather to be 1693, and in that case the tract might have been three times printed between that period and 1690. The date in the title-page of my copy appears properly to have in it a 9, which resembles a zero, only because the compositor used a type on which the lower part of the figure was broke. That this conjecture is true, I have, I think, sufficiently proved; though Munchhausen, Haller, and others read the date 1603.

In the year 1669, John Evelyn gave to the Royal Society of London a complete description of Locatelli's invention[553]. He there says that the inventor went with his machine to Spain, where he proved the advantage of it by public experiments, and described them in a Spanish work, dedicated to Geronimo de Camargo, member of the *Consejo real de Castilla*, who was commissioned by the king to make known and promote the use of this machine, the sale of which was secured to the inventor at a price fixed in his patent. This Spanish work, from which Evelyn made an extract, was printed with the Austrian approbation of Crollolanza, and the date Aug. 1st, 1663. Locatelli must immediately after have gone to Spain, for it is there

stated that his machines were made and sold in great abundance at Madrid, in 1664. The invention belongs, therefore, to the year 1663.

This machine was exceedingly simple. The seed-box, the cylinder of which was furnished with two small wheels, required only to be hooked or fastened, by means of ropes, to the stilt of the plough. A figure of it may be found in the before-mentioned German tract; also in the Philosophical Transactions, and thence copied into Duhamel's Traité de la Culture des Terres[554].

The Italians, however, dispute with Locatelli the honour of the invention. They assert that one of their countrymen, named M. Giovanni Cavallina, of Bologna, proposed such a sowing-machine a century and a half before; and they refer for a proof to the account preserved by Gio Battista Segni in his work upon Scarcity. This book I have never seen. Haller gives the title from Seguier, and says that it was first printed at Bologna, in 1602; but Zanon states 1605, and says that this Segni, who is not noticed by Iöcher, was a *canonicus regularis*[555]. Of Cavallina I have not been able to find any further account; not even in the large and full work of Fantuzzi. I can therefore give only the description of Segni as transcribed by Zanon[556]. From this it appears that the machine alluded to had also a seed-box with two wheels, and might be compared to a bolting-mill, but below each hole of the bottom board there seems to have been an iron funnel, which before was shaped like a plough-share. The machine, therefore, seems to have formed as many small furrows as it dropped grains of corn; and, as far as can be judged, there was in the bottom only one row of holes. It appears also that each grain of corn, as soon as it dropped, was covered with earth by the machine. Whether Locatelli took advantage of this invention, and gave it out, with some alteration, as his own, cannot be easily determined.

Soon after Locatelli's invention another sowing-machine was proposed at Brescia, by the Jesuit Lana, who seems to have had no knowledge of the preceding ones; at least he makes no mention of them. The case with Lana was perhaps the same as with many ingenious men, who possess great powers of invention. As they never read, but only think, they are unacquainted with what others have done before them, and therefore

consider every idea which comes into their mind as new. He proposed a harrow, the spikes of which should make holes in the earth, in the same manner as gardeners do with their bean-planter, and the grains of corn were to fall into these holes from a box pierced like a sieve, and placed over the harrow[557].

I do not know whether this, at present, could be called a sowing-machine; but it is not improbable that an apparatus of this kind would facilitate the planting, or, as it is termed, setting of wheat, which in modern times has been revived in England, and particularly in Suffolk. For this purpose holes are made three inches apart, in rows four inches distant from each other, with a bean-planter, by men and women. Each labourer is followed by three children, who throw two or three grains of seed into each hole. One labourer in a second can make four holes, and in two or three days plant an acre. For this he obtained nine shillings, one-half of which was given to the children[558]. By these means there is a saving of one-half the seed; and this defrays the expenses. The wheat also, when it grows up, is cleaner as well as more beautiful; and this method, besides, affords employment to a great number of persons.

However minute and ridiculous this method of planting may appear to our practical farmers, it is nevertheless true that it has been found beneficial in Upper Lusatia[559].

The objection that corn when planted in this manner may throw out too many stems, which will not all ripen at the same time, can be true only when the grains are placed at too great a distance from each other. The German mode of farming however is still too remote from horticulture to admit of our attaching great value to the advantages with which this method is attended.

I shall here remark, that Sir Francis Bacon says that in his time, that is, in the beginning of the seventeenth century, attempts had been made to plant wheat, but being too laborious it was again abandoned, though he declares it to be undoubtedly advantageous[560]. In the most populous districts of China almost all the corn is set, or it is first sown in forcing-

beds, and then transplanted. The English call the labour with the sowing-machine *drilling*, and the planting of wheat they name *dibbling*.

[Several sowing-machines have been invented, and patents taken out for them in late years. As it is very difficult to give a description of them, and still more so for the reader to comprehend them without figures, we refer to the Penny Cyclopædia, art. "Sowing-machine," for an account of the more important.]

FOOTNOTES

552 The title is, Beschreibung eines neuen Instruments mit welchem das Getraide zugleich geackert und gesäet werden kan; erfunden von Locatelli, Landmann im Erz-Herzogthum Cärndten. Anno 1603. Without the name of any place, printer, or publisher.

553 Phil. Trans. vol. v. No. 60, p. 1056.

554 Paris, 1753, 12mo, i. p. 368, tab. 6. Duhamel has committed a double error. He speaks of the invention as if the first experiments were made in Spain, and as if those in Austria had been later. He says also, that the latter were made *dans le Luxembourg in Istria*. The English account also says erroneously Luxembourg, instead of Lachsenburg or Laxemburg, which is in Austria, and not in Istria.

555 Of Segni an account may be found in Notizie degli Scrittori Bolognesi raccolte da Giovanni Fantuzzi. In Bologna 1784–1794, 9 vols. 4to, vii. p. 377. Segni, who died in 1610, wrote a great many ascetic books, the names of which are there given.

556 Dell' agricultura, dell' arti e del commercio. Lettere di Antonio Zanon. In Venezia 1764, 8vo, vol. iii. p. 325.

557 Prodromo, overo saggio di alcune inventioni nuove, premesso all' arte maestra. In Brescia 1670, fol. p. 96, fig. 26.

[558] See the excellent account of the agriculture in Suffolk in my Journal, the Beytragen zur Oekonomie, &c., i. p. 1. It was written by M. F. Wild, of Durlach, who in the year 1767 was one of my pupils, and afterwards became teacher in the Institute of Education at Colmar. But alas! I do not know whither he has now been swept by the vortex of the revolution.

[559] Leske Reise durch Sachsen. Leipzig, 1785, 4to, p. 319.

[560] Sylva Sylvarum, cent. 5, § 442.

MANGANESE[561].

That the art of glass-making may have arisen from an accident, such as that mentioned by Pliny[562], I am ready to admit; but by what accident were artists made acquainted with the use of manganese, a mineral the outward appearance of which seems to announce nothing that could be useful to the glass-maker? It is not found in such abundance as to allow us to suppose that it naturally presented itself; nor do we know that any older application of it may have induced the ancients to employ and examine it in such a manner that the present use of it might be accidentally discovered. In general, it resembles some kinds of iron-stone, which it was considered to be till a very late period. That iron, however, colours glass must have been very early remarked; and therefore it could occur to no one to employ manganese for depriving frit[563] of its colour. It produces this decoloration only when it is added sparingly, and according to a determinate proportion; otherwise it gives to the glass a violet colour, something similar to that of the amethyst.

The application of manganese was certainly taught by accident, and not by theory. But in regard to the question, why it frees glass from its dirty colour, it must be admitted, if we readily acknowledge the truth, that we can offer only hypotheses; as the old chemists called in the aid of phlogiston, and the new that of oxygen[564]. Did a false hypothesis, then, conduct to this discovery? That this was the case, has been asserted by old as well as more modern writers, and is no doubt possible. Thus Kepler, from an erroneous hypothesis in regard to the revolution of the planets, discovered the ratio of their motion, according to their distance from the sun; and such instances may be adduced in favour of hypotheses which have done more harm than good. But, in my opinion, in examining the origin of the ancient arts, we ought not to give credit to any cause assigned for an invention until no other can be found. In regard to the art in question, I think I can mention one

which, at any rate, has probability in its favour, and which I shall here submit to the reader's decision.

That it was observed at an early period that metallic oxides, and particularly that of iron, which most frequently occurs, communicate various colours to glass, has been already proved[565]. It needs therefore excite no wonder that men should be induced to make experiments on colouring glass with various minerals, and especially such as contained iron. Now, since manganese, as already said, has a great resemblance to iron-stone, it was also occasionally employed; and it was soon found that this supposed species of iron-stone, according as it is used in greater or less quantity, gives to glass many beautiful shades of a violet, red, and dark brown colour. As it was necessary that the artist should weigh the manganese, in order to proportion it to the vitreous mass, according to the required colour, it is possible that the glass, when a very small quantity had been added, was found to be colourless. This observation must have been made with the greater satisfaction, and more readily turned to advantage, the higher colourless glass, which approached nearest to rock crystal, was at that time esteemed[566].

The period however when this great improvement in one of the most useful arts was fortunately introduced, cannot with certainty be determined; but it is very probable that it was practised in the time of Pliny. Were not this the case, what should have induced him, more than once, to remark that the magnet was employed in glass? Under this name the ancients certainly comprehended manganese; which, in general, had a resemblance to the magnet, and was considered as such by Agricola, Kircher, and others, at a more modern period. Pliny[567], in one passage, speaks of a kind of magnet which was found in Cantabria, not in veins, but interspersed or in nuclei; and he adds that he did not know whether it was useful in glass-making, because no one had ever tried it. This use of manganese then must at that time have been very common, since it occurred so readily to a writer in speaking of a supposed magnet.

Another passage of Pliny has been supposed to allude to manganese, but in my opinion with much less probability. It is that where he says *Alabandicus* flows in the fire, and is fused at the glass-houses[568]. But by

that term he seems to understand a kind of marble, according to the opinion of Isidorus, by whom the word is repeated. As a calcareous earth it was perhaps added to promote the fusion of the sand. Camillus Leonardus, however, considered the *Alabandicus* as manganese[569].

It is not improbable that the ancients employed manganese, if not for glazing, at any rate for painting their pottery or earthenware, as soon as they became acquainted at the glass-houses with its susceptibility of being converted into a coloured vitreous mass.

But this is far from being proved, though count Caylus, Genssane and others positively assert that the so-called Etruscan vases and lamps were painted with the same manganese that we use for our earthen-ware.

Those who attempt to trace out the history of the arts must be very cautious not to admit, without sufficient proof, that what the ancients accomplished was effected by the same means as those employed by us for the same purpose. This, in some cases, may be true; but in many others false. Thus, they made a beautiful kind of blue and red glass, without being acquainted with our cobalt and mineral purple; and they performed very long sea voyages without our compass. It is the duty of the historian either to point out the means which the ancients employed, whether they were the same or not as those used at present, or to acknowledge that their processes are unknown to us. Those who invariably follow this rule will sometimes discover that, in ancient times, men were able to accomplish the same objects and to produce the same effects, by means totally different from those used at present; and then the question will sometimes arise, Which of the means, the old or the new, are the cheapest, the most convenient, and the surest? This leads to technological problems, the solution of which, notwithstanding the great superiority we possess in those auxiliaries of the arts, natural history, chemistry, &c., is impossible. I have indulged in these observations, in mentioning the celebrated Caylus, because I well know that he has often erred in not attending to them. I acknowledge and respect the service of this eminent man; but I am convinced that by the boldness of his assertions he acquired greater confidence and more celebrity than he deserved.

The colours on the Etruscan vases have a resemblance indeed to those on our stone-ware, but it is also true that they might be produced by oxide

of iron.

The substances used by the ancient potters can be determined only by the testimony of the ancients or by experiments; but the former is not to be found; and the latter have never been made, though they would not be difficult to any chemist who might choose to sacrifice a few vessels of that kind.

The question how the use of manganese was first found out, occurred even to Pliny; and his opinion on that subject deserves to be quoted, especially as it was long considered as true by Albertus Magnus, Caneparius, and many later writers. To understand it one must know that it was at first believed that the magnet, as it attracts iron, could attract other bodies also; and it was conjectured that other minerals might possess a similar property. Some imagined that they had found magnets for gold and silver. In the oldest times men had so erroneous an opinion of the art of glass-making, that they conceived that glass was obtained from sand, as metal from its ore; and Pliny thinks that they then conjectured that a magnet could attract glass as well as it does iron. Now as manganese, on account of its similarity, was considered to be a magnet, it was consequently subjected to experiments, which gave rise to the beneficial discovery that it renders glass colourless.

This use of it then has been retained through every age to the present time, and it is mentioned by all those authors who have written on glass-making. Avicenna[570] makes so complete a distinction between it and the magnet, that he treats of each in a particular section, though he says nothing of its employment in the glass-houses; but indeed as a physician he had no opportunity of doing so. Albertus Magnus[571], however, who lived a century later, Roger Bacon, Basilius Valentine, Camillus Leonardus, Biringoccio, Mercati, Neri and many others have spoken in the plainest terms of this application.

It is seen by the words quoted from different authors, that the name, which as far as I know occurs first in Albertus Magnus, was written in a great many different ways: *magnesia*, *magnosia*, *magnasia*, *manganensis*, *mangadesum*, and in French *magalaise*, *méganaise*, *magnese*. One might imagine that it is derived from magnet, partly on account of the similarity of

the two substances, and partly on account of its supposed power to attract glass. Besides, its other name *sidera* seems to have a reference to the Greek word for iron. Mercati, however, deduces the term from *mangonizare*, because potters besmear their wares with this mineral; but I suspect that the name was common before that use of the substance was known. It is to be observed that to this word various other significations have been given. Sometimes it seems to denote common iron-stone, and sometimes pyrites. What the gold-makers understood by it will be best discovered by consulting the works of their followers. *Braunstein* also, the German name, the earliest mention of which occurs perhaps in the writings of Basilius Valentine, denoted at first every kind of ferruginous earth employed by the potters for painting. Thus Schwenkfeld gave the name of *Braunstein* and *Braunfarbe* to a kind of bloodstone[572].

For a long time the manganese imported from Piedmont was in Germany accounted the best, and therefore was much sought after by the artists of Nuremberg. Afterwards, a kind brought from Perigord, a place in Guyenne, and named *pierre de Périgueux*, or *lapis petracorius*, was highly esteemed. Wallerius gives this as a peculiar species; and in my opinion he is right. Its distinguishing characters are, that it resembles a burnt coal or cinder; has a somewhat shining surface, and on the fracture appears to be finely striped and a little coloured. A piece which I have in my possession exhibits all these marks. This species has been mentioned by very few of the new mineralogists. Germany, however, for some centuries past has employed its own manganese, which even in the time of Biringoccio was sent as an article of commerce to Italy.

[The distinctness of the metal contained in the manganese of commerce from iron was first proved by the experiments of Pott in 1740, by Kaim and Winterl in 1770, and by Scheele and Bergman in 1774. Soon after this the metal itself was obtained in an isolated state by Gahn, who gave to it the name of *magnesium*, which term however was subsequently applied to the metal contained in magnesia, and the word *manganese* has been adopted to designate both the metal and the black ore. In addition to its application in the manufacture of glass, it is now very extensively used in the decomposition of common salt for the production of chlorine for bleaching. Some salts of the lower oxides of manganese have lately been used in calico-printing as a source of brown colours.]

FOOTNOTES

561 [The word manganese, strictly speaking, designates the metal itself, the peroxide of which is understood by the author whenever the word manganese occurs in the text.]

562 Lib. xxxvi. 26, § 25.—See Hambergeri Vitri Historia, in Comment. Societ. Götting. tom. iv. anni 1754, p. 487.

563 Under this appellation, writers on the art of glass-making understand a mixture of sand or siliceous earth and alkaline salts, which at the German glass-houses, where the above word is seldom heard, is called *Einsatz*. It appears to have been brought to us, along with the art, from Italy, where it is written at present *fritta*, and to be derived from *fritto*, which signifies something broiled or roasted. It seems to be the same word as *freton*, which occurs in Thomas Norton's Poem, Crede mihi, sive Ordinale, where it however signifies a particular kind of solid glass, fused together from small fragments. This Englishman lived about the year 1477. His treatise was several times printed.

564 [The action of peroxide of manganese (the only compound of the metal used in the manufacture of glass) is simple and clearly understood. The sand (silica) used in the manufacture of glass frequently contains iron, which by the heat necessary for the fusion of the glass becomes reduced to the state of protoxide, giving the glass a greenish or yellowish colour; also, if any organic substance be present in the materials (and where sulphate of soda is used, charcoal is added), the glass is not colourless. When peroxide of manganese is added, it parts with some of its oxygen, becoming reduced to the protoxide, which remains colourless in the glass, the protoxide of iron absorbing the oxygen, becomes at the same time converted into the peroxide, which also imparts no colour to the glass, which is thus rendered colourless. If more of the peroxide of manganese be added than the carbon or protoxide of iron can

reduce, it will tinge the glass of an amethyst colour, as stated in the text.]

565 See the History of Ruby-glass in vol. i. p. 123.

566 Plin. xxxvi. 26, p. 759, and lib. xxxvii. cap. 6, p. 769; he says that artists could make glass vessels nearly similar to those of rock crystal; but he remarks that the latter had nevertheless risen in price.

567 Lib. xxxvii. 24, § 66.

568 Plin. xxxvi. 8, § 13, p. 735.

569 Speculum Lapidum, Parisiis, 1610, 8vo, p. 71. It may not be superfluous here to remark, that this *Alabandicus* of Pliny must not, as is often the case, be confounded with the precious stone to which he gives the same name, lib. xxxvii. cap. 8. The name properly denotes only a stone from Alabanda in Caria. It occurs, but much corrupted, as the name of a costly stone, in writings of the middle ages. See in Du Cange Alamandinæ, Alavandinæ, Almandinæ; and even in our period so fertile in names, a stone which is sometimes classed with the ruby and sometimes with the garnet, and which is sometimes said to have an affinity to the topaz and hyacinth, is called *Alamandine* and *Alabandiken*. See Brückman on Precious Stones, who in the second continuation, p. 64, deduces the word from *Allemands*, without recollecting the proper derivation, which he gives himself, i. p. 89 according to Pliny.

570 Canon Medicinæ, lib. ii. tract. 2, cap. 470, de Magnete; and cap. 472, de Magnesia.

571 In his book De Mineralibus, lib. ii. tract. 2, cap. 11.

572 Stirpium et Fossilium Silesiæ Catalogus, Lipsiæ, 1600, 4to, p. 381.

PRINCE RUPERT'S DROPS. LACRYMÆ VITREÆ.

It is more than probable that these drops, and the singular property which they possess, have been known at the glass-houses since time immemorial. All glass, when suddenly cooled, becomes brittle, and breaks on the least scratch. On this account, as far back as the history of the art can be traced, a cooling furnace was always constructed close to the fusing furnace. A drop of fused glass falling into water[573] might easily have given rise to the invention of these drops; at any rate this might have been the case in rubbing off what is called the navel[574]. It is however certain that they were not known to experimental philosophers till the middle of the seventeenth century. Their withstanding great force applied at the thick end, and even blows; and on the other hand, bursting into the finest dust when the smallest fragment is broken off from the thin end, are properties so peculiar that they must excite the curiosity of philosophers, and induce them to examine these effects, especially at a time when mankind in general exert themselves with the greatest zeal to become better acquainted with the phænomena of natural bodies. On this account they have been noticed in almost every introduction to experimental philosophy. To determine the time then in which they were first made known, seems to be attended with little difficulty; but it still remains doubtful by whom and in what country.

It appears certain that the first experiments were made by philosophers with these drops in the year 1656. Monconys[575], who travelled at that period, was present when such experiments were made at Paris, before a learned society, which assembled at the house of Mommor, the well-known patron of Gassendi; and the same year he saw similar experiments made by several scientific persons at London. He tells us expressly that Chanut, the Swedish resident, procured glass drops for the first Parisian experiments, and that these drops were brought from Holland.

It appears, therefore, that the first glass drops were made in Holland; yet Montanari, who was professor of mathematics at Bologna, says that the first were not made by the Dutch, but by the Swedes. The grounds, however, on which he rests his assertion are exceedingly weak. Because a Swedish resident procured those used for the first experiments, it does not follow that they were made at Swedish glass-houses, especially as it is positively said that they were brought from Holland. It was indeed stated so early as 1661, by Henry Regius or Van Roy, professor at Utrecht, that these glass drops came from Sweden; but may not this have been a lapse of memory, occasioned by the circumstance that the first drops used by the natural philosophers of Paris were procured by a Swedish resident.

Monconys, whose relation indeed bears evident marks of great haste as well as credulity, calls Chanut *Résident de Suède*, and seems to have considered him as a Swedish resident at the French court; an opinion in which he has been followed by many literary men. But Pierre Chanut was French resident at Stockholm, and at that time so well-known that Monconys could hardly be unacquainted with his quality. He was resident from the year 1645 to 1649; and he was afterwards envoy for adjusting the disputes between Sweden and Poland, which were to be settled at Lubec. He is often mentioned in Puffendorf's book De Rebus Suecicis, and the printed account of his missions and negociations contain important materials towards a history of queen Christina, with whom he was a great favourite. He superintended the funeral of Descartes, who was interred with great honour. He was born in 1601; but with the time of his death I am unacquainted. He was celebrated as a man of great learning, and particularly an able mathematician; and it is neither improbable nor even impossible that he may have sent the first glass drops to Paris from Sweden; but why does Monconys add that they were brought from Holland?

It deserves to be mentioned, that about fifteen years before, that is in 1641, the first glass-houses were established in Sweden, and in all probability by Germans. It is possible that when the blowing of glass was first seen, glass drops may have excited an attention which they had not met with in Germany, where no one expected anything new in glass-houses, which were there common and had long been established. It can nevertheless be proved that they were known to our glass-blowers at a much earlier period.

In 1695, John Christian Schulenburg, subrector of the cathedral school of Bremen, published there a German Dissertation on glass drops and their properties, in which he says that he was informed by glass-makers worthy of credit, that these drops had been made more than seventy years before at the Mecklenburg glass-houses, that is to say, about the year 1625.

Samuel Reyher, professor at Kiel, says that Henry Sievers, teacher of mathematics in the gymnasium of Hamburg, had assured him that such glass drops were given to his father by a glass-maker so early as the year 1637; and that his father had exhibited them in a company of friends, who were much astonished at their effects. Reyher adds, that he himself had seen at Leyden, in 1656, the first of these glass drops, which had been made at Amsterdam, where he afterwards purchased some of the same kind; but in 1666 he procured for a very small sum a great many of them from the glass-houses in the neighbourhood of Kiel. It is worthy of remark, that Huet[576], who paid considerable attention to the history of inventions, says that the first glass drops, which he had seen also in the society held at the house of Mommor, were brought to France from Germany. According to Anthony Le Grand they came from Prussia[577].

The first glass drops were brought to England by the well-known Prince Rupert, third son of the elector Palatine, Frederic V., and the princess Elizabeth, daughter of James I.; and experiments, described by Rupert Moray, were made with them in 1661 by command of his majesty. This is expressly stated by Merret[578]; and therefore what some English writers have supposed, that Prince Rupert himself was the inventor, is entirely erroneous[579]. The services which he rendered to the useful arts were too great and too numerous to be either lessened or increased by such trifles.

I shall take this opportunity of remarking, that those small glasses hermetically sealed and containing a drop of water, which when placed on hot coals burst with a loud report, and therefore are called in German *knallgläser*, fulminating glasses, were known before 1665. Hooke speaks of them in his Micrographia[580] printed in that year, and they were mentioned by Reyher in 1669, in his Dissertation already quoted. In Germany they are made chiefly by Nuremberg artists; one of the most celebrated of whom

was Michael Sigismund Hack. He learnt the art of glass-blowing in England, and in 1672 returned to Nuremberg, where he was born in 1643[581].

FOOTNOTES

[573] It is not always necessary that the water should be cold; these drops will be formed also in warm water, as well as in every other fluid, and even in melted wax. See Redi's experiments in Miscellan. Naturæ Curios. anni secundi, 1671, p. 426. They succeed best with green glass, yet I have in my possession some of white glass, which in friability are not inferior to those of green.

[574] The navel, in German *nabel*, is that piece of glass which remains adhering to the pipe when any article has been blown, and which the workman must rub off. These navels, however, are seldom in so fluid a state as to form drops.

[575] Journal des Voyages de M. Monconys, Lyon, 1666, 4to, ii. p. 162.

[576] Commentarius de rebus ad eum pertinentibus, Lips. 1719.

[577] Historia Naturalis. Edit. secunda, Londini 1680, 4to, p. 37.

[578] In his Observations on Neri Ars Vitraria, Amstel. 1668, 12mo.

[579] This is said, for example, by Grainger in his Biographical History of England. London, 1769, vol. ii. part 2, p. 407.

[580] This book was only once printed, but the title-page has the date 1667. See Biographia Britannica, iv. p. 2654.

[581] Doppelmayer, p. 276.

FIRE-ENGINES.

The invention of pumps I shall leave to those who undertake to write the history of hydraulics, and here only remark that, on the testimony of Vitruvius[582], it is in general ascribed to Ctesibius, on which account they are called *machinæ Ctesibicæ*; and that Ctesibius lived at Alexandria in the time of Ptolemy Philadelphus and Ptolemy Euergetes I., consequently two centuries before the Christian æra. My present object extends no further than to state what I know in regard to the question, At what time were these machines first employed for extinguishing fires?

For this purpose, however, it was necessary that the pump-work employed at first only for raising water should undergo some alteration. To use it for extinguishing fires, it was requisite that the water should be speedily driven from the upper aperture as high as possible; whereas for the first purpose, it is enough if the water be thrown out in sufficient quantity to be conveyed to the place of its destination. More additional parts necessary for extinguishing fires would then be an imperfection; as the power which gives the water a needless velocity might be employed with more advantage to raise a greater quantity of it.

In my opinion it is highly probable that Ctesibius had an idea of converting his pump into a fire-engine, for his scholar, Hero of Alexandria, speaks expressly of this use, and describes the construction of a forcing-pump with two cylinders[583]; but it is very doubtful whether this application of it soon became general, and whether this advantageous machine was known to the ancient Romans. What I have been able to learn on the subject is as follows.

Pliny the younger, after telling the emperor Trajan, in one of his letters, that the town of Nicomedia in Bithynia had been almost entirely destroyed by a fire, adds, that the devastation had been increased by a violent storm which took place at the time; by the laziness of the inhabitants, and by the

want of machines or apparatus proper for extinguishing the flames[584]. The word *sipho*, which the author here uses, was certainly the fire-engine of Ctesibius; though some under this term understand only aqueducts, canals, and pipes for distributing water throughout the city. I will not deny that this word may have signified such pipes, particularly on account of a passage in Strabo[585], where he speaks of the subterranean conduits of Rome, and says that almost all the houses had cisterns, *siphones*, or water-pipes, and running streams. But Pliny at the same time mentions water-buckets, which may be considered as an appendage absolutely necessary to a fire-engine. It is also hardly possible to believe that a town, immediately situated on an arm of the sea, should be destitute of water[586].

I can however produce from a contemporary writer, a strong proof that Pliny alluded here to a fire-engine, and I do not find that the passage has been before quoted. Apollodorus, the architect, who was employed by the emperor Trajan in constructing the celebrated bridge over the Danube, and erecting some large works at Rome, and who was put to death by his successor Adrian, out of revenge for a jeering answer which he received from him, as we are told by Dio Cassius, describes in the fragment of his book on warlike machines, how assistance may be given when the upper part of a building is on fire, and the machine called *sipho* is not at hand. In this case leathern bags filled with water are to be fastened to long pipes in such a manner, that by pressing the bags the water may be forced through the pipes to the place which is in flames[587]. The *sipho*, therefore, was a machine by which water might be easily projected to a considerable height, to extinguish a place on fire that could not be reached by any other means.

That in the fourth century at least a fire-engine, properly so called, was understood under the term *sipho*, is fully proved by Hesychius, and also by Isidorus, who lived in the beginning of the seventh century[588]. As the latter remarks that such engines were employed in the East for extinguishing fires, there is reason to conclude that they were not then used in the west.

The question still remains, at what time this apparatus for extinguishing fires was introduced at Rome. From the numerous ordinances for preventing accidents by fire, and in regard to extinguishing fires, which

occur in the Roman laws[589], there is reason to conjecture that this capital was not unprovided with those useful implements and machines, of the want of which in a provincial town Pliny complains, and which he himself had supplied. This conjecture, however, I am not able to prove; and instances both in ancient and modern times show that the good police establishments of small towns are not always to be found in capitals. Antioch and several other towns were provided with lanterns, which were wanting even in the proud Rome. But what excites some doubt is, that fire-engines are never mentioned in the numerous accounts given of the fires which took place in that city. At present it is impossible to speak of a misfortune of this kind without stating whether a sufficient number of engines were assembled, and what they effected, as Pliny has not failed to do in his short account of the fire at Nicomedia.

One passage, however, in Ulpian is commonly quoted as a proof that in his time there were fire-engines at Rome. Where he enumerates those things which ought to belong to a house when sold, he mentions, besides other articles used for extinguishing fires, *siphones*[590]. But if this word means here fire-engines, the passage seems to prove too much; for it must then be admitted that each house had a fire-engine of its own. These implements therefore must have been small hand-engines, such as are kept in many houses at present; and in that case the passage cannot be adduced as a proof of public engines, such as Pliny regrets the want of at Nicomedia. But it is much more probable that Ulpian alludes only to those *siphones* which, according to the account of Strabo, were to be found in every house at Rome; that is, pipes which conveyed water to it for domestic purposes.

From the total want of fire-engines, or the imperfect manner in which they were constructed, what Seneca says must have been true, namely, that the height of the houses at Rome rendered it impossible to extinguish them when on fire[591]. That the buildings there were exceedingly high, and the lanes, the bridges and even the principal streets remarkably narrow, is well-known[592]. It is supposed by Archenholz and others, that the houses at Rome were built of such a height on account of the great heat in that warm climate; but the chief reason was undoubtedly that assigned by Vitruvius[593], which still produces a like effect. For want of room on the earth, the

buildings were extended towards the heavens; so that at last the greatest height of an edifice was fixed by law at seventy, and afterwards at sixty feet. In Hamburg, at present, where ground is dear and daily becoming more valuable, the greater part of the houses are little less than sixty feet in height; a few even are seventy; and that it is thereby rendered difficult, if not impossible, notwithstanding the perfection of the German engines, to extinguish fires, is proved by the melancholy instance of Gera, where the houses are now built lower. With Neubert's engine, which was tried at Hamburg in 1769, eight firemen threw eleven and a half cubic feet of water to the height of sixty-two or sixty-three feet.

In the East engines were employed not only to extinguish but to produce fires. The Greek fire, invented by Callinicus, an architect of Heliopolis, a city afterwards named Balbec, in the year 678, the use of which was continued in the East till 1291[594], and which was certainly liquid[595], was employed in many different ways; but chiefly on board ship, being thrown from large fire-engines on the ships of the enemy. Sometimes this fire was kindled in particular vessels, which might be called fire-ships, and which were introduced among a hostile fleet; sometimes it was put into jars and other vessels, which were thrown at the enemy by means of projectile machines[596], and sometimes it was squirted by the soldiers from hand-engines; or, as appears, blown through pipes. But the machines with which this fire was discharged from the fore-part of ships, could not have been either hand-engines or such blow-pipes. They were constructed of copper and iron, and the extremity of them sometimes resembled the open mouth and jaws of a lion or other animal; they were painted and even gilded, and it appears that they were capable of projecting the fire to a great distance[597]. These machines by ancient writers are expressly called spouting-engines. John Cameniata, speaking of the siege of his native city, Thessalonica, which was taken by the Saracens in the year 904, says that the enemy threw fire into the wooden works of the besieged, which was blown into them by means of tubes, and thrown from other vessels[598]. This passage, which I do not find quoted in any of the works that treat on the Greek fire, proves that the Greeks in the beginning of the tenth century were no longer the only people acquainted with the art of preparing this

fire, the precursor of our gunpowder. The emperor Leo, who about the same period wrote his art of war, recommends such engines, with a metal covering, to be constructed in the fore-part of ships[599], and he twice afterwards mentions engines for throwing out Greek fire[600]. In the East one may easily have conceived the idea of loading some kind of pump with the Greek fire; as the use of a forcing-pump for extinguishing fires was long known there before the invention of Callinicus.

At what time the towns in Germany were first furnished with fire-engines I am not able to determine. In my opinion they had regulations in regard to fires much earlier than engines; and the former do not seem to be older than the first half of the sixteenth century. The oldest respecting the city of Frankfort-on-the-Maine, with which I am acquainted, is of the year 1460. The first general ordinance respecting fires in Saxony was issued by Duke George in 1521. The first for the city of Dresden, which extended also to the whole country, was dated 1529. In many towns, the first regulations made by public authority for preventing fires will no doubt be found in the general regulations in regard to building, which seem to be somewhat older than the particular ordinances concerning fires. At Augsburg an express regulation in regard to building was drawn up and made publicly known as early as 1447. In turning over old chronicles, it is remarked that great fires began to occur less frequently in the sixteenth century; and this is undoubtedly to be ascribed to the improved mode of building[601], the precautions enjoined by governments to prevent fires, and the introduction of apparatus for extinguishing them. But by the invention of fire-engines, every thing in this respect was so much changed, that a complete revision of the regulations in regard to the extinguishing of fires became necessary; and therefore the first mention of town fire-engines will in all probability be found in the new fire ordinances of the sixteenth and following century.

It has been remarked by Von Stetten, that in the building accounts of the city of Augsburg, fire-engines are first mentioned in the year 1518. They are called there *instruments for fires*, *water syringes* useful at fires; and these names seem to announce that the machine was then in its infancy. At that time they were made by a goldsmith at Friedberg, named Anthony Blatner, who the same year became a citizen of Augsburg. From the account added,—that the wheels and levers were constructed by a wheelwright, and

from the greatness of the expense,—there is reason to conclude that these were not small, simple hand-engines, but large and complex machines. In that respectable dictionary entitled Maaler's Teutschsprach, Zurich, 1561, I find fire-hooks and fire-ladders, but no instrument similar to a fire-engine.

In the year 1657, the well-known jesuit Caspar Schott was struck with admiration on seeing at Nuremberg a fire-engine, which had been made there by John Hautsch. It stood on a sledge, ten feet long and four feet broad. The water-cistern was eight feet in length, four in height, and two in width. It was moved by twenty-eight men, and forced a stream of water an inch in diameter to the height of eighty feet[602]; consequently over the houses. The machine was drawn by two horses. Hautsch distributed throughout Germany an engraving of it, with an offer of constructing similar ones at a moderate price, and teaching the use of them; but he refused to show the internal construction of it to Schott, who however readily conjectured it. From what he says of it, one may easily perceive that the cylinders did not stand in a perpendicular direction, but lay horizontally in a box, so that the pistons moved horizontally, and not vertically, as at present. Upright cylinders therefore seem to belong to the more modern improvements. Schott adds, that this was not a new invention, as there were such engines in other towns; and he himself forty years before, and consequently in 1617, had seen one, but much smaller, in his native city. He was born, as is well-known, in 1608, at Königshofen, not far from Würzburg. George Hautsch also, son of the above artist, constructed similar engines, and perhaps with improvements, for Wagenseil[603] and others have ascribed to him the invention.

The first regulations at Paris respecting fires, as far as is known, were made to restrain incendiaries, who in the fourteenth century, under the name of *Boutefoux*, occasioned great devastation, not only in the capital, but in the provinces. This city appears to have obtained fire-engines for the first time in the year 1699; at any rate the king at that period gave an exclusive right to Dumourier Duperrier to construct those machines called *pompes portatives*; and he was engaged at a certain salary to keep in repair seventeen of them, purchased for Paris, and to procure and to pay the necessary workmen. In the year 1722 the number of these engines was increased to thirty, which were distributed in different quarters of the city;

and at that time the contractors received annually 20,000 livres. The city, however, besides these thirty royal engines, had a great many others which belonged to the Hotel de Ville, and with which the Sieur Duperrier had nothing to do[604].

In the middle of the seventeenth century fire-engines indeed were still very imperfect. They had neither an air-chamber nor buckets, and required a great many men to work them. They consisted merely of a sucking-pump and forcing-pump united, which projected the water only in spurts, and with continual interruption. Such machines, on each movement of the lever, experience a stoppage, during which no water is thrown out; and because the pipe is fixed, it cannot convey water to remote places, though it may reach a fire at no great distance, where there are doors and windows to afford it a passage. At the same time the workmen are exposed to danger from the falling of the houses on fire, and must remove from them to a greater distance. Hautsch, however, had adapted to his engine a flexible pipe, which could be turned to any side as might be necessary, but certainly not an air-chamber, otherwise Schott would have mentioned it. In the time of Belidor there were no other engines in France, and the same kind alone were used in England in 1760. Professor Busch at least concludes so[605], from the account then given by Ferguson, who called Newsham's engine, which threw the water out in a continued stream, a new invention. In Germany the oldest engines are of this kind.

Who first conceived the idea of applying to the fire-engine an air-chamber, in which the included air, by compressing the water, forces it out in a continued stream, is not known. According to a conjecture of Perrault, Vitruvius seems to speak of a similar construction; but Perrault himself acknowledges that the obscure passage in question[606] might be explained in another manner. The air-chamber in its action has a similarity to Hero's fountain, in which the air compressed by the water obliges the latter to ascend[607].

I can find no older fire-engine constructed with an air-chamber than that of which Perrault has given a figure and description. He says it was kept in the king's library at Paris, and during fires could project water to a great height; that it had only one cylinder, and yet threw out the water in

one continued jet. He mentions neither its age nor the inventor; and I can only add that his book was printed in 1684. The principle of this machine, however, seems to have been mentioned before by Mariotte, who on this account is by some considered as the inventor; but he does not appear to have had any idea of a fire-engine, at least he does not mention it.

It is certain that the air-chamber, at least in Germany, came into common use after it was applied by Leupold to fire-engines, a great number of which he manufactured and sold. He gave an account of it in a small work, consisting of four sheets quarto, which was published in 1720, but at first he kept the construction a secret. The engines which he sold consisted of a strong copper box closely shut and well-soldered. They weighed no more than sixteen pounds, occupied little room, had only one cylinder; and a man with one of them could force up the water without interruption to the height of from twenty to thirty feet. About 1725 Du Fay saw one of Leupold's engines at Strasburg, and discovered by conjecture the construction of it, which he made known in the Transactions of the Academy of Sciences at Paris for that year. It is very singular that on this occasion Du Fay says nothing of Mariotte, or of the engine in the king's library. Leupold, however, had some time before, that is in 1724, given a description and figure in his Theatrum Machinarum Hydraulicarum[608], with which undoubtedly Du Fay was not acquainted.

Another improvement, no less useful, is the leather hose added to the engine, which can be lengthened or shortened as necessary, and to which the fire-pipe is applied, so that the person who directs the jet of water can approach the fire with less danger. This invention, it is well known, belongs to two Dutchmen, both named Jan van der Heide[609], who were inspectors of the apparatus for extinguishing fires at Amsterdam. The first public experiments made with it took place in 1672; and were attended with so much success, that at a fire next year, the old engines were used for the last time, and the new ones introduced in their stead. In 1677, the inventor obtained an exclusive privilege to make these engines during the period of twenty-five years. In 1682, engines on this construction were distributed in sufficient number throughout the whole city, and the old ones were entirely laid aside. In 1695 there were in Amsterdam sixty of these engines, the

nearest six of which were to be employed at every fire. In the course of a few years they were common throughout all the towns in the Netherlands.

All these circumstances have been related by the inventor in a particular work; which, on account of the excellent engravings it contains, is exceedingly valuable[610]. Of these, the first seven represent dangerous conflagrations at which the old engines were used, but produced very little effect. One of them is the fire which took place in the stadthouse of Amsterdam in the year 1652. The twelve following plates represent fires which were extinguished by means of the new engines, and exhibit, at the same time, the various ways in which the engines may be employed with advantage. According to an annexed calculation, the city of Amsterdam lost by ten fires, when the old apparatus was in use, 1,024,130 florins; but in the following five years, after the introduction of the new engines, the loss occasioned by forty fires amounted only to 18,355 florins; so that the yearly saving was ninety-eight per cent. Of the internal construction of these engines no description or plates have been given; nor do I remember to have read a passage in any author from which it can be concluded that they were furnished with an air-chamber, though in the patents they were always called *spouting-engines*, which threw up one continued jet of water. The account given even of the nature of the pipe or hose is short and defective, probably with a view to render it more difficult to be imitated. It is only said that it was made of leather in a particular manner; and that, besides being thick, it was capable of resisting the force of the water.

The conveyer or bringer was invented also about the same time by these two Dutchmen. This name is given at present to a box which has on the one side a sucking-pump, and on the other a forcing-pump. The former serves to raise the water from a stream, well, or other reservoir, by means of a stiff leathern pipe, having at the extremity a metal strainer pierced with holes to prevent the admission of dirt, and which is kept suspended above the mud by a round piece of cork. The forcing-pump drives the water thus drawn up through a leathern pipe into the engine, and renders the laborious conveyance of water by buckets unnecessary.

At first, indeed, this machine was exceedingly simple. It consisted only of a leathern pipe screwed to the engine, the end of which widened into a bag supported near the reservoir, and kept open by means of a frame, while

the labourers poured water into it from buckets. A pump, however, to answer this purpose was soon constructed by the Van der Heides, who named it a *snake-pump*. By its means they were able to convey the water from the distance of a thousand feet; but I can find no account of the manner in which it was made. From the figure, I am inclined to think that they used only one cylinder with a lever. Sometimes also they placed a portable pump in the water, which was thus drawn into a leathern hose connected with it, and conveyed to the engine. Every pipe or hose for conveying water in this manner they called a *wasserschlange*, water-snake, and this was not made of leather, like the hose furnished with a fire-pipe, but of sail-cloth. They announced, however, that it required a particular preparation, which consisted in making it water-tight by means of a proper cement. The pipe also, through which the water is drawn up, must be stiffened and distended by means of metal rings; otherwise the external air, on the first stroke of the pump, would compress the pipe, so that it could admit no water. It is here seen that pipes made of sail-cloth are not so new an invention as many have supposed. That our present apparatus for conveying water to the fire-engine is much more ingenious, as well as convenient, must be allowed; but I would strongly recommend that in all cities there should be pumps, or running wells of water, to the spout of which pipes having one end screwed to a fire-engine might be affixed. The Van der Heides, among the advantages of their invention, stated that this apparatus rendered it unnecessary to have leathern buckets, which are expensive, or at any rate lessened their number, as well as that of the workmen.

From this account, the truth of which cannot be doubted, one may readily believe that engines with leathern hose were certainly not invented by Gottfried Fuchs, director of the fire apparatus at Copenhagen, in the year 1697, as publicly announced in 1717, with the addition, that this invention was soon employed both in Holland and at Hamburg. Fuchs seems only to have made known the Dutch invention in Denmark, on occasion of the great fire which took place on the 19th of April 1689, at the Opera-house of Amalienburg, when the beautiful palace of that name, and more than 350 persons were consumed. At any rate we are told in history, that, in consequence of this calamity, an improvement was made in the fire establishment, by new regulations issued on the 23rd of July 1689, and that

engines on the Dutch construction, which had been used more than twelve years at Amsterdam, were introduced.

Hose or pipes of this kind for conveying water were however not entirely unknown to the ancients. At least the architect Apollodorus says, that to convey water to high places exposed to fiery darts, the gut of an ox, having a bag filled with water affixed to it, might be employed; for on compressing the bag, the water would be forced up through the gut to the place of its destination[611]. This was a conveyer of the simplest kind.

Among the latest proposals for improving the hose is that of weaving one without a seam. In 1720, some of this kind were made of hemp at Leipsic, by Beck, a lace-weaver, as we are told by Leupold, in his before-mentioned work on fire-engines, which was printed the same year. After this they were made by Erke, a linen-weaver of Weimar; and at a later period they were made of linen at Dresden, and also in Silesia[612]. In England, Hegner and Ehrliholzer had a manufactory at Bethnal-green, near London, where they made water-tight hose without seams[613]. Some of the same kind are made by M. Mögling on his estate near Stutgard, on a loom of his own invention, and are now used in many towns of the duchy of Wirtemberg. I shall here remark, that Braun had a loom on which shirts could be wove without a seam, like those curious works of art sometimes brought from the East Indies, and of which he has given a full description with an engraving[614].

In the last place, I shall observe, that notwithstanding the belief of the Turks in predestination, fire-engines are in use at Constantinople, having been introduced by Ibrahim Effendi.

[The fire-engines now in use are made upon the air-chamber principle above-described. Mr. Braithwaite has applied steam-power to the working of fire-engines. On this principle a locomotive and a floating engine have been constructed. The former was first employed at a fire in the Argyle Rooms in 1830. It required eighteen minutes to elapse before the water in the boiler was raised to 212°, and threw up from thirty to forty tons of water per hour, to a height of ninety feet. Two others have been constructed by the same engineer, one of which threw up ninety tons of water per hour, and

one made for the king of Prussia threw up about 61¾ tons per minute. In the steam floating engine which lies in the Thames, the machinery either propels the vessel, or works the pumps as required. The pipes used for conveying the water from the plugs to the engines are now constructed of leather, the seams being either sewed up or fastened with metallic rivets.]

FOOTNOTES

[582] Lib. x. cap. 12, p. 347. Compare lib. ix. cap. 9. p. 321.

[583] In that book entitled Πνευματικὰ, or Spiritualia. It may be found Greek and Latin in Veterum Mathematicorum Opera, Parisiis 1693, fol. p. 180.

[584] Epist. 42, lib. x.

[585] Lib. v. edit. Almel. p. 360.

[586] Plin. lib. v. cap. ult.

[587] Poliorcetica, p. 32, in Veterum Mathematicorum Opera.

[588] Orig. xx. 6. Fire-engines are used in many towns to wash the windows in the upper stories, which cannot be taken out.

[589] See Digest. i. tit. 15, where all persons are ordered to have water always ready in their houses. Also Digest. 47, tit. 9. Many things relating to this subject may be found in L. A. Hambergeri Opuscula, Jenæ et Lips. 1740, 8vo, p. 12; in the Dissertation de Incendiis. Further information respecting the police establishment of the Romans in regard to fires, is contained in two dissertations, entitled G. C. Marquarti de Cura Romanorum circa Incendia. Lips. 1689, 4to. And Ev. Ottonis Dissertat de Officio Præfecti Vigilum circa Incendia. Ultrajecti 1733.

590 Digest. xxxiii. 7, 18. Dier. Genial. v. 24.

591 Controvers. 9, libri ii.

592 In Germany also the roads and the distance between the ruts made by cart-wheels were in old times very narrow. Some years ago, when the new tile-kiln was built before the Geismar gate at Göttingen, there was found at a great depth, a proof of its antiquity, a street or road which had formerly proceeded to the city with so small a space marked out by carriage-wheels, that one like it is not to be seen in Germany.

593 Lib. ii. cap. 8.

594 Hanovii Disquisitiones. Gedani 1750, 4to, p. 65.

595 Annæ Comnenæ Alexiad. lib. 16. p. 385; πῦρ ὑγρόν.

596 A projectile machine of this kind is mentioned by Joinville, p. 39.

597 See the passage of Anna Comnena quoted by Hanov. p. 335.

598 In Leonis Allatii Σύμμικτα. Colon. 1653, 8vo, p. 239.

599 Cap. 19, § 6, p. 322.

600 Pp. 344, 346.

601 Thus in the year 1466 straw thatch, and in 1474 the use of shingles were forbidden at Frankfort.—Lersner, ii. p. 22.

602 Doppelmayer says that the water was driven to the height of a hundred feet.

603 Doppelmayer, p. 303.

604 Contin. du Traite de la Police, par De la Mare, p. 137.

[605] Mathematik zum Nutzen und Vergnügen, 8vo, p. 396.

[606] Lib. x. cap. 12.

[607] Spiritualia, 36, p. 35.

[608] Vol. i. p. 120, tab. 45, fig. 2.

[609] In the patent, however, they were named *Jan* and *Nicholas van der Heyden*.

[610] Beschryving der nieuwliiks uitgevonden Slang-Brand-Spuiten, Jan van der Heide, Amst. 1690, folio.

[611] Poliorcet. page 32.

[612] Leipziger Intelligenzblatt, 1775, p. 345; and 1767, p. 69. Teutscher Merkur, 1783.

[613] Lysons's Environs of London.

[614] Vestitus Sacerdotum Hebræorum. Amst. 1701, 4to, i. p. 273. Much useful information in regard to various improvements in the apparatus for extinguishing fires may be found in Aug. Niemann Uebersicht der Sicherungsmittel gegen Feuersgefahren. Hamb. und Kiel, 1796, 8vo.

INDIGO.

It is more than probable that indigo, so early as the time of Dioscorides and Pliny, was brought to Europe, and employed there in dyeing and painting. This I shall endeavour to show; but under that name must be understood every kind of blue pigment, separated from plants by fermentation, and converted into a friable substance by desiccation; for those who should maintain that real indigo must be made from those plants named in the botanical system *Indigofera tinctoria*, would confine the subject within too narrow limits; as the substance which our merchants and dyers consider as real indigo is prepared, in different countries, from so great a number of plants, that they are not even varieties of the same species.

Before the American colonies were established, all the indigo employed in Europe came from the East Indies; and till the discovery of a passage round the Cape of Good Hope, it was conveyed, like other Indian productions, partly through the Persian Gulf, and partly by land to Babylon, or through Arabia and up the Red Sea to Egypt, from which it was transported to Europe. Considering this long carriage, as the article was not obtained, according to the Italian expression, *a drittura*, that is, in a direct manner, it needs excite no surprise, that our knowledge, in regard to its real country and the manner of preparing it, should be exceedingly uncertain and imperfect. Is it astonishing that articles, always obtained through Arabia, should be considered as productions of that country; and that many commodities which were the work of art, should be given out to be productions of nature? For more than a hundred years the Dutch purchased from the Saxons cobalt, and smalt made from it, and sold them again in India; and the Indians knew as little where and in what manner the Dutch obtained them, as the Saxons did the people who were the ultimate purchasers and consumers. The real nature of indigo was not generally known in Europe till the Europeans procured it from the first hand; yet long after that period, and even in the letters-patent obtained on the 23rd of

December 1705, by the proprietors of the mines in the principality of Halberstadt and the county of Reinstein, indigo was classed among minerals on account of which works were suffered to be erected; but this only proves the individual ignorance of the undertakers, and also of their superiors, when they read what they had written, and confirms the justness of Ovid's advice,

Disce bonas artes, moneo, Germana juventus;
Non tantum trepidos ut tueare reos.

What Dioscorides calls *Indicon*, and Pliny and Vitruvius *Indicum*, I am strongly inclined to believe to have been our indigo[615]. It was a blue pigment brought from India, and used both in painting and in dyeing. When pounded it gave a black powder, and when suspended in water it produced an agreeable mixture of blue and purple. It belonged to the costly dye-stuffs, and was often adulterated by the addition of earth. On this account, that which was soft without any roughness, and which resembled an inspissated juice, was esteemed the best. Pliny thinks[616] that pure indigo may be distinguished from that which is adulterated by burning it, as the former gives an exceedingly beautiful purple flame, and emits a smell similar to that of sea-water. Both he and Dioscorides speak of two kinds, one of which adheres to reeds, in the form of slime or scum thrown up by the sea; the other, as Dioscorides says, was scraped from the sides of the dye-pans in the form of a purple-coloured scum; and Pliny expressly remarks, that it was collected in this manner in the establishments for dyeing purple. The former relates also, that *Indicum* belonged to the astringent medicines; that it was used for ulcers and inflammations, and that it cleansed and healed wounds.

This is all, as far as I know, that is to be found in the works of the ancients respecting *Indicum*. I have given it at full length, as accurately as possible, and I have added, in order that the reader may be better able to compare and judge, references to the original words of the authors. *Indicon*, it is true, occurs in other passages; but it was certainly different from the one already mentioned. I allude, for example, to the black *Indicon* of Arrian and the *Indicon* of Hippocrates. Of the former I shall treat in particular hereafter; and in regard to the latter, I refer to the author quoted in the note

below[617]. It is not at all surprising that these names should be applied to more Indian commodities, since at present we give to many kinds of fruit, flowers, fowls and other things, the appellation of Indian. The ancients, indeed, were not so careful as to distinguish always, by a proper addition, the many articles to which they gave the name of *Indica*; and they had reason to expect that their contemporaries would readily comprehend by the connexion, the kind that was properly meant. Their commentators, however, in later times have for the most part thought only of one species or thing, and by these means they have fallen into mistakes which I shall here endeavour to rectify.

Everything said by the ancients of *Indicum* seems to agree perfectly with our indigo. The proper country of this production is India; that is to say, Gudscharat or Gutscherad, and Cambaye or Cambaya, from which it seems to have been brought to Europe since the earliest periods. It is found mentioned, from time to time, in every century; it is never spoken of as a new article, and it has always retained its old name; which seems to be a proof that it has been used and employed in commerce without interruption.

It is true, as the ancients say, that good indigo, when pulverized, is of a blackish colour. The tincture, however, is partly blue and partly purple; but under the latter term we must understand an agreeable violet, and not, as is often the case, our scarlet. It is true also that good indigo is soft or smooth to the touch[618] when pounded; it floats on water, and at present, as in the time of Pliny, is adulterated and rendered heavier by the admixture of some earth, which in general, as appears, is fine pounded slate[619]. It is further true that the purity of it can be discovered by burning it. Indigo free from all foreign bodies leaves but little ash, while that which is impure leaves a large quantity of earth. Pliny, perhaps, did not rightly understand this test by fire, and added from conjecture, what he says in regard to the colour of the flame and the smell of the smoke, that this proof might not remain without an explanation. It is, however, possible that those who considered indigo to be sea-slime, imagined that they perceived in it a smell of sea-water. A naturalist of modern times, who refers petrifactions to Noah's flood, believed that he could smell sea-water in them after the lapse of so many thousand years.

Indicum, on account of its long carriage by land, must have been dear, and therefore it was one of those pigments which the ancient painters, who were often poor slaves, were not accustomed to keep in any quantity by them, and with which it was necessary they should be supplied by those for whom they executed paintings[620]. Our indigo was also exceedingly dear till it was cultivated in the West Indies, where the value of it decreased as long as good land was plentiful and the price of labour was lessened by the slave-trade.

That indigo, which at present is used only by dyers, should have been employed also for painting, needs excite no surprise. It was applied to this purpose till the invention of painting in oil, and the discovery of Prussian blue, smalt and other pigments of a superior quality. It is even still used by landscape-painters to produce a pale gray; but it will not harmonise with oil. As to the medical properties of indigo, I can at any rate show that the experiments made with it at the end of the seventeenth and the beginning of the eighteenth century fully confirm the high encomium bestowed by Dioscorides upon his *Indicum*. There was a time when the former was much prescribed and recommended. At present our physicians are acquainted with purer and more powerful remedies than indigo, the internal use of which, as the fermented mass is prepared in copper vessels, must be attended with suspicion.

That the author, so often mentioned already, was not acquainted with the preparation of indigo, cannot be denied. It would, indeed, have been extraordinary had the account of it reached the Greeks and the Romans undisguised by fables, added either to answer the purposes of the interested merchant, or accidentally in the course of its long journey, in passing through so many countries and languages. It appears to me, however, that through these it may still be discovered; and in all probability we should be better able to form some idea of it were the oldest method of making indigo still known. In the slime deposited on the reeds, I think I can remark the first degree of fermentation, or commencement of putrefaction, without which the pigment could not be separated. Who knows whether the indigo plants in the earliest times were not deposited in pits or in stagnant water, in the same manner as our flax and hemp? Who knows whether after putrefaction they were not taken out, and the colouring parts adhering to them washed off and collected? The quantity indeed obtained by this

process would not be great, and at present a much better method is employed; but the improvements made in every art have been gradual. The old inhabitants of the Canary islands scratched their land with the horns of oxen, because they were not acquainted with the spade, and far less with the plough. The above conjecture will appear much more probable, when it is known that in many parts of India the plants were formerly placed in large pits; and in Malta, where indigo was still cultivated in the seventeenth century, they were put into reservoirs or basins in order to ferment[621]. If this was usual in the oldest times, it may be easily seen how fabulous accounts might arise. Indigo was a slime attracted from the water by a reed, which the indigo plant, stripped of its bark, was considered to be.

Dioscorides speaks of another kind of indigo, which was the dried purple-coloured scum of the dye-pans. My predecessors, considering this account as an error, which might have arisen either from conjecture or misconception, or which was purposely occasioned by merchants, did not think it worthy of further examination. I cannot, however, refrain from remarking, that a blue pigment, and even a very fine one, if the proper preparations had been made for that purpose, might have been obtained in this manner. It was not indeed indigo, in the proper sense of the word, but a pigment of a similar nature. That fine high-priced powder sold, at present, under the name of blue carmine, is made from the separated scum of a dye-liquor, in which the finest colouring particles remain suspended. The scum or flower of a blue pan[622] which floats on the surface exhibits a play of many colours; and as among these the ancient purple is frequently observed, it may therefore very properly be said to have a purple colour[623]. In my opinion, there is no reason to disbelieve Dioscorides, when he says that in his time a blue pigment named indigo was made in this manner, especially as it can be proved that the woad-dyers, at the end of the sixteenth century, separated from their pans a colouring substance, which they sold instead of indigo, an article at that time exceedingly dear[624]. Besides, we read that in the establishments for dyeing black, the scum was in like manner collected in old times in the form of a black pigment, and this practice, as appears, was usual in all the dye-houses in general. Pliny, who says that this indigo was made in the purple dye-houses, seems either to have misunderstood Dioscorides, or to have been too precipitate; but it is

certain that the scum in the purple dye-houses may have been collected and dried into a purple-coloured carmine.

As the Europeans did not become acquainted with the nature of indigo till modern times, it needs excite no astonishment that the old commentators should have erred in explaining the passages to which I here allude; and their opinion can therefore be of little weight in opposition to mine. Those who have approached nearest to the truth, Sarazen, Mathioli, Salmasius, &c., speak as if indigo were made from our woad, which however does not grow in India. Dioscorides speaks also of woad in a particular section. Marcellus Vergilius says, that Dioscorides meant indigo is certain; and this article is so generally known that it is not worth while to mention it. But he himself seems not to have been acquainted with it, else he would have amended the erroneous passage which speaks of *Indian stone*[625]. This arose from the ignorance of the old transcribers, who being unacquainted with *Indicum* thought only of *gemma Indica*, mentioned by Pliny[626]. But Vergilius was right in this, that the purple lake, spoken of by Pliny, and not by Dioscorides as he believes, can no longer be produced.

I have long made it a rule, and prescribed it to others, in explaining any object mentioned by the ancients, never to admit, without the strongest proofs, that the same article is denoted by different appellations. This, it is true, has been often done. By these means the small knowledge we possess of a thing that occurs under one name only may be increased. A wider field may thus be opened for conjecture, and more latitude may be given to the imagination; but at the same time one may fall into groundless explanations, and hazard assertions, which, with whatever caution and learning proposed, will, on closer examination, be found either false or highly improbable. According to this rule, I have carefully endeavoured not to suffer myself to be so far misled by the respectability of my predecessors, as to consider the *Indicum* and *Indicum nigrum* of the ancients to be the same substance. On further research I find that the latter not only appears by the epithet to be different from indigo, but that it is China, or, as the Dutch call it, Indian ink. To prove this, I must refer to the passage of Pliny[627] on which my assertion is founded; and perhaps the short illustrations added will render this minuteness less tedious to those who are fond of such disquisitions. In the passage referred to, Pliny enumerates all

the materials which in his time were used for black ink. He therefore mentions two vitriolic substances, a slime or sediment (*salsugo*), and a yellow vitriolic earth (called also *misy*). Such minerals continued in use as long as men were unacquainted with the art of lixiviating the salt, and causing it to crystallize; or in other words, as long as they had no vitriol-manufactories. He speaks also of lamp-black being made in huts built for the purpose, which are described by Vitruvius, and from which the smoke of burning pine-wood was conveyed into a close apartment. The article was certainly adulterated, when soot, taken from the baths and other places where an open fire was maintained with wood of all kinds, was intermixed with it. It is very remarkable that black from burnt refuse of grapes, *noir de vigne*, which at present our artists, and particularly our copper-plate printers, consider as the most beautiful black, was made even at that period. Germany hitherto has obtained the greater part of this article from Mentz, through Frankfort, and on that account it is called Frankfort black. Some is made also at Kitsingen, Markbreit, and Munich. For this purpose the refuse of the grapes is charred in a close fire, and being then finely pounded is packed into casks. Pliny observes, that it was asserted that from this substance one could obtain a black which might be substituted for indigo. Another pigment was bone-black, or burnt ivory, which is highly esteemed even at present. Besides these, continues he, there is obtained from India what is called *Indicum*, the preparation of which I have not yet been able to learn: but a similar pigment is made from the black scum of the dye-pans, in places for dyeing black, and another kind is obtained from charred fir-wood finely pulverized. The cuttle-fish (*sepia*) likewise gives a black; but that however has nothing to do with the present question. He remarks, in the last place, that every kind of black pigment is improved, or rather the preparation of it completed, by exposure to the sun[628]; that is to say, after gum has been added to that intended for writing, and size to that destined for painting. But that which was made with vinegar was more durable, and could not be easily effaced by washing. All this is very true. Our ink acquires a superior quality when exposed to the light of the sun in flat vessels. That vinegar renders black colours faster, is well known to our calico-printers; and those who wish to have good ink must employ in making it the brightest vinegar of beer. It is equally true, that every black

pigment mixed up with gum or size can be sooner and easier washed out again with water[629].

A considerable part of what has hitherto been quoted from Pliny, may be found also in Vitruvius[630]. The latter, in like manner, mentions huts for making lamp-black; he speaks also of ivory-black, and says expressly, that when it is properly made it not only forms a good colour and excellent ink, but approaches very near to *Indicum*.

Now I might here ask, whether it is at all probable that the learned Pliny and the practical connoisseur of painting, the architect Vitruvius, could consider and describe our blue indigo as a pigment which, like lamp-black, could be employed as a black colour and as ink? Is it credible that Pliny, if he meant blue indigo in the before-mentioned passage, would have said that he was not able to learn the preparation of it, when he expressly describes it, as he believed it to be, in the course of a few lines further? Would Pliny and Vitruvius, had they been acquainted with black indigo only, remark immediately after, that, when costly indigo could not be obtained, earth saturated with woad, consequently a blue earth, might be used in its stead? Is not allusion here made to a blue pigment, as was before to a black one? Is it not therefore evident, that the name of *Indicum* was given to a black and also to a blue pigment brought from India? And if this be the case, is it not highly probable that the black *Indicum* was what we at present call Indian ink, which approaches so near to the finest ivory-black, and black of wine lees, that it is often counterfeited by these substances, a preparation of which is frequently sold as Indian ink to unwary purchasers? Indian ink is in general use in India, and has been so in all probability since the earliest ages. In India all artificial productions are of very great antiquity; and therefore I will venture to say, that it is not probable that Indian ink is a new invention in India, although it may probably have been improved, and particularly by the Chinese.

To confound the two substances, however, called indigo (*indicum*) at that period was not possible, as every painter and dealer in colours would know that there were two kinds, a blue and a black. It has, nevertheless, occurred to me, that in the works of the ancients obscurity may have sometimes been avoided by the addition of an epithet; and I once thought I had found in Pliny an instance of this foresight; that is, where he names all

kinds of colours—*purpurissum*, *Indicum cæruleum*, *melinum*, *auripigmentum*, *cerussa*[631]. I conceived that in this passage our indigo was distinguished from the black *indicum* by the epithet *cæruleum*. But my joy at this discovery was soon damped by Hardouin, who places between *Indicum* and *cæruleum* a comma, which is not to be found in many of the oldest and best editions. I cannot, therefore, get rid of this comma; for it is beyond all dispute that *cæruleum* was the common appellation of blue copper ochre, that is, mountain blue. I shall now proceed to examine whether my observation be true, that the Greeks frequently used the term black *indicum*, when they meant to denote the black, and not the blue.

The term *nigrum Indicum* occurs in Arrian, Galen, Paulus Ægineta, and perhaps in the works of other Greek physicians; and as the Latin writers were acquainted with an *Indicum* which dyed black, there is reason to conjecture that this was the *Indicum nigrum* of the Greeks, though I should rather be inclined to translate this appellation by the words Indian black, in the same manner as we may say Berlin blue, Roman red, Naples yellow, Brunswick green, Spanish brown, &c.; or I should as readily translate it Indian ink. Arrian introduces it along with other Indian wares. I do not indeed find that he makes any mention of indigo properly so called; but a complete catalogue of merchandise is not to be expected from him. *Indicum*, however, occurs once more in this author; but in the passage where it is found it is only an epithet to another article. Speaking of cinnabar, he adds, that he means that kind called Indian, which is obtained from a tree in the same manner as gum. I am inclined to think that he alludes to dragon's blood, which on account of its colour was at that time called cinnabar.

Some have conjectured that what in Arrian is named *laccos chromatinos* was our indigo, which indeed might be classed among the lakes, according to the present meaning of that word. Others understand by it gum-lac[632]. But I am unacquainted with any proofs that gum-lac was known at so early a period. I much doubt whether this meaning of the word lac be so old; and I must confess that the opinion of Salmasius appears to me highly probable, namely, that Arrian alluded to a kind of party-coloured garment: for besides the grounds adduced by Salmasius, it deserves to be remarked, that in the passage in question different kinds of clothes, and no

other articles are mentioned. Besides, the epithet *chromatinos* is applied by the same writer, in the same sense, to other kinds of clothing. It cannot therefore be said that Arrian mentions our gum-lac, the origin of which word Salmasius endeavours to discover.

In the works of Galen, which have not yet been sufficiently illustrated, I have found *Indicum nigrum* only four times. In a place where he speaks of diseases of the eyes[633], he extols it on account of its cleansing quality; and says it can be used for wounds, when there is no inflammation. In another place[634], it occurs in three prescriptions for eye-salves. I have however endeavoured, but without success, to find in this excellent writer an explanation of what he calls *Indicum*; though he has explained almost all the different articles then used in the Materia medica. It appears therefore that the Greeks gave the name of *Indicum* to our indigo, and also to Indian black or Indian ink.

It however cannot be denied that, in opposition to this opinion, considerable doubts arise. Many who think that the black indigo (*nigrum Indicum*) of Pliny and Vitruvius was not ink, but our indigo, remark, that things of a dark blue or dark violet colour were by the Greeks and the Romans frequently named black; and therefore that the blue indigo might in this manner be called black[635]. But the examples adduced as proofs are epithets applied by the poets to dark-coloured flowers. Because nature produces no black flowers, the poets, who are fond of everything uncommon, extraordinary, and hyperbolic, call flowers black, when they are of so dark a tint as to approach nearly to black. Thus clear and deep water is called black. It is however hardly credible that painters and dyers, who must establish an accurate distinction between colours, should have spoken in so vague a manner. Salmasius suspects that *Nil* and *Nir*, the Arabic names of indigo, have arisen from the Latin word *niger*.

The objection, that Paulus Ægineta, the physician, in a passage where he refers to Dioscorides for the medical virtues of *Indicum*, applies to it the epithet black, seems to have more weight[636]. It may be added also, that the virtues, in general, which Galen ascribes to the *Indicum nigrum*, appear to be similar to those ascribed by Dioscorides to *Indicum*; and the latter in one

place[637], where he speaks of the healing of wounds, uses only the expression *Indicum*, and not *Indicum nigrum*. It is particularly worthy of remark, that Zosimus, the chemist, declares the hyacinth colour of the ancients, that of woad, and the *Indicum nigrum*, to be the same[638] or similar. But to those who know on how slight grounds the ancient physicians ascribed medicinal qualities to many substances, it will not perhaps appear strange, that, in consequence of the same name, they should ascribe the same qualities to two different things. It is not improbable that in cases of external injury, for which the *Indicum nigrum* was recommended, indigo and Indian ink might produce as much or as little effect. I should consider of far greater importance the opinion of the chemist Zosimus; but unfortunately his writings have not yet been printed. The period in which he lived is still uncertain, and it is not known whether all the chemical manuscripts which bear that name were written by the same author.

From what has been said, I think it may, at any rate, be inferred, that in the time of Vitruvius and Pliny, indigo, as well as Indian ink, was procured from India, and that both were named *Indicum*. It is less certain that the Greeks called indigo *Indicum*, and Indian ink *Indian black*. Nay, it appears that indigo, on account of the very dark blue colour which it exhibits both when dry and in the state of a saturated tincture, was often named Indian black. In my opinion, it is proved also that, in the old dye-houses, the workmen collected the scum thrown up by the dye-pans, and dried it into a kind of lake or carmine.

I shall now prove what I have already asserted, that indigo was at all times used, and continued without interruption to be imported from India. I shall quote mention made of it in various centuries; but I am convinced that attentive readers may find instances where it occurs in many other writers.

The Arabian physicians, it is probable, all speak of indigo; but it is unfortunate that in this point we must depend upon very incorrect Latin translations. It appears also that they often repeat the information of the Greeks, in regard to articles of the Materia medica, without having been acquainted with them themselves. Rhases, who lived at the end of the tenth century[639], mentions, “Nil, alias Indicum.” Avicenna, who died in 1036, often speaks of indigo[640]; but in the margin of the wretched translation it is

remarked, that under the term *Indicum*, alum (or much rather green vitriol) is to be understood. In a passage, however, where he speaks of dyeing the hair black, he certainly alludes to indigo, which, according to the translation, produced *colorem pavonaceum*, or a violet colour. In the Latin we find "Indicum indum bonum," and this awkward expression Salmasius explains by remarking, that the words in the Arabic are *Alusma Alhendia*, that is, Indian woad. In the same place he mentions *Indicum carmenum*, a kind of indigo which did not dye so much a violet colour as a black, that is to say with the addition of green vitriol. Carmania, indeed, bordered on Gedrosia, which is the proper country of indigo, where the best is still prepared at Guzerat. In the explanation of some Arabic words, printed in my copy of Avicenna, *Indicum* is translated *granum Nil*. Serapion, about the end of the eleventh century, mixed together, as appears, every thing that the Greeks have said in regard to indigo and woad. Averroes, in the middle of the twelfth century, mentions the medicinal qualities of indigo as given by the Greeks, and adds, that it was much used for dyeing.

Muratori gives a treaty, written in Latin, of the year 1193, between the citizens of Bologna and Ferrara, which contains a list of those articles subject to pay duty. Among these occurs *indigum*[641]. In the thirteenth century, the celebrated Marco Polo, who spent twenty-six years in travelling through Asia, and even some parts of China, relates that he saw indigo, which the dyers used, made in the kingdom of Coulan or Coilum; and he describes the process for preparing it[642]. Much curious information in regard to the trade with this article, in the middle of the fourteenth century, is contained in the valuable work of Francesco Balducei Pegolotti[643]. We there find the names of different kinds, such as *Indaco di Baldacca detto buccaddeo*, in all probability from Bagdad, a city which in many old books of travels is called Baldach or Baldac; also *Indaco del Golfo*, *Indaco di Cipri*, *Indaco Rifanti*. Indigo, at that time, was imported in hides (*cuojo*), or in leather bags (*otre*), and also in boxes (*casse*). What this traveller says in regard to the signs by which its goodness may be known, is very remarkable. Nicolo Conti, who travelled through India before the year 1444, mentions *endego* among the merchandise of Camboia[644]. That the expression *color indicus* was used in the middle ages to denote blue mixed with violet, is proved by Du Cange. It appears to me therefore highly

improbable that indigo should not be known to Rosetti, as Professor Bischof supposes[645]. In that important work on dyeing, however, which I mentioned long ago[646], it occurs several times, and always under the name *endego*.

I shall here make one observation, which is of some importance in the history of dyeing. It is found that in the middle ages the Jews maintained in the Levant a great many establishments for dyeing, and were the principal people who carried on this branch of business. Benjamin the Jew, who died in 1173, says in his travels, in speaking of some places, that "a Jew lived there who was a dyer;" or he remarks, in regard to others, that "most of the Jews followed the occupation of dyeing." A scarlet-dyer lived at Tarento, and a purple-dyer at Thebes. At that period the Jews at Jerusalem had hired from the king a place particularly well-fitted for dyeing, on the express condition that no person besides themselves should be suffered to carry on there the same business[647]. I am fully aware that well-founded doubts have been entertained in regard to the credit which ought to be given to Benjamin's narration, and Jewish vanity is everywhere well-known; but I do not see why he ought not to be believed in regard to this point; for it may very naturally be asked, why he should have falsely ascribed this occupation to his countrymen and no other? He speaks only once of a Jew glass-maker, a woollen- and a silk-weaver. To this may be added, that it is frequently stated in various authors, that the business of dyeing was carried on in Italy by the Jews. Thus, in the eleventh century, among the branches of revenue arising to the popes from Benevento, mention is made of the taxes paid by the Jews on account of their dye-houses. In the middle ages princes seem to have maintained dye-houses on their own account. Instances occur of their giving away, as presents, such establishments with all their apparatus[648]. A place of this kind was called *tincta*, *tingta*, or *tintoria*. This dye regale is to be deduced perhaps from the old establishments for dyeing purple, which could be formed only by sovereigns, and not by private individuals. Along with these *tinctæ* the Jews are often mentioned, so that it appears probable they were employed there as workmen.

There is reason therefore to conjecture that the Jews learned this art in the East, and that they employed in Italy the same pigments as were used in the dye-houses of the Levant. It is not improbable also, that in the room of woad, which was then cultivated in Italy, they introduced indigo, a substance richer in colouring matter, or at any rate, rendered it more common. The Italians were the first people in Europe who brought this art to a greater degree of perfection, as they did many others; and it can be proved that the knowledge of it was thence diffused to other countries. In the same proportion as this took place, indigo, in my opinion, banished the native woad, which was neither so advantageous, nor communicated so beautiful a colour as the Italians were able to dye with the former. The use of it became more extended when the productions of the East Indies were brought to Europe by sea, and particularly after it could be obtained from America at a much cheaper rate.

The first Portuguese ship, that commanded by Vasco de Gama, returned from the East Indies in the year 1499, and was soon followed by several more, all laden with the most valuable merchandise of the East. I have never yet been able to find any invoice of the cargoes of these vessels; and, unfortunately, we have no account of the early trade carried on by the Portuguese with Indian productions. I have no means, therefore, of proving that indigo was among the commodities first imported. Spices, which in consequence of the general prevalence of luxury, sold at that time exceedingly dear, together with precious stones, formed, no doubt, the first articles of trade; but it is not improbable that they were soon followed by indigo, for all the travellers who about that period visited India, speak of it as one of the most current articles.

Barbosa, a Portuguese, who collected there in 1516 valuable information in regard to geography and trade, who afterwards accompanied Magelhaens on his voyage round the world, and perished with him at the island of Zebu, has given a price-current of the merchandise at Calecut, in which the value of good indigo at that time is stated[649]. Corsali also, in his letters written from India in 1516, mentions indigo among the wares of Camboya. Louis Guicciardini, who wrote first in 1563, and died in 1589, speaking of the merchandise obtained by Antwerp from Portugal, mentions *anil* among that of the East Indies[650].

It is however certain that the trading company established in the Netherlands in 1602, who learned at an early period the art of rendering indispensably necessary to the Europeans cottons, tea, sago, and other things of which they could always hope to find a sufficient supply in India, carried on the greatest trade with these articles. The first German writers who complain of indigenous woad being banished by indigo, and those sovereigns who, by public orders, endeavoured to prevent this change, ascribe the fault to the Netherlanders. Niska, who wrote in 1630, says indigo had been introduced into Germany only thirty years; and an order of the emperor Ferdinand III., dated 1654, says that it had been imported into Germany from Holland some years before that period.

That the importation at this time was very great, is proved by the cargoes of the ships which arrived in Holland from the East Indies in 1631. The first had 13,539 pounds of Sirches indigo; the second 82,734 pounds of Guzerat indigo; the third 66,996 pounds of the same; the fourth 50,795 pounds of Bajano indigo; the fifth 32,251 pounds of Chirches indigo; the sixth 59,698 pounds of Bejana indigo; and the seventh 27,532 pounds of Chirches. I have mentioned these so particularly, as one may thence see the different kinds, and the places where made. These seven vessels, therefore, brought to Europe 333,545 pounds, which, at a low valuation, were worth five tons of gold, or 500,000 dollars. In the month of April 1633, three ships brought home 4092 *kartel* of indigo, which were worth 2,046,000 rix-dollars.

The profit attending this trade induced people, soon after the discovery of America, to manufacture indigo in that country; and they were the more encouraged to do so by observing that the native Americans, before they had the misfortune to become known to the Christians, tinged their bodies and faces of a blue-violet colour, by means of indigenous plants, which resembled the indigo plant of Asia.

Whether the two plants are of the same genus, or whether the American is different from that used in the other quarters of the globe, has not yet, as far as I can find, been with certainty determined[651]. It is however proved, that the assertion of Raynal and others, that this plant was first conveyed to the new world from Asia by the Europeans, is entirely erroneous. It is mentioned by Francis Colon (or Columbus), in the Life of his father[652],

among the valuable productions of the island of Hispaniola or St. Domingo. Francis Hernandes reckons it among the natural plants of Mexico, and says that the Americans used it for dyeing their hair black. He adds, that they made from it a pigment which they named *Mohuitli* and *Tleuohuilli*, the same as the Latins named *cæruleum*, and he describes also the method of preparing it. This is confirmed by Clavigero in his account of Mexico.

This plant therefore must be reckoned among the few which are indigenous in three-quarters of the globe. It is, however, highly probable that the Europeans, in the course of time, introduced a better species or variety into America, where several kinds are actually cultivated at present.

In the history of the American indigo, I must here leave a considerable hiatus, which perhaps may be one day filled up from books of travels and topography. All that I know at present is, that the first indigo brought to Europe was procured from Guatimala, consequently from Mexico, and that this article was supplied at first, and for a long time, by none of the West India islands but St. Domingo alone.

Krunitz says[653], but on what authority I do not know, that Lopez de Gomes relates, that in his time a very fine sky-blue colour was prepared in Hispaniola. If the person here alluded to be Lopez de Gomara, who accompanied Ferdinand Cortez as chaplain[654], this would be the oldest testimony that could be expected, and would correspond with the account given by Labat. But I shall leave the further investigation of this subject to others, and observe, that the cultivation of indigo was begun in Carolina in 1747, and according to Anderson, was encouraged the year following by premiums.

This article, therefore, was brought from both the Indies to Europe, and recommended itself so much by the superiority and richness of its dye, by the facility with which it could be used, and the advantages attending it, that it suddenly banished from all dye-houses the European woad, which was cultivated, in particular, in Thuringia in Germany, in Languedoc in France, and in the neighbourhood of Rieti in the dominions of the church. At first, a small quantity of indigo only was added to the woad, by which the latter was improved; more was afterwards gradually used, and at last the quantity became so large, that the small admixture of woad served only to revive the

fermentation of the indigo, but was not capable itself of communicating any colour. It was soon observed that every yard of cloth could be dyed somewhat cheaper when indigo was used along with woad, than when the latter was employed alone, according to the ancient method. Germany then lost a production by which farmers, merchants, carriers, and others, acquired great riches.

In the sixteenth century people began, in many countries, to make considerable improvements in dyeing. For this purpose, new dye-stuffs, both indigenous and foreign, were subjected to experiment, and trials were made with salts which had never before been employed. In this manner dyers sometimes obtained colours which pleased by their novelty and beauty; but it needs excite no surprise that many new methods of dyeing did not produce the desired effect. Many communicated colours which were agreeable to the eye, but they soon faded; and some rendered the dyed cloth so tender that it soon rotted on the shopkeepers' shelves. Governments conceiving it then necessary to do something for the security of the purchaser, considered the imperfection of the art as a premeditated deception; and as it was at that time supposed that some pigments could give durable and genuine colours, and others fading or false ones; and also that the pernicious effects of salts could not be prevented or moderated, they, in general, prohibited the use of all new materials from which hurtful consequences had been observed to arise.

Legislators are neither almighty, omniscient, nor infallible. With the best views, and a firm determination to discharge their duty, they may recommend things hurtful, and prohibit others that might be attended with advantage. Were their commands and prohibitions inviolable, insuperable, and irresistible, they would often confine the progress of the arts and sciences, and render useful inventions impossible. But the people, when they have not entirely become machines, know how to elude, even at great personal hazard, faulty regulations, and by prohibited ways to obtain greater advantages than those which formed the object of the orders issued by their government. This was the case in regard to the art of dyeing in the sixteenth century.

A recess of the diet held in 1577, prohibited, under the severest penalties, the newly invented pernicious, deceitful, eating, and corrosive dye called the *devil's dye*, for which vitriol and other eating substances were

used instead of woad. This prohibition was renewed in 1594 and 1603, with the addition of this remark, that, in consequence of the weight of the bad dyes, a pound of undyed silk for sewing or embroidery would produce two or three pounds of dyed[655].

Allusion seems to be made here to black, which at that time was the colour of the higher orders. It appears that at this period astringent juices and green vitriol began to be used more than they had been formerly, and cloth when too long boiled with these substances, becomes exceedingly tender: black cloth is even sometimes spoilt in this manner at present. It is also true that cloth receives the greatest addition in weight when dyed black, and the next greatest when dyed blue. I am not acquainted with accurate experiments in regard to the weight which cloth acquires by dyeing; but one may safely assert, that it is stated far too high in the recess of the diet. Fifteen ounces of raw silk lose by that kind of scouring which the French call *décruement*, four ounces; consequently white silk weighs eleven ounces, but after it is dyed black its weight is increased to thirteen ounces. In general, a black dye increases the weight of cloth a fifth more than bright dyes.

As indigo after this soon became common, and the sale of woad was injured, the first prohibition against the former was issued by Saxony in the year 1650; and because government well knew how much depends on a name, when one wishes to render an object odious or estimable, the prohibition was couched in terms which seemed to show that indigo was included among those eating substances, termed in the recess already mentioned *devil's dyes*. In the year 1652, Duke Ernest the Pious caused a proposal to be made to the diet by his envoy, Dr. Hœnnen, that indigo should be entirely banished from the empire, and that an exclusive privilege should be granted to those who dyed with woad. This was followed by an imperial prohibition on the 21st of April 1654, in which every thing ordered in regard to the *devil's dyes* is repeated, with this addition, that great care should be taken to prevent the private introduction of indigo, by which the trade in woad was lessened, dyed articles injured, and money carried out of the country. The elector took the earliest opportunity the same year to make known and enforce this prohibition with great severity in his dominions[656].

The people of Nuremberg, who at that time cultivated woad, went still further. They made a law that their dyers should annually take an oath not to use indigo; and at present they are obliged to do the same thing, though indigo is as necessary to them as to others; a most indecent disregard to religion, which, however, is not without example. In the French monarchy, where all offices were purchased and sold, every counsellor of parliament, on his entrance, was obliged to swear that he had not obtained his place by money, until at length some one had the courage to refuse taking a false oath. Thus also in Germany many placemen must swear that they will observe all the orders of government, yet many of them are daily violated, and indeed cannot be observed, or at any rate, not without great mischief and confusion.

What was done in Germany in regard to Thuringia, was done in France in regard to Languedoc. In consequence of an urgent representation by the states of that province, the use of indigo was forbidden in 1598; and this prohibition was afterwards repeated several times. But in the well-known edict of 1669, in which Colbert separated the fine from the common dyers, it was stated that indigo should be used without woad; and in 1737 dyers were left at liberty to use indigo alone, or to employ a mixture of indigo and woad[657].

In England, where, I believe, woad was not at that time cultivated, the first mention of indigo in the laws occurs in the year 1581, under the reign of Elizabeth, not, however, on account of a blue but a black dye. No woollen articles were to be dyed black with the gall-nut, madder or other materials, till they had received the first ground, or been rendered blue by woad, or woad and indigo together[658]. In like manner it was long believed that no durable black could be produced unless the article were first dyed in a blue pan. Hats also were not considered to be properly dyed unless traces of a blue tint could be discovered on the place where they were cut[659]. At present our dyers can communicate a durable black without a blue ground, as well as dye a fixed blue without woad; and in every part of Europe foreign indigo will continue to be the most common material for dyeing, till its high price render it necessary to obtain a similar pigment from indigenous plants[660].

[The dye-stuff of indigo is obtained from the plant by allowing it to ferment with water; during this process it subsides in the form of a blue deposit, which is collected and dried. As it occurs in commerce, it contains several impurities, such as lime, silica, alumina, and oxide of iron, in addition to the colouring matters, which are three in number, a brown, red and blue; as also some glutinous matter.

The chief localities of the indigo-plant at present are Bengal and Guatimala, though of late years the exportation from the latter has been materially checked by the disturbed state of Central America. In the early period of our occupation of India, indigo formed a leading branch of the Company's trade; but the rude manufacture of the native population was in the course of time expelled from the markets of Europe by the more skilfully prepared drug of America and the West Indies. Soon after the peace of 1783, the West Indian process of manufacture was introduced into Bengal, and the directors having relaxed their prohibitory system so far as to permit the application of British capital and skill to the cultivation of the plant on the alluvial depositions of the Ganges, the exportations were gradually increased, and the American and West Indian indigo almost entirely driven from the market. The manufacture was also introduced into Oude and the other north-western districts of the great plain of the Ganges; and in later periods into some of the Madras provinces, into Java and the Philippine Islands. The indigo produced everywhere else is, however, very secondary both in quantity and quality to that of Bengal and Bahar, the soil and climate of which seem to be particularly congenial to the plant. The average supply of indigo at present may be estimated as follows:—Bengal provinces, 34,500 chests, or about 9,000,000 lbs.; other countries, including Madras and Guatimala, 8500 chests; total, 43,000 chests. Of this there are consumed in the United Kingdom, 11,500 chests, or about 3,000,000 lbs.; France, 8000 chests; Germany and the rest of Europe, 13,500 chests; Persia, 3500 chests; India, 2500 chests; United States, 2000 chests; other countries, 2000 chests; total, 43,000 chests, or upwards of 11,000,000 lbs. The quantity imported into the United Kingdom in 1840 amounted to 5,831,269 lbs., and the quantity entered for home consumption amounted to 3,011,990 lbs. Upwards of four-fifths of the imports are from the East Indies; the remainder chiefly from the West Indies, Guatimala, Peru and the Philippine Islands. The surplus imported beyond the quantity consumed is re-exported to Germany, Russia, Italy, Holland and other parts of the continent of

Europe. France and the United States derive their main supplies by direct importation from Calcutta.]

FOOTNOTES

615 Dioscor. lib. v. cap. 107, p. 366. Περὶ Ἰνδικοῦ.

616 Plin. lib. xxxv. cap. 6, § 27, p. 688; and Isidorus, Origin. lib. xix. cap. 7, p. 464.

617 Foesii Œconomia Hippocratis. Francof. 1588, fol. p. 281.

618 Ἔγχυλον means also juicy, or something that has a taste. Neither of these significations is applicable here, where the subject relates to a substance which is dry and insipid, or at any rate which can possess only a small degree of astringency. It must in this place denote an inspissated or dried juice; but I can find no other passage to support this meaning.

619 In Pliny's time people coloured a white earth with indigo, or only with woad, *vitrum*, in the same manner as coarse lakes and crayons are made at present, and sold it for indigo. One of them he calls *annularia*, and this was one of the sealing earths, of which I have already spoken in the first volume. In my opinion it is the same white pigment which Pliny immediately after calls *annulare*: "Annulare quod vocant, candidum est, quo muliebres picturæ illuminantur." These words I find nowhere explained, and therefore I shall hazard a conjecture. Pliny, I think, meant to say that "this was the beautiful white with which the ladies painted or ornamented themselves."

620 Plin. lib. xxxv. § 12, p. 684.—Vitruv. lib. vii. cap. 14.

621 Tavernier, ii. p. 112. We are told so in Malta Vetus et Nova a Burchardo Niederstedt adornata. Helmest. 1659, fol. lib. iv. cap. 6,

a work inserted in Grævii Thesaurus Ital. vi. p. 3007. This man brought home with him to Germany, after his travels, a great many Persian manuscripts, which were purchased for the king's library at Berlin. Niederstedt, however, is not the only person who speaks of indigo being cultivated in Malta. Bartholin, Epist. Med. cent. i. ep. 53, p. 224, says the same.

622 It is entirely different from the molybdate of tin, the laborious preparation of which is described by J. B. Richter in his Chemie, part ii. p. 97.

623 It deserves to be remarked, that the Greek dyers, speaking of a fermenting dye-pan covered with scum, used to say, like our dyers, that it had its flower, ἐπάνθισμον. In Hippocrates the words ἐπάνθισμα ἀφρῶδες denote a scum which arises on the surface. Among the Latins *flos* in this sense is very common.

624 Caneparius de Atramentis, Rot. 1718, 4to, v. 2. 17.—Valentini Museum Museor. i. p. 225.—Pomet, i. p. 192.

625 See his edition of Dioscorides, Colon. 1529, fol. p. 667.

626 Lib. xxxvii. 10. sect. 61, p. 791.

627 Lib. xxxv. cap. 6.

628 *Perfici* is a term of art which is often used to express the finishing or last labour bestowed upon any article: *Vasa sole perficiuntur*. When vessels of earthen-ware have been formed, they must be suffered to dry and become hard in the sun. See Hardouin's index to Pliny.

629 Gum and gummy substances of every kind used to make ink thicker and give it more body, were called *ferrumen*. See Petronius, cap. 102, 15.

630 Vitruv. vii. 10, p. 246.

631 Lib. xxxv. cap. 7.

632 Exercitat. Plin. p. 816, b. And in the Annotationes in Flavium Vopiscum, p. 398, in Historiæ Augustæ;, Paris, 1620, fol.

633 De Composit. Pharmac. secundum locos, lib. iv. cap. 4. Edit. Gesn. Class. v. p. 304.

634 Lib. iv. cap. 7.

635 Salmasii Exercitat. Plin. p. 908, a.

636 Pauli Æginetæ libri vii. Basiliæ, 1538, fol. p. 246, lib. vii.

637 Parabilium lib. i. 161, p. 43.

638 Salmasius in Homonymis Hyl. Iatr. p. 177, a; and in Exercitat. Plin. p. 810, b; and p. 936, b. In regard to the manuscripts of the work of Zosimus, which is commonly called Panopolita, see Fabricii Bibl. Græca, vol. vi. pp. 612, 613; and vol. xii. pp. 748, 761. I wish I may be so fortunate as to outlive the publication of it; it will certainly throw much light on the history of the arts. It is remarkable that Zosimus calls indigo-dyers λαχωταὶ and ἰνδικοβάφοι, in order perhaps to distinguish them from the dyers with woad. The distinction therefore between indigo-dyers and those who dyed with woad must be very old.

639 In the edition of some Arabian physicians, published by Brunfels, at Strasburg, 1531, fol.

640 Avicennæ Canon. Med.... Venet. 1608, fol. ii. p. 237.

641 Antiquitates Italiæ Medii Ævi, ii. p. 894.

642 Lib. iii. cap. 31, p. 150.

643 Lisbona e Lucca, 1766, 4to.

644 Ramusio Viaggi, 1613, i. p. 342.

645 Geschichte der Farberkunst. Stendal, 1780, 8vo, p. 69.

646 Anleitung zur Technologie, fourth edit. p. 123. I can now add, that Roso, in Memorie della Societa Italiana, Verona, 1794, 4to, vii. p. 251, quotes also the edition per Francesco Rampazetto, 1540, 4to.

647 Itinerarium Benjaminis, Lugd. Bat. 1633, 8vo.

648 Du Cange quotes a diploma of the emperor Frederick II., dated 1210, and under the word *Tintoria*, a diploma of Charles II. king of Sicily.

649 Ramusio, i. p. 323.

650 Totius Belgii Descript. Amst. 1660, 12mo, i. p. 242.

651 [They both belong to the same genus but are specifically distinct, the species cultivated in India being principally the *Indigofera tinctoria*, and that in America the *Indigofera anil*.]

652 This work has been several times printed. It is also in Barcia Historiadores primitivos de las Indias Occidentales. Madrid, 1749, fol. vol. i. At p. 61, we find among the productions of the above island, *minas de cobre*, *anil*, *ambar*, &c. An English translation in Churchill's Collection, ii. p. 621, renders these words *mines of copper, azure, and amber*.

653 Encyclop. vol. xxix. p. 548.

654 His works may be found in Barcia's Collection, vol. ii.

655 All these prohibitions may be found in Schreber's Beschreibung des Waidtes. Halle, 1752, 4to, in the appendix, pp. 1, 2.

656 Schreber *ut supra*, p. 11.

[657] See Mémoires de l'Acad. à Paris, année 1740.

[658] Statutes at Large, vol. ii. Lond. 1735, p. 250. [Dr. Ure, however, says that indigo was actually denounced as a dangerous drug, and forbidden to be used by our Parliament in the reign of Queen Elizabeth. An Act was passed authorizing searchers to burn both it and logwood in every dye-house where they could be found. This Act remained in full force till the time of Charles II., that is, for a great part of a century.]

[659] Marperger's Beschreibung des Hutmacher-handwerks. Altenburg, 1719, 8vo, p. 85.

[660] [This observation has been verified; for tolerably large quantities of indigo are now extracted from the *Polygonum tinctorium*, which is cultivated in some parts of France and Belgium for that purpose.]

VANES. WEATHERCOCKS.

If the poet Seneca was well informed, mankind, in the infancy of navigation, had no particular names for distinguishing the principal winds[661]. This is not at all incredible; because with their rafts and floats, which were the first vessels, they for a long time ventured out to sea only so far that they could easily return to the shore; and therefore while navigation continued in this state, they had little reason to trouble themselves about the direction of the winds. It is more certain that those nations respecting whom we have the oldest information, distinguished by names the four principal winds only. This is generally proved by a passage in Homer, where he intends to mention all the winds, and names only four[662]; but this proof is of little weight; for what poet at present would, with the like view, think of boxing the compass, or of introducing into a poem the names of all the thirty-two points? Would he not rather be satisfied with the names of the four chief winds alone? If more names, therefore, were usual in Homer's time, he would not consider it necessary to name them. In another passage he names only two winds[663]; and from these some have endeavoured to prove that no more were then known; but this assertion indeed is completely refuted by the passage first quoted. It can, however, be easily proved, that for a long time names were given to the four principal winds only.

It is easily seen what at first gave rise to this distinction. The sun at noon stands always over one point of the horizon, which appears to the observer as a circle, having the place where he himself is at its centre. This point is called the meridian or south, and the one opposite to it the north. If the observer turns his face towards the north, he will have on his right-hand the east, and on his left the west. The space between these principal winds contains ninety degrees, or a right angle. The number, however, must soon have been raised to eight, and this division was usual in the time of

Aristotle[664]. Afterwards twelve points in the heavens were adopted, also as many winds; and in the time of Vitruvius twenty-four were distinguished and named, though this division was very little used. To determine the names, however, employed in the last two divisions is attended with some difficulties; and it almost appears as if writers did not always apply to them the same meaning.

The Greeks considered Æolus as the first person who made navigators acquainted with the winds. He is said to have ruled over the Volcanic islands, afterwards named the Æolian; and if this be true, he would certainly have a good opportunity of observing the weather, and marking the winds by the smoke continually rising up there from burning volcanoes. This celebrated personage, who received Ulysses on his return from the Trojan war, by the knowledge thus obtained may have assisted navigators, who afterwards made known the services which he rendered to them.

The antiquity of the division into thirty-two points, used at present, I am not able to determine. Riccioli thinks that they have been employed since the time of Charles the Great, but I do not know whether this can be proved. That assertion perhaps is founded only on the opinion, that this emperor gave German names to the winds and the quarters of the world. This indeed is stated by his historian Eginhart, who mentions the names, which I shall here insert, together with the Latin names added by Eginhart, and those usual at present[665].

Subsolanus	*Ostroniwind*	EAST.
Eurus	*Ostsundroni*	East-south-east.
Euroauster	*Sundostroni*	South-east.
Auster	*Sundroni*	SOUTH.
Austroafricus	*Sundwestroni*	South-south-west.
Africus	*Westsundroni*	South-west.
Zephyrus	*Westroni*	WEST.
Corus	*Westnordroni*	West-north-west.
Circius	*Nordwestroni*	North-west.
Septemtrio	*Nordroni*	NORTH.
Aquilo	*Nordostroni*	North-north-east.
Vulturnus	*Ostnordroni*	North-east.

It has however been long since remarked, that these names are much older than Charles the Great[666]; and it is highly probable that they were only more accurately defined, or publicly confirmed by this prince, or that in his time they came into general use. How often have early inventions been ascribed to sovereigns, though they were only made in their reign! Even whole nations have been said to be descended from those princes under whom they first became known to foreigners; as, for example, the Poles from Lech, and the Bohemians from Zech.

Charles, however, did not give names to thirty-two, but to twelve winds. Nor was he the first who added to the four cardinal points eight others, for the same thing is asserted of many. But it deserves to be remarked, that in Charles's names one can discover traces of that ingenious mode of denoting all the winds with four words; that is to say, by different combinations of East, West, South, and North. It is certain that the names of the different points and winds used by all the European nations, the Italians only excepted, are of German origin, as well as the greater part of the terms of art employed in navigation and naval architecture.

It appears to me not improbable that the division used at present was introduced soon after the invention of the magnetic needle; at least Honorius, surnamed *Augustodunensis*[667], who must have flourished before the year 1125, speaks only of twelve winds; as do also Gervasius in 1211, and Vincent de Beauvois in the middle of the thirteenth century, who gives from Isidorus, who lived about the year 636, the twelve Latin names used by Eginhart[668].

It can scarcely be doubted that means for indicating the winds were invented at a very early period. I here allude to vanes, flags, and every other apparatus by which the direction of the wind can be conveniently and accurately discovered, and similar to those erected at present on many private houses, on most of our church steeples, and on board ships. I must however confess that I have hitherto scarcely observed any trace of them among the Greeks and the Romans. I can find no account of them in works where all the parts of edifices are named; where ships and everything belonging to them are expressly described; nothing in Pollux, and nothing in any of the poets. I am unacquainted also with any old Greek or Latin

word that can be applied to an apparatus for pointing out the wind. In the edition of Kirsch's German and Latin Dictionary, printed in 1754, we find *Wetterhahn* (a weathercock) *petalum*, *triton*; but the latter term is borrowed from the tower of Andronicus, of which I shall have occasion to speak hereafter; and neither this word nor *petulum*, or *petulæ*, *arum*, which Kirsch gives also, occurs in this sense in any ancient author; and the case is the same with *pinnacella*, *ventilogium*, *aurologium*, and other names which are to be found in some dictionaries.

I am acquainted with no older information in regard to an apparatus for observing the winds, than what is given by Vitruvius respecting the tower built at Athens by Andronicus Cyrrhestes, that is, of Cyrrhus, a town in Syria. This tower, which was built of marble, in an octagonal form, had on each side a representation of that wind opposite to which it was placed. Its summit terminated in a small spire, on which was a copper triton, made to turn in such a manner as to present its front to the wind, and to point with a rod held in its right-hand to the image of the wind blowing at the time[669]. This tower is still standing; and a description and figure of it may be seen in the travels of Spon and Wheeler, and in those also of Pocock[670]. The figures representing the winds, which are larger than the life, are executed in basso-relievo, and correspond to the seasons at which they generally blow. At the top of each side, under the architrave, the name of the wind is inscribed in Greek characters. Boreas, the North wind, holds in his hand a mussel-shell, which seems to denote his peculiar power over the sea. The Zephyr has its bosom full of flowers, because it prevails in March, at the time when the flowers chiefly blow in Greece; and similar attributes are assigned to the rest.

Varro had an apparatus of the same kind at his farm[671]. Within the building was a circle, in which the eight winds were represented, and an index, like that of a clock, pointed to that wind which was blowing at the time. Nothing therefore was necessary but to look at the ceiling to know from what quarter the wind came. I have seen an apparatus of the same kind on some exchange, either at Lubec or Rotterdam. Varro calls the tower of Andronicus *horologium*, a word which Salmasius wishes to change into *aurologium*. But it contained also a sun-dial, as we are assured by Pocock, who observed the necessary hour-lines; and therefore it is not improbable,

that the people, who through the want of clocks would oftener look to the dial than to the weathercock, gave to the tower a name alluding to the former rather than to the latter.

Du Cange says, that a triton, by way of weathercock, was placed on the temple of Androgeus at Rome; but I am unacquainted with the source from which he derived this information, and of that temple I have not been able to obtain any account[672]. Whether the tritons placed on the temple of Saturn at Rome were indicators of the wind, or whether they had a learned signification, as Macrobius asserts, I will not venture to determine[673]. It is probable that the pillar, some remains of which were found at Gaeta (*Cajeta*), in the kingdom of Naples, and on which the names of the winds were cut out in Greek and Latin, served as a wind indicator also.

But it is more than probable that an apparatus for pointing out the wind, similar to that at Athens, was erected also at Constantinople. At least I consider as such what was called by some *anemodulium*, and by others *anemoderium*; the information respecting which has not, as I conceive, been hitherto understood, not even by Banduri. In my opinion it was not a building or tower, but a column furnished with a vane, somewhat similar to what is still seen in many places on the sea coast, where a high pole is erected with a flag. This pillar, if I may be allowed the expression, consisted entirely of copper; it was square, and in height not inferior to the loftiest columns in the city. Its summit formed a pyramid, and, as I conjecture, an octagonal one, upon which stood a female figure that turned round with every wind, and consequently was a vane, only not a triton, as at Athens. Below it, on each side of the pyramid, were seen a great many figures, which I will venture to assert were attributes or images of the winds, to which the female figure pointed. Nicetas says, that there were observed among them birds, agricultural implements, the sea with shipping, fishing-boats, and naked cupids sporting with apples, which in my opinion denoted the different seasons in which each wind was accustomed to blow[674].

It is not improbable that the whole pillar was constructed of different pieces of copper, cast singly and then joined together; and it appears that neither Nicetas, nor Cedrenus, nor the Latins, who in the thirteenth century pulled down and melted the numerous objects of art, plundered from

various cities by the emperor Constantine to ornament his capital, were acquainted with the purpose for which this pillar was originally destined, or the meaning of the emblematical figures represented upon it. Nay, there is even reason to think that the Greeks themselves, at this time, were so ignorant as to believe such objects to be the productions of magic. According to Cedrenus, this costly wind indicator was erected by Theodosius the Great, and according to others by Leo Isauricus. Were the first assertion true, it would belong to the fourth century, and in the second case to the eighth; but I cannot help suspecting that it was constructed before the time of Theodosius. The female figure which indicated the wind, was, according to Nicetas, called *anemodoulon*, but according to Cedrenus *anemoderion*. The former denotes a person who belongs to the wind; the latter one who contends with the wind; and both these appellations are well suited to a vane or wind indicator. If my explanation be correct, this work of art at Constantinople had nothing in common with the statue of Jupiter constructed by Lysippus at Tarentum[675]. The latter was forty cubits in height; and what excited great astonishment was, that though it would shake when pushed with the hand, it withstood the force of the most violent storms. I should rather compare the statue of Lysippus to those moveable masses of rock which are mentioned by various authors, both ancient and modern.

It is not improbable that there may have been wind indicators of this kind in other places, and that more passages alluding to them, not hitherto remarked, may be found in different authors. Professor Michaelis, who was desirous to assist me in my researches, pointed out to me an account, undoubtedly written before the year 1151[676], in which it is stated that there was at Hems, in Syria, formerly called Emessa, a high tower, on the summit of which was a copper statue of a horseman that turned with every wind. It is worthy of remark, that under the vane there were figures, among which was that of a scorpion; in all probability the emblem of some season.

In Europe, the custom of placing vanes on the summits of the church-steeples is very old; and as these vanes were made in the figure of a cock, they have thence been denominated *weathercocks*. In the Latin, therefore, of the middle ages, we meet with the words *gallus* and *ventilogium*. The latter is used by Radulphus, who wrote about the year 1270[677]. Mention of

weathercocks occurs in the ninth[678], eleventh, twelfth and thirteenth[679] centuries. There is no doubt that the cock was intended as an emblem of clerical vigilance. In the ages of ignorance the clergy frequently styled themselves the cocks of the Almighty, whose duty it was, like the cock which roused Peter, to call the people to repentance, or at any rate to church[680]. The English, therefore, are mistaken when they suppose that the figure of a cock was first made choice of for vanes in the fourteenth century, under the reign of Edward III., in order to ridicule the French, with whom they were then at war; and that the custom of *cock-throwing*, that is to say, of throwing sticks at a cock exposed with his wings tied, as then practised, took its rise at the same time.

In France, in the twelfth century, none but noblemen were allowed to have vanes on their houses; nay, at one time this was the privilege of those who, at the storming of a town, first planted their standards on the ramparts. These vanes were painted with the knights' arms, or the arms were cut out in them, and in that case they were called *panonceaux*[681].

Flags or vanes on ships occur very early, but they are always mentioned on account of their use in making signals. They were of various forms and colours; were sometimes drawn up, and sometimes taken down; placed sometimes on the right and sometimes on the left side of the ship, and were changed in various other ways, directions for which may be seen in the Tactics of the emperor Leo. They were named *vexilla*, *flammulæ*, also *flammula* and *banda*, and the last two appellations occur in the works of the younger Greek writers[682].

But though the oldest writers on the art of naval warfare, such as Vegetius, recommend a knowledge of the winds, I have not yet met with any certain account of apparatus for determining the direction of them on board a ship. Before the discovery of the magnetic needle, such accuracy as is necessary at present would have been superfluous; yet naval commanders must long before have had some means of distinguishing at least the twelve winds then defined, though no traces of them are to be found in the works which have been accidentally preserved to us.

Scheffer[683], who, as is well-known, collected from the works of the ancients all the terms of art applicable to navigation, thinks that the band, *tænia*, affixed to a pole at the stern of the ship[684], did not serve so much for an ornament as to indicate the course of the wind. He is, however, able to produce no other authority for this opinion than a passage in one of Cicero's letters, which has been changed and amended, till it at length seems to say that Cicero had resolved to embark, because the vanes had announced a favourable wind[685].

I must acknowledge that at present I can produce no older information in regard to vanes used on board ship, to indicate the course of the wind, than of the eleventh century, taken from the life of Emma, the consort of Canute the Great, king of Denmark, Norway and England, the author of which was an eye-witness of what he relates. Describing the magnificent Norman fleet sent to England in the year 1013, he says that birds, which turned round with the wind, were placed on the top of the masts[686].

At that time, therefore, instead of the flags used at present, a vane, shaped like a bird, was placed at the summit of the mast; perhaps also the figure of a cock, as the emblem of vigilance, but in this case not of clerical vigilance. In the cathedral of Bayeux, in France, is a piece of tapestry, representing the actions of William the Conqueror, executed with the needle, either by his consort or under her direction, in which vanes are seen at the top of the masts in many of the ships[687].

[Anemoscopes, or instruments for showing the direction of the wind, are now in constant use in meteorological establishments; the indications are made upon dials, and the apparatus does not differ in principle from that described by Beckmann.

Anemometers, or instruments for measuring the power or force of the wind, have also been contrived of various kinds. The first was invented by Wolf. In this the wind acted upon four sails somewhat resembling those of a windmill, the motion being communicated by cog-wheels to a lever loaded with a weight. When the wind acted upon the sails, the bar rose, this motion continuing until the increased leverage of the weight counterpoised the moving power of the wind. Others on a different principle have been made

by Lind, Regnier, Martin, and a very beautiful instrument for this purpose, constructed by Mr. Dent, may be seen at Lloyd's room in the Royal Exchange.]

FOOTNOTES

661 Medea, ver. 316.

662 Odyss. v. 295.

663 Iliad, ix. 5.

664 Aristot. Meteorol. ii. cap. 5 et 6. On this account, as Salmasius remarks, the book De Mundo cannot belong to Aristotle, as mention is made in it of twelve winds.

665 De Vita et Gestis Caroli Magni. Traj. 1711, 4to, pp. 132, 133.

666 Adelung's Wörterbuch, under the word *East*.

667 Of the writings of this monk, whom I shall again have occasion to quote, separate editions are scarce. They are however to be found in Maxima Bibliotheca Patrum, tom. xx.

668 Speculum Natur. iv. 34, p. 254.

669 Vitruv. i. 6, p. 41.

670 See Stuart's Antiquities of Athens, i. 3, tab. i.—xix.

671 Varro De Re Rust. iii. 5. 17. Our common weathercocks and vanes, when well made, and preserved from rust, show the point from which the wind proceeds, but do not tell their names. By the vanes on church steeples, one knows that our churches stand in a direction from east to west, and that the altar is placed in the

eastern end. On other buildings an arrow, which points to the north, is placed under the vane.

672 Du Cange refers to Anonymus de Arte Architectonica, cap. 2.

673 Saturn. i. 8, p. 223.

674 The passage of Nicetas may be found in Fabricii Biblioth. Græca, vi. p. 407, and in Banduri Imperium Orientale, Par. 1711, fol. tom. i. lib. vi. p. 108. Nicetas speaks of it again in lib. ii. de Andronico, Venet. 1729, fol. p. 175. He there says that the emperor was desirous of placing his image on the *anemodulium*, where the cupids stood. Another writer, in Banduri Imper. Orient. i. p. iii. lib. i. p. 17, says expressly that the twelve winds were represented on it, and that it was erected with much astronomical knowledge by Heliodorus, in the time of Leo Isauricus.

675 Plin. Hist. Nat. xxxiv. 7. sect. 18. p. 647.

676 Geographia Nubiensis. Parisiis, 1619, 4to, p. 118.

677 In Vita S. Richardi Cicestrensis. See also Du Cange.

678 In Ughelli Italia Sacra, Romæ, 1652, fol. iv. p. 735, we find the following inscription on a weathercock then existing at Brixen:—"Dominus Rampertus Episc. gallum hunc fieri præcepit an. 820."

679 Raynerus; cap. 5.

680 Ambrosius, v. cap. 24.—Vossius de Idol. iii. cap. 86.—Pierii Valeriani Hieroglyphica. Franc. ad M. 1678, p. 288.

681 Dictionnaire à Trevoux, 1704, fol. article Girouette.

682 Hirtius de Bello Alexand. cap. 45.—Tacit. Annal. 22.—Livius, lib. xxxvii. cap. 24.—Leonis Tactica, cap. 19, § 40, 42, pp. 342, 343, edit. Meursii. Lugd. Bat. 1612, 4to.

683 De Milit. Navali. Upsaliæ, 1654.

684 Pollux, i. 9, § 90, p. 61.

685 Epist. ad Atticum, v. 12.

686 The Encomium Emmæ is printed in Du Chesne, Historiæ Normannor. Scriptor. Paris, 1619, fol.

687 This honourable memorial of the last half of the eleventh century is explained and illustrated by a figure in Mémoires de l'Academ. des Inscript. Paris, 1733, 4to, vol. viii. p. 602.

GILDING.

The astonishing extensibility of gold, a property in which it far surpasses all other metals, induced mankind, at an early period, to attempt beating it into thin plates, as the value of it led them to the art of covering or gilding things of every kind with leaves of it. It is proved by Herodotus, that the Egyptians were accustomed to gild wood and metals[688]; and gilding is frequently mentioned in the books of the Old Testament[689]. The gold plates, however, used for this purpose, as may be readily conceived, were not so thin as those made at present; and for this reason, the gilding on statues, which have lain many centuries in the earth, appears to be still entire. Winkelmann says[690], that among the ruins of two apartments in the imperial palace, on the palatine hill, in the Villa Farnese, the gold ornaments were found to be as fresh as if they had been newly applied, though these apartments, in consequence of being buried under the earth, were exceedingly damp. The circular bands of sky-blue, with small figures in gold, could not be seen without admiration. The gilding also is still preserved in the ruins of Persepolis.

But, in the time of Pliny, the art of gold-beating was carried so far at Rome, that an ounce of gold could be beat into seven hundred and fifty leaves and more, each four square inches in size[691]. I shall not compare this result with what the art can do at present, because the account of Pliny is not the most accurate, and because the conversion of the old measures into the modern standard is always attended with uncertainty. Buonarotti, however, who made some researches on this subject[692], is of opinion that the gold used at Rome for fire-gilding in his time, that is, at the end of the seventeenth century, was beat six times as thin; and that the gold employed for gilding wood and other things, without the application of fire, was twenty-two times as thin as the gold leaf made at Rome in the time of Pliny.

But this Italian author, as appears to me, has, through too great precipitation, translated the words “septingenæ et quinquagenæ bracteæ” fifty and seventy. Gold, however, at that time, was beat so thin at Rome, that Lucretius compares it to a spider’s web, and Martial to a vapour[693].

I have, however, not yet met with any information in regard to the method in which the ancient artists beat the gold, or the instruments and apparatus they employed for that purpose. But the German monk Theophilus, whose real name seems to have been Rüger, and who, as Lessing thinks, lived in the ninth, but, according to Morelli, in the twelfth century, describes the process nearly as it is at present[694]. The gold, at that time, was beat between parchment, in the same manner as is still practised; and the artists knew how to prevent the gold from adhering to the parchment, by covering it over with burnt ochre reduced to a very fine powder, and then rubbing it smooth with a tooth. With the like view, our gold-beaters rub over with a fine bolus the thin paper used for making the books into which they put their gold leaf, in order to preserve it. But the flatting-mills, between the steel rollers of which cast and hammered ingots of gold are at present reduced to thin leaves, seem not to have been then known, at least this monk makes no mention of them. Lessing, to whom we are indebted for this curious fragment of Theophilus, is of opinion that each artist at that time was obliged to beat the gold leaf which he used, because gold-beating was not then a distinct branch of business. This I will not controvert; but it is no proof of it, that the monk taught the art to his brethren; for in convents the clergy endeavoured to make everything they used, in order that they might purchase as little as possible.

During the progress of the art, it being found that parchment was too thick and hard for the above purpose, workmen endeavoured to procure some finer substance, and at length discovered that the skin of an unborn calf was the most convenient. By means of this improvement, gold leaf was made much thinner than it had ever been before possible; but the art was brought to still greater perfection by employing that fine pellicle which is detached from the gut of an ox or a cow. Lancellotti, who wrote in the first half of the seventeenth century[695], says that this invention was made by the German gold-beaters, when, in consequence of the war, they were not able to obtain from Flanders the skins of unborn calves.

I have often heard that the preparation of this pellicle, which the French call *baudruche* and the Dutch *liezen*, and which is so thin that two of them must be pasted together, is a secret, and that the best is obtained from England. But in the year 1785, when I paid a visit to a very ingenious gold-beater at Hamburg, he assured me that he prepared this substance himself, and that the case was the same with most of the gold-beaters in Germany. Even in England, in the year 1763, this art was known only to two or three persons, who practised it as a business, but kept it so secret that Lewis was not able to obtain a proper account of it[696]. In Ireland also this skin is prepared and sent to England[697]. When the French, in the beginning of the revolutionary war, hoped to out-manœuvre the Germans by the use of aerostatic machines, it became of some importance to them to obtain a supply of these skins. On this account, the *Commission des armes et poudres* drew up instructions for preparing them, which they caused to be printed and distributed to all the butchers. At Strasburg they were printed in French, and at the same time in German, but in many parts faulty and unintelligible.

About the year 1621, Mersenne excited general astonishment, when he showed that the Parisian gold-beaters could beat an ounce of gold into 1600 leaves, which together covered a surface of 105 square feet. But in 1711, when the pellicles, discovered by the Germans, came to be used in Paris, Reaumur found that an ounce of gold, in the form of a cube, five and a quarter lines at most in length, breadth, and thickness, and which covered only a surface of about twenty-seven square lines, could be so extended by the gold-beaters as to cover a surface of more than one hundred and forty-six and a half square feet. This extension, therefore, is nearly one-half more than was possible about a century before.

When these skins are worn out by the hammer of the gold-beater, they are employed, under the name of English skin, for plasters, or properly to unite small wounds. By the English they are called *gold-beaters' skin*[698]; but, since silk covered with isinglass and Peruvian balsam, which in Germany is named English plaster, for the Germans at present call every thing English, has become the mode, this skin is much less used[699]. I mention this that I might have an opportunity of remarking, that in the

middle of the twelfth century, in the Levant at least, a very thin pellicle was in like manner used for wounds. For when the emperor, John Comnenus, accidentally wounded himself in the hand with a poisoned arrow while hunting, a piece of skin, which, from the name and description may be considered the same as that used at present by the gold-beaters, was applied to the wound. The emperor, however, died in consequence of this wound, after it had become inflamed under the pellicle, which, in large wounds, and when the skin is suffered to remain too long, is commonly the case, though the poison alone would have been a sufficient cause of death. Reaumur and others are astonished that artists should have sought for and found a part of their apparatus in the bowels of an ox; but I am of opinion that this pellicle, which is sometimes separated in washing and cleaning the bowels, was first observed by the butchers, and made known by them as a plaster; and that it came into request among the German gold-beaters, as the finest of all the pellicles then known, in the beginning of the seventeenth century.

The art of gilding, and particularly unmetallic bodies, was much facilitated by the invention of oil-painting; but it must be acknowledged that the process employed by the ancients in cold-gilding was nearly the same as that used at present. Pliny says[700] that gold leaves were applied to marble with a varnish, and to wood with a certain kind of cement, which he calls *leucophoron*. Without entering into any research respecting the minerals employed for this cement, one may readily conceive that it must have been a ferruginous ochre, or kind of bole, which is still used as a ground (*poliment*, *assiette*)[701]. But gilding of this kind must have suffered from dampness, though many specimens of it are still preserved. Some of the ancient artists, perhaps, may have employed resinous substances, on which water can produce very little effect.

That gold-leaf was affixed to metals by means of quicksilver, with the assistance of heat, in the time of Pliny, we are told by himself in more places than one. The metal to be gilded was prepared by salts of every kind, and rubbed with pumice-stone in order to clean it thoroughly, and to render the surface a little rough[702]. This process is similar to that used at present for gilding with amalgam, by means of heat, especially as amalgamation was known to the ancients. But, to speak the truth, Pliny says nothing of heating the metal after the gold is applied, or of evaporating the quicksilver,

but of drying the cleaned metal before the gold is laid on. Had he not mentioned quicksilver, his gilding might have been considered as that with gold-leaf by means of heat, *dorure en feuille à feu*, in which the gold is laid upon the metal after it has been cleaned and heated, and strongly rubbed with blood-stone, or polished steel. Felibien was undoubtedly right when he regretted[703] that the process of the ancients, the excellence of which is proved by remains of antiquity, has been lost.

False gilding, that is, where thin leaves of a white metal, such as tin or silver, are applied to the article to be gilded, and then rubbed over with a yellow transparent colour, through which the metallic splendour appears, is much older than I believed it to be in the year 1780. The process for this purpose is given by the monk Theophilus, whose fragments were first printed in 1781[704]. According to his directions, tin beat into thin leaves was to be rendered of a golden yellow colour by a vinous tincture of saffron, so that other pigments could be applied over it. The varnish or solution of resin in spirit of wine or oil, used for this purpose at present, appears not then to have been known. But in the sixteenth century this art was very common; and instructions respecting it were given by Garzoni[705], Cardan[706], Caneparius[707] and others in their writings. About the same period a pewterer at Nuremberg, named Melchior Koch, was acquainted with the art of communicating a golden colour, in the like manner, to tin goblets and dishes. He died in 1567; and with him, as Doppelmayer says, the art was lost. A method of applying a white metal to paper, and then drawing over it a gold varnish, has been known in China since the earliest periods[708]. At present this method of gilding is practised more in Sicily than in any other country. It appears also to have been used, at an early period, for gilding leather and leather tapestry; and this perhaps was first attempted at Messina, as we are told by John Matthæus[709], who, however, in another place ascribes the invention to a saint of Lucca, named Cita. But gilt leather was made as early as the time of Lucian, who conjectures that Alexander the impostor had a piece of it bound round his thigh[710]. The dress of the priests, on the festival of Bacchus, was perhaps of the same kind[711].

FOOTNOTES

688 Herodot. lib. ii. 63. See Winkelmann Hist. de l'Art.—Caylus, Recueil d'Antiquités, i. p. 193. Gori seems to have had in his possession two Egyptian gilt figures. See Mus. Etr. t. i. p. 51.

689 In the books of the Old Testament gilding and gold plates are clearly mentioned. Moses caused several parts of the sanctuary to be overlaid with gold. 1st. The ark of shittim wood was covered with gold both on the outside and inside, Exodus, chap. xxv. ver. 11; also the staves, ver. 13. 2nd. The wooden table with its staves, ver. 23 and 28. 3rd. The altar of burnt incense, chap. xxx. ver. 3. 4th. The boards which formed the sides of the tabernacle, chap. xxvi. ver. 29.

Solomon caused various parts of the temple to be overlaid with gold. 1st. The whole inside of the house, 1 Kings, chap. vi. ver. 21 and 22. 2nd. The altar of burnt incense, ver. 20 and 22. 3rd. The wooden cherubim above seventeen feet in height, ver. 28. 4th. The floor, ver. 30. 5th. The doors of the oracle, on which were carved cherubims, palm-trees and open flowers, ver. 32 and 35, so that the gold accurately exhibited the figures of the carved work.

Now the question is, whether all these were gilt, or covered, or overlaid with gold plates. But when the passages are compared with each other, I am inclined to think that gilding is denoted.

"The Hebrews probably brought the art of gilding with them from Egypt, where it seems to have been very old, as gilding is found not only on mummies, the antiquity of which indeed is uncertain; but, if I am not mistaken, in the oldest temples, on images. It appears also, that in the time of Moses the Hebrews understood the art both of gilding and of overlaying with plates of gold, and expressed both by the general term צפה."

690 Page 534.

691 Lib. xxxiii. 3. The thicker gold-leaf was called, at that time, bractea Prænestina; the thinner, bractea quæstoria.

692 Osservazioni Istoriche sopra alcum Medaglioni Antichi. In Roma, 1698, fol. p. 370.

693 Lucret. iv. 730.—Martial. viii. 33.

694 Lessing zur Geschichte und Litteratur, iv. p. 309.

695 L'oggidi overo gl'ingegni non inferiori à passati. Venet. 1636. 8vo.

696 Zusammenhang der Künste. Zurich, 1764, 8vo, i. p. 75. For further information see Traité des Monnoies, par Abot de Bazinghen. Paris, 1764, 4to, i. p. 102.

697 Rutty's Natural History of Dublin, 1772, 2 vols. 8vo, i. p. 264.

698 Von Uffenbach Reisen, iii. p. 218.

699 I was told that Professor Pickel of Würzburg prepares gold-beaters' skin by means of a varnish, which renders it fitter for use; and that a student of that place had found out the art of making it transparent, in order that the wound might be seen.

700 Lib. xxxiii. § 20, p. 616.

701 Plin. lib. xxxv. § 17, p. 685.

702 Lib. xxxiii. § 32, p. 622. "Cum æra inaurantur, sublitum bracteis pertinacissime retinet. Verum pallore detegit simplices aut prætenues bracteas. Quapropter id furtum quærentes ovi liquore candido usum eum adulteravere." See also sect. 42, p. 626. I acknowledge that this passage I do not fully comprehend. It seems to say that the quicksilver, when the gold was laid on too thin, appeared through it, but that this might be prevented by mixing with the quicksilver the white of an egg. The quicksilver then remained under the gold; but this is impossible. When the smallest

drop of quicksilver falls upon gilding, it corrodes the noble metal, and produces an empty spot. It is therefore incomprehensible to me how this could be prevented by the white of an egg. Did Pliny himself completely understand gilding? Perhaps Pliny only meant to say, that many artists gave out the cold-gilding, where the gold-leaf was laid on with the white of an egg, as gilding by means of heat. I shall here remark, that the reader may spare himself the trouble of turning over Durand's Histoire Naturelle de l'Or et d'Argent, Londres 1729, fol. This Frenchman did not understand what he translated.

703 Principes de l'Architecture. Paris, 1676, 4to, p. 280.

704 Lessing zur Geschichte und Litteratur, vi. p. 311.

705 Piazza Universale. Venet. 1610, 4to, p. 281.

706 De Rerum Var. xiii. cap. 56.

707 De Atramentis.

708 Mémoires concernant les Chinois, xi. p. 351.

709 De Rerum Inventoribus, Hamb. 1613, 8vo, pp. 41, 37.

710 Luciani Opera, ed. Bipont. v. p. 100.

711 Plutarchi Sympos. iv. *in fine*.

FUR DRESSES.

As long as mankind lived under palm-trees in their original country, between the tropics, they had no occasion to provide either food or clothing: the former was spontaneously supplied by the earth, that is, without care or labour; and the latter in that warm climate was superfluous. The art of cultivating plants, and that of preparing clothes, were not innate, but first taught by necessity; and this did not exist till men, in consequence of their increase, were obliged to spread towards both the poles. In proportion as they removed from their former abode, provisions became scarcer, and the climate colder. Hence arose the breeding of cattle, as well as agriculture; and men then first ventured on the cruelty of killing animals, in order that they might devour them as food, and use their skins to shelter them against the severity of the weather.

At first these skins were used raw, without any preparation; and many nations did not till a late period fall upon the art of rendering them softer, and making them more pliable, durable, and convenient. As long as mankind traded only for necessaries, and paid no attention to ornaments, they turned the hairy side towards the body; but as the art of dressing skins was not then understood, the flesh side must have given to this kind of clothing, when the manners of people began to be more refined, an appearance which could not fail of exciting disgust. To prevent this the Ozolæ inverted the skins, and wore the hair outwards; and in this manner some account for the bad smell which exhaled from their bodies[712]. This custom, however, was so general, that Juvenal, where he describes a miserly person, says, “to guard himself against the cold he does not wear the costly woollen clothing of the luxurious Romans, but the skins of animals, and these even inverted, that is to say, with the hairy side turned inwards, without caring whether the appearance be agreeable or not[713].” In what manner the art of tanning was afterwards found out, Goguet has endeavoured to conjecture from the accounts given by travellers, in regard

to the savages in the northern parts of America and Asia, but particularly in regard to the Greenlanders. The far more ingenious method of manufacturing wool, first into felt and then into cloth, seems to have been discovered by the inhabitants of temperate districts, where the mildness of the winter rendered fur dresses unnecessary.

The sheep came from Africa; but in that country it has hair and not wool; and it is only in colder climates that the former acquires a woolly nature. If it be true that a Hercules first brought this species of animal from Africa to Greece[714], that improvement may have first been effected in the latter country; in which case it is probable that the first attempts to manufacture wool were made by the Athenians, that is to say, among the Greeks; for this art was before known to the Egyptians, who ascribe the invention of it to their Isis.

It may be readily comprehended that many centuries must have elapsed before the tender sheep could be conveyed to and reared in the northern countries, where thick and immense forests produced in abundance a great variety of those animals which were capable of supplying the best furs; where mankind increased but slowly; applied to hunting till a later period; and were not so soon compelled to employ artificial methods of obtaining the most necessary productions; and where they also lived too widely scattered to be soon conducted to the arts by a communication of experience and inventions. The northern nations, therefore, clothed themselves in the raw skins of animals, a long time after the southern tribes were acquainted with the spinning and weaving of wool, flax, and cotton; and on this account the former were astonished at the appearance of the latter.

When the Greeks give us a picture of these barbarians, they scarcely ever fail to state how disgusting they were on account of their dress; which however, by the acknowledgement of their historians, was long worn by their own forefathers[715]. The heroes even of the Grecian fabulous history clothed themselves in the skins of the most terrible animals[716], such as lions and tigers, and on these they also slept. When the Romans wished to describe the manners of their ancestors, and to exhibit the difference between them and their own, they commonly mentioned the use of skins.

Thus Propertius calls the senators of the earliest periods the *pelliti*[717], and Valerius Maximus says[718], speaking of the luxury of his time, that no one in imitation of Cato would use goat skins as a covering to his bed. But it appears that the Greeks and the Romans, at the time of their prosperity, when the arts and sciences were cultivated among them, made little use of fur clothing. It was worn at that period only on certain festivals, and merely by the poorer classes and rustics[719], or employed in the time of war[720]. At any rate, it is not mentioned among the dresses of the rich, or articles of magnificence and ornament.

The ancient physicians, where they treat on the influence which clothing has on the health, and the choice of it for winter and summer, make no mention of furs. Suetonius, describing the manner in which the emperor Augustus dressed in winter, names various articles of clothing, but no furs; which the emperor, who was so sensible of cold, would certainly have worn, had they been usual. They no doubt would have been much more convenient and answered the purpose better, than the four *tunicæ* drawn over each other, and the thick *toga*, the woollen shirt and breast-cloth, and all the other articles mentioned. Martial ridicules a *petit-maître*, who wished for the arrival of winter and for severe weather in that season, in order that he might exhibit his costly winter dresses. Had furs, at that period, been the fashionable and principal winter clothing, the poet certainly would not have omitted to mention them. At present the *baccaræ* for the like reason make their appearance as soon as the first frost takes place, along with large muffs, which leave scarcely any part of the body to be seen but the head and the feet. Had furs been employed by way of ornament in the time of Pliny, he no doubt would have noticed this use of them, especially as he mentions and ridicules so many superstitious ways of applying the skins of animals; but I do not remember to have read in the works of this naturalist any account of fur clothing. He relates that an attempt had been made to manufacture the fur of the hare; but it had not succeeded, because the fur, on account of its shortness, as he supposes, would not adhere, or, as we say at present, could not be felted[721]. He, however, says nothing of hare's fur being employed to line clothes. It appears also that furs do not often occur as clothing in the sacred scriptures[722]. In the third, or perhaps even the

second century of the Christian æra, fur dresses seem to have been known to the Romans, and to have been much esteemed by them. The numerous northern tribes, who at that time advanced towards the south, were clothed in furs; but they were not all raw, dirty, and disgusting, like those which had before been in use. It may with certainty be supposed that the chief men among them had the most beautiful furs; and that in general they were so well acquainted with the art of preparing them, and wearing them in the most graceful manner, that they by these means recommended them to the notice of the young Romans. For that all those warlike tribes who attacked the Roman empire, and in part subdued it, are not to be considered as uncultivated, savage barbarians, unacquainted with the arts or the sciences, addicted to plundering and murder, who overturned governments and destroyed public happiness and trade, has been lately remarked, when the French applied the term Vandalism to the horrid cruelties committed during the late revolution[723]. It can be proved that the Romans adopted from their uninvited guests those kinds of dress; that furs soon became fashionable among them, and were an object of luxury and of commerce; and it appears that skins were the first article which occasioned a trade from Italy to the most distant parts of the North, as in the fifteenth century they were the cause of the discovery and conquest of Siberia.

The later the art of manufacturing wool, and of converting the noble metals into lace and other ornaments, was known, in the northern countries, and the later the inhabitants became acquainted with cotton, silk, and precious stones, the earlier and the more they exerted themselves to find out and prepare the most beautiful furs, and to trim and to border with them their dresses; and it needs excite no surprise that the southern nations, though their climate did not require it, adopted this magnificence; especially as the distance and scarcity of furs made them dear enough to be considered by the rich and people of rank as a luxurious mark of distinction. This, in my opinion, will be proved by what follows.

When historians speak of those northern nations with whom the Romans carried on long and for the most part unfortunate wars, they scarcely ever forget to mention their fur clothing; and this is the case in particular with those writers who lived at the time. We are told by Herodotus, that the people near the Caspian sea clothed themselves in seal-skins. The same thing is related by Strabo of the Massagetæ; and Cæsar and

Sallust both assert, that the skin of the rein-deer formed in part the clothing of the ancient Germans. I allude here to those dresses which they call *renones*. That this word is derived from the animal named at present by the Swedes *Ren*; that the rein-deer was common in ancient Germany, when, in consequence of its being covered with forests and marshes, it had a much colder climate and produced more rein-deer moss than at present; and that Cæsar, where he describes the most remarkable things of Germany, mentions the rein-deer under the name of *bos cervi figura*, I think I have proved in my juvenile production on the ancient animals of that country. *Reno* is also *Lappmud*, or the rein-deer skin, which is still worn in Sweden, which I have worn there myself, and which is handsome and costly. The objection of Wachter[724] to this opinion is of very little weight. How is it possible to believe, says he, that these animals were formerly so numerous, that all the Germans and Gauls could clothe themselves in their skins? But on this occasion he does not recollect what he has often proved by examples, that the name of a species is often given to the whole genus. Because a great many wore *renones*, of which the Romans perhaps were fondest, they gave the name of *renones* to all these fur dresses of the Germans. The proofs, in ancient authors, in regard to the fur clothing of the Scythians, the Goths, the Getæ, and Huns, are too numerous to be collected. I shall therefore refer only to those passages which I have occasionally remarked, and which I shall soon employ for another purpose[725].

It can easily be proved that the Germans and other northern nations, in consequence of their intercourse with the Romans, gradually left off the use of furs, and became more and more accustomed to woollen clothing; and, on the other hand, that the Romans adopted the state dress of their conquerors. Even in the time of Tacitus, those Germans who lived on the Rhine and the Danube, and consequently who were nearest to the Romans, set much less value on furs than those who, residing further within the country, were at a greater distance from intercourse with foreigners and from trade[726]. The latter had the most costly furs, which they knew how to ornament and variegate with trimmings of every kind, in the same manner perhaps as our furriers at present ornament white fur with the tail of the ermine[727]. These people possessed no other articles of luxury, and had no other means of distinguishing themselves among their countrymen, but by

the rarity and costliness of their furs. Such was the case with the Spartans when Lycurgus deprived them of all their superfluities. They then ornamented, and thereby enhanced the value of the necessary articles they had left, beds, tables and wooden bowls, from which they drank water, and to such a degree, that at length these things were as capable of gratifying the taste of luxury as the foreign wares they had before purchased at so dear a rate[728].

The same thing has been remarked by the Danish and Swedish historians. When these nations, by their sea voyages, piratical expeditions and trade, became acquainted with foreign manners, and more convenient kinds of clothing, they accustomed themselves to wool, cotton and silk; yet, in so slow a manner, that the use of these wares was introduced as an extravagant luxury. Harold Härdrät Sigurdson, or Harold IV. king of Norway, in the middle of the eleventh century, who had collected great riches in the Levant, wore a red mantle lined with white furs. In the twelfth century the principal men at the Danish court were clothed in sheep-skins[729]; and when Duke Canute, or Canute Laward, the son of Eric Eiegod, who was assassinated in the year 1131, appeared at a festival at Ripe in a dress of red cloth, he excited attention and envy, and was subjected to the mortification of hearing the most bitter sarcasms from Henry Skatteler, or rather Skokal, that is, the lame, who wore a native sheep-skin[730].

That furs were considered by the Getæ as objects of magnificence, and that as such they were worn by their kings and the principal men at court, is proved by the passages I have quoted. The reproach thrown out by Claudian against Rufinus, that he was not ashamed to wear Getic furs, proves that the Romans adopted the manners of their conquerors, and that this practice was censured by their patriots. It is worthy of remark also, that the jurists, Ulpian and Paulus, reckon furs among articles of dress, to which before their time they did not belong[731].

Acron, an old commentator on Horace, whose period, as far as I know, has not yet been determined, says that in his time the senators and principal men, when they appeared in their official dresses, wore costly furs obtained

from foreign countries, and Tertullian[732] indignantly inveighs against the female dresses bordered and trimmed with furs, which seem to be mentioned also by bishop Maximus in the fifth century.

In the year 397, the emperor Honorius forbade Gothic dresses, and in particular furs, to be worn either in Rome or within the jurisdiction of the city; but that such orders against fashions had very little effect appears from this circumstance, that these laws, extended as well as rendered more severe, were renewed in 399 and 416, and yet were not obeyed. Even the Goths themselves were forbidden to use such dresses. The Gothic servants, who at that time were kept in most families, were to be subjected to corporal punishment, and those of higher rank to a fine, in case they transgressed this prohibition. But Synesius, who lived at that period, and as a good patriot lamented the use of these outlandish dresses, which afforded a melancholy presage that the dominion of the Goths would at length prevail, relates, that the principal men among these people appeared at Rome in the Roman dress, but on their return home they exchanged it for their native clothing, and again assumed their furs.

Furs, however, were not the only part of the Gothic costume which became modish among the Romans; for they adopted also their breeches or hose. That such articles of dress were not used before that time, either by the Greeks, the Romans, or the Hebrews, has been proved by many. On this account mention is so often made of indecent postures, as when the Scotch Highlanders *rendent les armes*, by which parts are exposed that modesty requires to be concealed. This is considered by Theophrastus as one of the marks of clownishness[733]. Thus, a posture inadvertently assumed, exposed Philip to reproach, as we are told by Plutarch[734]; and to guard against a similar indecorum, Cæsar, as he fell, collected his robes around him. Hence, as is well known, the expression retained by Luther, *seine Füsse bedecken*, "to cover one's feet," or as the Greeks say, "to compose one's clothes[735]." Persons who laboured under weakness or indisposition, wrapped bandages around their legs; and in the time of Quintilian, the use of these could be excused only by sickness[736]. They, however, became afterwards more common, so that by Ulpian they are reckoned among the ordinary articles of

dress[737]. They formed a step towards breeches, properly so called, which, as is well known, covered for many centuries the loins, thighs and legs, as may be seen on seals and carved work of the thirteenth century[738]. That the Batavians, Gauls, Germans, Sarmatians, Getæ, Goths, &c. had such articles of clothing, is proved by many passages in ancient authors, already quoted by others, and by the well-known appellation *Gallia braccata*. The *anaxurides* also of the Persians were breeches, which the Romans adopted, not from these people, but from the northern nations, yet without the approbation of the patriots, who exclaimed against them, as they had before done against furs. At first they seem to have been used only on journeys and in war. When the Gothic costume was forbidden by Honorius, breeches were expressly mentioned; and Ovid reproaches the people of Tomi, on the Pontus Euxinus, that though they wished to be thought of Greek extraction, they were not ashamed to wear Persian breeches[739].

As furs for dresses of ceremony were either not used at all by the Greeks and the Romans, or were adopted only at a late period and seldom employed, an account of the fur trade is not to be expected in their writings. I am well aware that Isaac Vossius had an idea that the history of the golden fleece might be considered as the oldest trace of it[740], and therefore asserted that the object of the Argonautic expedition to Colchis was a commercial speculation, as was the case with the voyages of the English to Nootka Sound. It is also true that this opinion met with some approbation; but it has no more probability than that entertained by the alchymists in regard to the same expedition since the time of Suidas. That the Colchi, indeed, carried on a very extensive trade is sufficiently proved by the testimony of Pliny and Strabo; but the latter, in the catalogue of wares, mentions timber for ship-building, pitch, wax, linen and hemp, but not furs, which at that time could not be an article much sought after in foreign commerce.

Another account which we read in Pliny seems much rather to refer to the fur trade. I here allude to that quoted by Böttiger[741], from which it appears that furs were reckoned among the articles obtained at that time from the Seres[742]. I, however, freely confess that I cannot readily admit this single word of Pliny as a complete proof. As far as I have yet been able to

find, other writers, among the articles furnished by the Chinese, mention iron, pearls, silk, cotton, and silk or cotton clothes, but say nothing of furs; and it is very improbable that a country which produced silk or cotton could supply such furs as would be worth conveying to so great a distance. The only thing I can admit is, that the furs were brought by a transit trade to Europe; that is to say, the Seres obtained them from the fur countries, properly so called, or those which at present furnish sables, and again sold them to the Romans. Now this was a very circuitous route, whether we consider *Serica* to have been China, Siam, or the Lesser Bucharia; yet not so circuitous as that by which the Chinese obtained from the English, through Russia, the best beaver-skins brought from Canada and Hudson's Bay.

Were we to reckon among the *pelles Serum* of Pliny the *lucida vellera*, *tactu mollia Serum*, mentioned by Seneca, Boethius and others, we should undoubtedly be in an error; for these may be explained by the false information which at that time was obtained partly in regard to cotton, and partly in regard to silk, and which may be seen in Solinus[743] and others. Is it not possible that these *lucida vellera* may have been meant likewise by Pliny?

I have some doubts also respecting a passage of Strabo, where he relates that among the wares brought by the nomadic tribes of Europe and Asia to the Tanais, or present Azoph, at the mouth of the Don, there were slaves and furs[744]. It is certain that *dermata* may signify, not only furs, but also tanned skins. If Strabo here meant furs, I am inclined to conjecture that they were disposed of in the nearest countries, but did not come into the European trade; and the case, perhaps, was the same with the slaves mentioned in the same passage. Polybius also, among the wares brought from Pontus to Byzantium, mentions *dermata*[745]. I must, however, confess, that if I found that the Romans actually obtained *dermata* from Asia, I should carefully examine whether under that term skins, or even dyed leather, were not rather meant. Skins, and particularly for military purposes, they indeed procured from very distant places. Thus the Frieslanders, instead of a tax, were obliged to supply ox-hides[746]; and it may be proved by the testimony of various writers, that the art of giving a beautiful dye to

leather is very old in Asia; and therefore that many kinds of what we call morocco was at an early period brought from thence to Europe.

On the other hand, from what is said by Ælian[747], I entertain no doubt that in his time a trade in furs was carried on with Persia. To that country were sent, he says, the soft skins of the Pontic mouse, which, when sewed together, formed warm dresses. I am convinced also that more proofs might be found of the use of fur-clothing among the Persians. They employed furs likewise instead of mattresses and bolsters. Thus we are told by Plutarch[748] that Pharnabazus reclined upon soft furs: and it is not improbable that the rough or thick winter gloves of the Persians, mentioned by Xenophon, were of the same material[749]. It is stated by modern travellers, that at present sable and ermine skins are among the most common and valuable ornaments of the Persians; and it is well known that the costume of these people is very old, because they are not exposed as we are to the influence of fickle fashion.

But the Persian skins, *pelles Parthicæ* or *Persicæ*, which are often extolled, especially in later times, on account of their beauty, do not belong to this head; though Vossius, Brisson and Gesner, consider them to have been sables. They were undoubtedly different kinds of dyed leather, of which shoes were made for princes and opulent persons. In the time of the emperor Maximianus, a Roman soldier having found a leathern purse which contained real pearls, threw away the latter and retained only the purse, because it had a beautiful colour[750]. Of the same kind of leather was that dyed with kermes, mentioned by Zosimus[751]; and that which by Constantine Porphyrogenetes, where he mentions all those wares which the northern nations obtained through Constantinople, is expressly named highly-dyed Persian leather.

Of a similar kind, as appears, was the Babylonian leather. Zonaras[752] speaks of a costly tent made of it; and in the time of St. Jerome it was considered as an object of luxury. As Persian and Babylonian leather are mentioned at the same time, there is reason to think that a distinction was made in commerce between these two kinds[753]. The emperor Constantine, among the persons charged to furnish articles for the imperial wardrobe at

Constantinople, and who on that account enjoyed certain immunities, mentions the *parthicarii*, *particarii*, or *parthiarii*[754]; and though we are uncertain in regard to the orthography, it may be readily conceived that these words do not allude, as Vossius says, to furriers, but to merchants who dealt in costly dyed, and perhaps painted skins, which they procured from Persia. It is well-known that at present the Persians understand the art of preparing and dyeing many kinds of leather in a more beautiful manner than the Europeans; and among these in particular are shagreen and morocco, which are still imported from the East[755].

From the grounds here adduced, I am led to conjecture that the trade in furs to the southern parts of Europe had its commencement during the expeditions of the northern tribes to Italy; and I must acknowledge that I have found no older information on this subject than that furnished by Jordanes or Jornandes, who lived in the sixth century. This writer, speaking of the northern nations, mentions the *Suethans*, and says[756], that these are the people who send to the Romans the celebrated furs; which, however, passed necessarily through the hands of many intermediate tribes. These Suethans, according to his account, inhabited a part of *Scanzia*, and that under this name he included Sweden, Norway, Lapland, Finland, &c. has been already proved by Mascou[757]. Soon after he mentions also *Hanugari*, whom he reckons among the Scythians; these he says were known on account of their trade with mouse-skins[758].

It is too well known to require any proof, that in the oldest periods the whole riches of the northern countries consisted in furs; that these, if not the only, were the principal wares exported, and that all taxes were paid with them. Other, who lived in the ninth century, states the number of marten, rein-deer, bear and otter skins, which were delivered annually by the Finlanders and Norwegians[759]. When Thorolf, in the year 878, sent a ship to England with merchandise, there were among it *pelles mustelinæ albæ*[760]. I shall remark also, that so early as the third century skins and leather began to be counted by *decuriæ*; from which is derived the appellation *decher*, adopted into the English, Swedish and Danish languages, as well as the word *dacra* or *dacrum pellium*[761], used in the middle ages. Sables and

ermines, however, are still sold by *zimmern*; and this appellation also is very old. A *timber* of hare-skins occurs about the year 1300, and *unum timbrium martrinarum* as early as 1207. At present a *zimmer* makes four *dechers* or twenty pairs, and in the time of George Agricola sable-skins were sold in this manner, forty in one lot[762]. But a *zimmer* has not always been the same in all countries and at all times; at any rate in France a *zimmer*, *timbre*, was reckoned to contain sixty skins.

Before I proceed further, I must endeavour to explain the different names of furs which occur in the works of the ancients; but in this attempt I can scarcely hope to attain to great probability. The information of the ancients in regard to those species of animals with the country of which they were not acquainted, is exceedingly defective. What they relate was obtained from the accounts of merchants; and these, in all probability, through a principle of self-interest, falsified the little that they really knew. Besides, the ancient writers do not always accurately distinguish the names of the different furs, nor affix to them the same meaning; which is the less surprising, as few know how to give proper names to the principal kinds of furs even at present. It is probable that the skins of the ermine, marten, and squirrel, became at a very early period objects of commerce, and formed the chief articles in this branch of trade; but from the little known on this subject, no zoologist would venture to determine with certainty the species. He must be so candid as to admit all conjectures which he is not able to refute.

If I am not mistaken, the skin of the mouse, and particularly the Pontic or Caspian mouse, is that of which the first and most frequent mention occurs in the oldest times. That the name *mus* denoted at first not only that animal to which we apply it, but also all small warm-blooded quadrupeds, has been long ago remarked. In the same manner every large animal was formerly called *bos*. When the Romans first saw elephants they gave them the name of *boves lucæ*. Pausanias also calls the rhinoceros the Ethiopian ox; and Cæsar names the rein-deer, the ox with stag's horns. The ox was the largest, as the mouse was the smallest, warm-blooded animal with which the ancients were acquainted, and therefore they called all large animals oxen, and all small ones mice[763]. It is to be observed, in explaining the ancient names of animals, that at first they had a much more extensive

signification, and one must endeavour to conjecture what the animals comprehended under them had in common with each other, according to the ideas of the ancients. To words of this kind *formica* seems to belong, and perhaps the principal idea related to collecting and laying up; and perhaps in this manner one might be able to explain the fable of the gold-searching ants, mentioned by Herodotus. It is however often difficult to conjecture what the principal idea was. What idea did the ancients affix to the term *passer* (sparrow), when they called the ostrich the large Libyan or Arabian sparrow? We learn nothing more therefore from the words *pelles murium*, than that they were not the skins of large animals. The epithets Pontic and Caspian only show, that these wares, like many others, were brought from Pontus and the Caspian sea. From such epithets were we to determine the original country of any article used in commerce, or the place where it was first produced, we should often fall into error. Wares were frequently called Syrian, Turkish and Arabian, though it is certain that they were brought from very different countries.

What further information I have been able to find in regard to this species of animal, merely is, that its skin was exceedingly soft; that it formed a good defence against the wind, and that a great many of them were sewed together in order to make a garment[764]. Now, if credit be given to the account of Aristotle and Pliny, that the Pontic mouse belongs to the ruminating class of animals, how can anything characteristic be deduced from it?

Those who wish to afford more room for conjecture might, from a passage of St. Jerome, render it probable that this kind of fur had the same smell as musk. Musk indeed was then known; but is it not possible that this father may have considered the musk animal to be a mouse, as Conrad Gesner suspected? To me it is more probable that he was acquainted with the musk bags used in commerce, and named them *peregrini muris olentes pelliculæ*. It however cannot be proved by this passage, that the skin of the musk animal was purchased for fur clothing on account of its smell. For, in the first place, the skin of this animal, with the hair on it, has not a musky smell; and this is known not only from the description given of it, but is proved by a skin which I obtained in a very fresh state. In the second place, this animal is as large as a deer half a year old; the size therefore will not warrant the use of the diminutive *pellicula*. And, in the third place, the skin

does not afford valuable fur. The hair is thick; almost bristly, and so tender that it breaks with the least force. These skins are used only by the natives of the country where they are produced, for caps and winter clothing; but when they have been freed from the hair, and tanned white, they form leather exceedingly soft and fine. Those who are satisfied with an appearance of probability may recollect, in reading the passage of Jerome, that the sable, when daily used, throws out a faint and not unpleasant smell of musk, and assert that the Pontic mouse was the sable.

Far more probable is the conjecture of our great zoologist, that *mus Ponticus* was the name given at first to the earless marmot, *M. catili*, and that it was afterwards applied to the squirrel and ermine[765]. This opinion he supports by the observation, that the torpidity in winter, the rumination, and the affinity to the alpine mouse, *M. alpinus*, which Pliny seems to acknowledge[766], agree better with the *M. catili* than any other animal. To this may be added, that it is said by Hesychius and Phavorinus, that the Parthian name of the animal was *simoor*; and that the earless marmot is still named by the Tartars *symron*, and by the Calmucks *dshymbura*. The similarity is indeed great, and this opinion is further confirmed by the skins of the earless marmot being used at present by some of the Siberian tribes for summer clothing, and sent as articles of commerce, with other furs, to China, though they belong only to the cheapest kinds, so that a thousand of them cost scarcely eight or ten roubles[767].

Amidst this scanty information, were I allowed to offer a conjecture, I should be inclined rather to the opinion of those who consider the Pontic mouse to have been our ermine. For, in the first place, this animal is very abundant in the countries from which the ancients obtained their beautiful furs; and it seems almost impossible that they should not at an early period have remarked the superiority of its skin to that of the earless marmot. Secondly, it appears that the Pontic mouse has been commonly considered as the ermine, since that name in general was known; and there is reason to think that our forefathers could not err in the name of an article which has been uninterruptedly employed in commerce.

The name ermine occurs very often in works of the middle ages, and written in various ways, such as *Harmellina*, *Harmelinus*, *Ermelinus*,

Harminiæ and *Arminiæ* or *Armerinæ* or *hereminiæ pelles*, *Ermena*, *Erminea* and *erminatus*, ornamented with ermine; all which words Du Cange supports by proofs. At what time these names were first used I am not able to determine; but they are to be found, at any rate, as early as the eleventh century, in the letters of Peter Damiani[768]. Du Cange asserts that they came from Armenia, in which country this kind of fur was in old times highly esteemed, as is proved by a passage in Julius Pollux; and this appears the more probable, from the circumstance that the words *Hermenia* and *Hermenii* were formerly used and written instead of *Armenia* and *Armenii*[769]. Fischer has rejected this opinion too inconsiderately, because the ermine was not procured from Armenia, but sent through it, from the northern countries to Europe. The same thing is said by Du Cange; but he gives it to be understood that this commodity was among the Armenian productions; and even if he has erred in this respect, his derivation still remains the most probable. Marco Polo, the celebrated traveller of the thirteenth century, mentions the ermine among the most expensive ornaments of the Tartars, and says that it was brought from the northern countries to Europe.

The sable seems to have been known much later than the ermine. Its real country is the most northern part of Asia, to which commerce was not extended till a late period; yet it is probable that it was known before the Russians became acquainted with Siberia, by means of the Permians, Woguls and Samoeides, at the end of the fifteenth century. It is also fully proved that the fine furs of Siberia were the production which induced the Russians to make a conquest of that country[770]. Besides, sables existed formerly in Permia, where at present they are very scarce. The numerous remains of antiquity still found in Siberia prove that at a very early period it was inhabited by a people who carried on commerce, and were well-acquainted with the arts.

Conrad Gesner believed that the name sable occurs for the first time in Albertus Magnus, who wrote in the thirteenth century, under the word *Cebalus*, or *Chebalus*. In the same century Marco Polo mentions, at least in the Latin translation, *zibellina pellis*, as a valuable kind of fur. But if *sabelum* be the sable, as the similarity of the word seems to show, it must have been known in the twelfth century, and even earlier. The name

sabelum occurs in Alanus Insulanus, and Du Cange found *sabelinæ pelles* as early as the year 1138, though *sabelum* perhaps means the marten. *Gebellinica pellis*, *gibelini* or *gibellini martores*, were mentioned in the eleventh century, and *sabellinæ* and *gebellinicæ pelles* were undoubtedly the same[771]. I shall not however enter further into this inquiry, which it appears would be endless, and at the same time of little benefit.

The marten, the fur of which approaches nearest to that of the sable, appears to be first mentioned by Martial, who says, speaking of an unsuccessful hunting excursion, that the hunter was overjoyed if he caught only a marten[772]. But the reading is very doubtful; for many, instead of *martes*, read *meles*; and the latter occurs in Varro, Pliny, and other writers, whereas the former is found nowhere else. In the middle ages, however, or at any rate in the twelfth century, *martures*, *mardrini*, and *marturinæ vestes* frequently occur; and I can see no reason why they may not be considered as marten skins, a name which has been retained in all the European languages.

With as little certainty can it be determined what our forefathers meant by the words *vares*, *varii*, *vairus*, *vajus*, *varus*, *vayrus*, *veyrus* or the *vair* of the French, and under *griseum* and *grisum*. That they belong to costly kinds of fur is universally admitted. Sometimes *varium* and *griseum* appear to be the same; and sometimes the former seems to be more valuable than the latter. That the former was spotted, or parti-coloured, is apparently announced by the name; for both the leopard and panther are by Pliny called *variæ*. What in heraldry is named by the French *vair*, and the Germans *eisenhütlein*, *vellus varium*, and which is considered by the former as the skin of an animal gray on the back and white on the belly[773], alludes to this also. Sometimes, however, it seems to signify a fur dress composed of differently-coloured pieces of fur sewed together. Most writers are of opinion that it means *grauwerk*, *petit-gris*, *vech*, *veh*, *vech*, *vehwammen*, also the squirrel; and there is certainly a species of that animal which might justify the name *varius*, as its skin is at present employed for variegated bordering or trimming; but I do not know whether *grauwerk*[774] could be so dear as *varium* is said to have been, as it is among the productions of Europe, though the best at present comes from Siberia. The word *veeh* is

derived, as Frisch says, from the Italian *vaio*; the latter, according to Muratori[775], is formed from *varius*, and even at present a dress lined with fur is called *roba vaja*.

Cirogillinæ pelles, named by the council of Paris in the year 1212, were rabbit skins[776]. Rabbit warrens, so early as the thirteenth century, were not scarce in England; for in a letter of grace respecting the forests, in 1215, every proprietor was permitted to establish them on his own lands[777].

By the term *cattinæ pelles*[778], which are also often named, must undoubtedly be understood cats' skins. In France, in the twelfth century, the skins of native animals were considered as of little value; but the Spanish and Italian were highly prized. The skins of the black fox, which at present are the dearest kind of furs, as a single one in Russia is often sold for six hundred and even a thousand roubles, occur in the thirteenth century, among the wares which were sent from the most northern countries to Europe[779]; and without doubt these were meant by Damiani in the passage above quoted[780].

Clothing made of the beaver skin occurs much earlier. It seems to be mentioned by Claudian[781] in the fourth century; and it is spoken of by Ambrosius[782], who lived at the same period. Sidonius Apollinaris, in the fifth century, called those who wore it *castorinati*. The scholiast of Juvenal, who indeed belongs to an unknown but much later period, has also *pelles bebrinæ* or *beverinæ*. As the ermine was called the Pontic mouse, the beaver was named the Pontic dog.

I however firmly believe that this castor clothing was no more fur clothing, than our beaver hats are fur hats. At that time the hair was spun and wove; and Claudian, in my opinion, speaks of a worn-out beaver dress, which had nothing more left of that valuable fur but the name. This method of manufacturing beavers' hair seems not to have been known in the time of Pliny; for though he speaks much of the castor, and mentions *pellis fibrina*[783] three times, he says nothing in regard to manufacturing the hair, or to beaver fur. As attempts, however, had then been made to manufacture

the fur of the hare, it is probable that beaver hair began to be worn soon after. Isidorus, who lived nearly about that period, as he died in 636, reckons beaver hair, which he calls *fibrinum*, among the materials employed for making cloth[784]; and where he enumerates the different kinds of cloth, he mentions also *vestis fibrina*, and says that the warp was of beaver, and the woof of goats' hair, perhaps the so-called camel hair[785]. An upper garment of this cloth was worn by the emperor Nicephorus II. Phocas, at his coronation in the year 963, which undoubtedly was not a castor pelisse; because fur clothing, as I shall soon prove, was not fashionable at the court of the Greek emperors[786].

It deserves here to be remarked, that furs began to be dyed so early as the twelfth century; and it appears that the colour was chiefly red, for we find *pelles rubricatæ arietum*, that is, sheep-skins dyed red; but Du Cange thinks he can prove that the skins of the marten and ermine were dyed of the same colour. This I can believe in regard to the ermine; but to dye the dark fur of the marten and sable would, in my opinion, be hardly possible. St. Bernard[787] says, that such red dyed leather in the twelfth century was called *gulæ*, which, with *Hermin engolé* of the old poets, seems to signify the same thing, ermine skins dyed red.

When fur dresses became fashionable in Italy, they were soon spread all over Europe. At first the best indigenous furs were employed; but afterwards those of foreign countries, as being superior; and the dearer they were, the more they were esteemed. At every court they formed the state costume of the reigning family, and in a little time that of the richest nobility. In particular, the mantle, *cottes d'armes* of the knights, which they drew over their cuirass or harness, was bordered with the costliest furs. It had no sleeves, and resembled the dress of ceremony worn by our heralds. On this account, as is well known, ermine and other kinds of fur became parts of the oldest coats of arms. Sometimes magnificence, in this respect, was carried to such an extravagant length, that moralists declaimed against it, while governments endeavoured to limit the use of furs by laws, and the clergy to prohibit them entirely. Many kinds, therefore, were retained only by the principal nobility, and others were forbidden.

Charlemagne, however, wore in winter a pelisse which covered his shoulders and breast; but being an enemy to all foreign dress, he employed only the furs of his native country; and, according to the statement of some manuscripts, otter skins alone[788]. It nevertheless appears that the costly oriental furs were then known at his court; for having gone out hunting with his suite, on a cold rainy holiday, he himself wore only a sheep's skin; but the dresses of his attendants, who had become acquainted in Italy with the valuable articles in which the Venetians then dealt, consisted of foreign cloth and furs. These, when thoroughly drenched and dried at the fire, crumbled to pieces. The emperor then caused his sheep's skin when dried to be rubbed, and showing it to his courtiers ridiculed them on their foreign fur dresses, which though expensive were of little use[789]. The imperial princesses, however, on holidays wore dresses ornamented with precious stones, gold, silver and silk, and also foreign furs; at any rate the princess Berta had a valuable mantle or tippet of ermine, which Alcuin calls *murina*[790].

Fur gloves were at that time usual also. The monks, at least, in winter wore gloves of sheep's skin, which were called *muffulæ*; whereas the summer gloves were named *wanti*[791].

In the Welsh laws of Hywel Dda, who reigned in the tenth century, the skin of an ox, a deer, a fox, a wolf and an otter, are estimated at the same price, that is, eight times as dear as the skin of a sheep or a goat. The skin of a white weazle was eleven times as dear, that of a marten twenty-four times, and that of a beaver one hundred and twenty[792].

In the year 1001 the emperor Otto III. sent an ambassador to Constantinople, whose attendants were clothed in costly furs[793]. Adam of Bremen, who lived in the same century, says, in his description of the countries bordering on Poland and Russia, that from these districts were procured those costly furs which were so eagerly purchased by the luxurious[794]. When Godfrey of Bouillon, in the year 1096, paid a visit to the emperor Alexius at Constantinople, what the latter chiefly admired was the rich and costly dresses of the Europeans bordered with furs[795]. In the

beginning of the twelfth century the canons of a cathedral suffered themselves to be corrupted by beautiful furs[796]. The use of them, however, was forbidden to the clergy at one of the councils. According to that of London, in 1127, the abbesses and nuns were to wear those only made of lamb-skins and cat-skins[797]. In the year 1187, when the Christians were beaten near Tiberias, count Raimond having treacherously gone over to the Turks, the latter found among the plunder of the Christian camp a complete assortment of furs[798]. At the end of the twelfth century, Gottfried or Gaufred, prior of Vigeois, complained that no one would any longer wear sheep-skins and fox-skins, which before had been worn by barons and the principal clergy[799].

We however find that princes sometimes endeavoured by the most effective means to restrain this magnificence. When Philip II. of France and Richard I. of England, about the end of the twelfth century, undertook a crusade to the Holy Land, they resolved that neither of them should wear ermine, sable, or other costly furs[800]. It appears that a similar resolution was adopted by St. Louis (Louis IX.) in the following century; for the historians, speaking of his crusade, expressly say that he avoided all magnificence, and wore no costly furs[801]. In the year 1336, in the reign of Edward III., king of England, when foreign articles imported into the kingdom began to be taxed, it was enacted, that no person whose yearly income did not amount to a hundred pounds should wear furs, under the penalty of losing them[802].

In Germany, in 1497, citizens who did not belong to the nobility or equestrian order were forbidden to wear lining of sable or ermine. According to an ordinance of 1530, common citizens, tradesmen, and shopkeepers were to wear no trimmed clothes, nor to use marten or other costly lining, and the rich were to wear lining made only of lamb-skins, or those of the cow, fox, weasel, and the like. Merchants and tradespeople were not to wear marten, sable, or ermine, and at most weasel-skins; and their wives were to wear the fur only of the squirrel. Counts and lords were allowed all kinds of lining, sable and such like expensive kinds excepted. The latter permission was repeated, word for word, in the year 1548.

When one considers how much the use of fur dresses was spread all over Europe, it must excite astonishment that they were not introduced at the court of Byzantium. No traces of them are to be found in any of the Byzantine historians; not even in that work in which the emperor Constantine describes the whole ceremonial of his court, and in which dresses of various kinds are named, as Reiske has already remarked[803]. Furs are nowhere represented on Grecian statues, in paintings, or other works of art; and it will be seen in the passages quoted, that in the magnificence which the European princes displayed in the time of the crusades at the court of Constantinople, nothing attracted so much attention as the different kinds of fur dresses. This seems the more astonishing, as a great trade was carried on at that time between Constantinople and those countries from which these wares were sent to Europe.

Over one of the gates of Milan is an image cut out in stone of the twelfth century, representing an emperor whose mantle is ornamented with small triangular patches of fur. Flamma believed that this carving was intended to represent one of the Greek emperors; but Giulini justly remarks, in opposition to this opinion, that furs never occur in any of the Greek sculpture. Besides, that image was evidently formed to ridicule the emperor, as is proved by the hideous monster seated close to him. But at that time the Milanese certainly had no cause to offend the Greek emperor, with whom they were in alliance; and Giulini has proved, in a very satisfactory manner, that the Milanese erected this image to ridicule the emperor Frederick I., who was their bitterest enemy[804]. On another image at Milan, cut out in stone, of the thirteenth century, which represents the emperor of Germany on his throne, surrounded by the electors, the latter have small mantles, which are ornamented with triangular patches of fur of the same kind[805].

[Since the discovery and settlement of Canada, furs or peltries have mostly been obtained from the northern parts of America, some from the states of Rio de la Plata, a few from Germany, Holland, &c.

The success obtained by the French after their settlement in Canada in 1608, induced the formation of the English Hudson’s Bay Company, which was chartered by Charles II. in 1670, with the exclusive privilege of trading with the Indians in the vast territories adjoining Hudson’s Bay. But their

charter never having been confirmed by parliament, hunting in those regions was still considered as open to all British subjects, and many engaged in it. In 1766, private adventurers began to traffic from Michillimakinac, whose success incited others to follow their example; and independent traders gradually spread over every part of the country, until 1787, when these scattered parties were united into one great body, under the name of the "North-west Company." The rivalry of these associations had the effect of inspiriting and extending the trade, and led to constant and furious disturbances between the two. At length, in 1821, the two concerns united, under the title of the "Hudson's Bay Fur Company," with much advantage to the peace of the fur countries, and perhaps to the permanent interests of the trade. The skins collected by this company are all shipped to London, mostly from their factories of York Fort and Moose Fort in Hudson's Bay; others from Fort Vancouver, on the river Columbia, and from Montreal.

On the part of the United States, the fur trade is chiefly prosecuted by the North American Fur Company, whose principal establishment is at Michillimakinac, where it receives skins from the posts depending on that station and from those on the Mississippi, Missouri and Yellowstone rivers, and the great range of country extending thence to the Rocky Mountains. Of other associations in the United States, the most celebrated are Ashley's Company from St. Louis, and Captain Bonneville's, formed at New York in 1831; which last has pushed its enterprises into tracts between the Rocky Mountains and the coasts of Monterrey and Upper California. Indeed the whole of the districts from the Mississippi to the Pacific, and from the Arctic Sea to the Gulf of Mexico, are now traversed in every direction by the hunter. Almost all the American furs which do not belong to the Hudson's Bay Company find their way to New York, where they are either distributed for home consumption, or exported chiefly to London.

The fur trade is also extensively pursued by the Russians in the north of Asia and the north-west coast of America. Their chief association is the Russian American Company of Moscow; and the principal markets for their furs are the fairs of Kiachta, Novgorod and Leipsic.

London is the principal emporium of the fur trade: the vessels of the Hudson's Bay Company arrive here about September; the public sales are held in March, and are attended by a great many foreign merchants, whose

purchases are chiefly sent to the great fairs of Leipsic, whence they are distributed to various parts of the continent.]

FOOTNOTES

712 Pausan. x. 38. p. 895.

713 Sat. xiv. 185.

714 Varro De Re Rust. lib. i. 1, 6.

715 Diodor. Siculus, Pausanias, Propertius.

716 Virg. Æneid. viii. 177, 368; ix. 306; xi. 576. To the same purpose are various passages in the Odyssey.

717 Eleg. iv, 1. 12.

718 Lib. iv. 3, 11.

719 See Ferrarius De Re Vestiar. iv. 2. 2. in Thesaurus Antiquitat. Roman. vi. p. 908. Aristophan. Nubes, 1, 1, 73.

720 Livius, v. 2. p. 11.—Florus, 1. 12.—Tacit. Annal. 14. 38.—Corn. Nepos, Agesil. cap. 8.—Lipsius De Militia Rom. lib. v. dial. 1, p. 313.

721 Lib. viii. 55, p. 483. The hair of this animal seems to have been an article of trade, and comprehended under the head of wool, as we find by the Roman code of laws. L. 70. § 9.—De Legat. 3, or Digest. lib. xxxii. leg. 70. 9. Cushions however were stuffed with it. See Waarenkunde, i. p. 271.

722 For the following information on this subject I am indebted to the friendship of Professor Eichorn:—“Of furs being used as dresses

of magnificence I find very faint traces. I shall however quote all the passages where allusion is made to furs.

“In Genesis, chap. xxv. ver. 25, Esau is said to have felt to the touch like a hairy garment, אדרת שער. A fur dress must here be meant; for Rebecca endeavoured to make Jacob like his brother, by binding pieces of goats’ skins around his hands and neck.—Genesis xxvii. ver. 16.

“In Joshua, chap. vii. ver. 21, the true reading is אדות שכער, and signifies a Babylonian mantle, consequently one made of wool, respecting which many passages have been collected by various authors, and particularly Fischer in Prolus. de Vers. Græc. Vet. Test. p. 87. One manuscript, according to Kennicot, has however אדרת שעו, a hairy mantle or fur; but this has arisen either through an error in transcribing, one consonant, נ *Nun*, being omitted; or from the conjecture of some Jewish copyist, who was acquainted with costly furs but not with a Babylonian mantle. If the reading of Kennicot is to be retained, it would, on account of the price, be an important passage, in regard to costly furs.

“Among the Hebrews, the prophets wore fur dresses, if not in general, at any rate very often.

“The mantle of Elijah, 2 Kings, chap. ii. ver. 8, 13, 14, was of fur; because on account of his clothing he was called a hairy man, 2 Kings, chap. i. ver. 8.

“A hairy mantle, as a mark of distinction, is mentioned in the book of Zechariah, chap. xiii. ver. 4.

“In 1 Maccabees, chap. xiii. ver. 37, the high priest Simon obtained from king Demetrius βαίνη, which is certainly a false reading for βαίτα, or βαίτη. The only question is, whether βαίτη, which was merely a shepherd’s dress, consequently made of sheep skins, signified also a dress of state, as there is reason to conjecture from the persons who sent and who received it as a present. See Theocrit. Idyll. iii. 25. et ibi Schol. Furs, as a present, in the hot climate of Bassorah, are mentioned by Niebuhr.”

723 The best refutation of this supposed Vandalism is to be found in Schlözer's Essay, in the second edition of F. I. L. Mayers Fragmenten aus Paris. Hamb. 1798, 8vo, ii. p. 353. Nowhere do we find that the works of art were destroyed by the Goths or Vandals; on the contrary, it appears that they had sufficient culture to hold them in just estimation. Genseric carried away works of art from Rome, in the same manner as the Romans had done from Greece; but they were carefully packed up and not destroyed; he did therefore what Bonaparte did in those countries which were unable to withstand the force of his armies. If the epithet of Vandalism is to be applied to modern events, it seems most applicable to those who carried away works of art from countries into which the conquerors promised to introduce the rights of man, liberty, and happiness. The Christian writers, even, and among these St. Augustine, admit that the Goths after their victories were not so cruel and rapacious as the Romans. Orosius, who lived in the beginning of the fifth century, relates, that a Goth of high rank, after the taking of Rome, having found in a house some gold and silver vessels which had been plundered from the church of St. Peter, gave notice to Alaric, and that the latter caused them to be sent back safe to the church. The account given of the arms and accoutrements of these northern tribes proves also that they were acquainted with the arts, and that they employed them to ornament their clothing. The fur dresses therefore may have been very handsome.

724 Glossarium, p. 1282.

725 Virgilii Georg. iii. 381.—Ovid. Trist. iii. 10, 19; v. 7, 49.—Ex Ponto, iv. 10, 1.—Justinus, ii. 2, p. 43.—Seneca, epist. 90.—Rutilii Itiner. ii. 49.—Claudian, viii. 466; xxvi. 481.—Ammian. Marcell. xxxi. 2.—Prudentius in Symmachum, ii. 695.—Isidor. Origin. xix. 23.—Sidon. Apollin. epist. i. 2, where he describes Theodoric II. king of the Goths, the son of Theodoric I. and brother of Thorismundus: *pellitorum turba satellitum*. In epist. vii. 9, the kings of the Goths are called *pelliti reges*.

[726] Tacitus De Moribus German. 17.

[727] Variegated furs of this kind sewed together are mentioned by Pollux, vii. 60, p. 729.

[728] Plutarchus in Lycurgo. In like manner, the savages in the South Seas are acquainted with the art of giving more beauty and value to their ornaments made of feathers, shells, and the teeth of their enemies killed in battle.

[729] Lagerbring Svea Rikes Hist. Part 2. p. 88.

[730] At this period the Danes appear to have spent in eating and drinking the treasure they obtained in plundering; they employed their time only in hunting and breeding cattle, and clothed themselves in the skins of their sheep; but Canute endeavoured to introduce among them the Saxon manners and dress. He had invited into his kingdom from Lower Saxony, which at that time was considered the seat of the arts and sciences, and refined manners, a great many workmen and artists, a colony of whom he established in Roeskild, the capital.

[731] Digestor. lib. xxxiv.

[732] De Habitu Muliebri, cap. i. p. 551.

[733] Charact. cap. 5 et 12.

[734] Apophthegm.

[735] See Herodian, ix. 13.

[736] De Institut. Orat. xi. 3, 144.

[737] Lex. 25, De Auro, Argento, Mundo.

[738] See the instances quoted by G. S. Treuer in Anastasis Veteris Germani Germanæque Feminæ. Helmst. 1729, 4to.

739 Trist. v. 10, 31. For a complete history of their dress the reader must consult the authors quoted in Fabricii Bibliograph. Antiquaria, p. 861; and in Pitisci Lex. Antiq. v. Bracca.

740 In his Annotations on Catullus, p. 100.

741 In that learned and ingenious work, Erklärung der Vasengemälde, i. 3, p. 186.

742 Lib. xxxiv. cap. 14, § 41, p. 667.

743 Cap. 50, § 3.

744 Lib. xi. p. 755: ἀνδρόποδα καὶ δέρματα.

745 Histor. lib. iv. p. 306.

746 Tacitus, Annal. iv. 72.

747 Hist. Animal. xviii. 17. The singular word καναυτᾶνες, respecting which a great deal has been said by Pauw in his annotations to Phile de Animal. 48, p. 246, has lately been translated by Böttiger very happily, by the word *kaftane*, a kind of Turkish robe. In the present day these dresses of ceremony are of cotton, with flocks of silk worked into them, and for the most part are whitish, with a few rudely-formed pale yellow flowers: but the word formerly may have signified clothes in general, or fur clothing in particular, and perhaps the silk flocks may have been at first intended to represent fur. That furs at present are employed at Bassorah as presents, is proved by Professor Eichorn.

748 Vita Agesilai, p. 602. See also Hellenica, lib. iv.

749 Cyropædia, lib. viii., where he mentions χειρίδας δασείας. The Greeks and the Romans, however, did not wear gloves.

750 Ammian. Marcell. xxii. 5, p. 232.

[751] Lib. v. 41.

[752] Annal. lib. xiii. In Athenæus, Deipnos. v. p. 197, Callixenus describes Persian counterpanes with figures representing animals, but I do not know whether I ought not, with Valois, to consider them as painted leather, or rather worked tapestry.

[753] Digest. lib. xxxix. tit. 4, 16, 7, or L. ult. § 7, de publicanis. In Gronovii Geographia Antiqua, p. 261, it is said that a great trade was carried on in Cappadocia with Babylonian leather. The *vestes leporinæ* appear to have been made of the hair of the Angora rabbits.

[754] L. 7, C. de excus. mun. or Cod. lib. 10, tit. 47, 7.

[755] Chardin, iv. p. 245.

[756] De Rebus Geticis, cap. 3, p. 612.

[757] History of the Germans, vol. ii.

[758] Cap. 5, p. 616.

[759] Langebek Scriptores Rerum Danicarum, fol. ii. p. 111.

[760] Torfæi Hist. Norveg. P. 2, p. 34. Compare Schlözer's Nordische Geschichte in Algem. Welthistor. vol. xxxi. pp. 445, 458.—Having heard from M. Schlözer that the first certain traces of the Russian fur trade were to be found in the Russian Chronicles, works never yet used, I requested him, as the only person in Germany who could draw from these sources, to transmit to me what he had remarked on that subject. I am indebted to him, therefore, for the following valuable information, the result of a laborious comparison of various manuscript chronicles, for which he will no doubt receive the reader's thanks.

"The following passages are taken from the ten Russian Chronicles, the greater part of them still in manuscript, as a proof

that from the ninth century tribute in furs was demanded from the people in Russia by their conquerors.

I. "In the year 859, the Waringians, who came by sea, had tribute from the Tschudi, the Slavi, the Meri, and the Kriwitsches, a squirrel per man. The Chazares (in the Crimea) had tribute from the Poles (the inhabitants of the Ukrain), the Severians and the Wæitsches, a squirrel for each fireplace or hearth.

"The squirrel *Sciurus vulgaris* had in the old and new Russian language the five following names:—1st. 'Bēla.' This primitive word has been lost in the new Russian language, but is still preserved in the Chronicles, and in the adjectives 'bēlij' and 'bēliczij mēch, Grauwerk' (squirrel-skins). 'Bēl' in all the Sclavonic dialects signifies white. Can any connexion be discovered between the squirrel and a white colour? 2nd. 'Bēlka,' the diminutive of the former, is at present generally current. 3rd. 'Wēkscha,' from which is derived, 4th. 'Wēkschitza,' the diminutive. 5th. 'Weweritza' is old, but still exists in the Polish.

"The variations of these words which occur in manuscripts are abundant, and some of them exceedingly laughable. One transcriber has 'bēla;' most of the rest add 'wēkscha,' 'wēkschitza' or 'weweritza,' as if 'bēla' were the adjective white. Two manuscripts say expressly, 'bēla,' that is 'wēkscha.' In one, however, from 'bēla weweritza' has been made 'bēla 'dewitza,' a fair or beautiful maid.

II. "In the year 883 Oleg went against the Drewians and Severians, whom he obliged to pay tribute, each a black marten.

"'Po czernē kunē' stands in all the manuscripts; one only has the diminutive 'kunitzē.' Another bad manuscript, which has 'konē,' a black horse, is not worthy of any remark.

III. "In 969 Svātoslav spoke to his mother and boyars: 'I am not fond of Kief; I will reside in Pereyaslawetz on the Danube. There I shall be in the middle of my lands, to which every thing good in my territories flows: from the Greeks gold and *pavoloki* (silk-stuffs?), and wine and fruit of every kind; from the Tscheches

(Bohemians) and Hungarians silver and horses; from Russia *skora*, wax, honey, and servants.' *Skora*, *skura*, furs (according to the Great Lexicon of the Russian Academy), from which is derived *skornak*, similar furs prepared. That coarse skins or furs (in Russian *schurka*), such as the *terga boum*, imposed by the Romans on the Frieslanders, are not here meant, is proved by a passage in the Chronicle of Nicon, vol. ii. p. 15, where it is related of a savage people, who lived far to the north on the Ural, that they gave *skora* for a knife and a hatchet.

"That marten-skins, as well as pieces of them (*mortki*) and of squirrel-skins, were used as money in Novogorod, till the year 1411, is well-known from Saml. Russ. Geschichte, vol. v. p. 430."

761 Du Cange Glossarium.

762 De Animantibus Subter. p. 490.

763 Varro De Ling. Lat. lib. vi. p. 51.

764 Seneca, epist. 90.

765 Pallas, Novæ Species Quadr. e Glirium ord. 1778, p. 120.

766 Lib. viii. 37.

767 Pallas, p. 142. I shall here take occasion to remark, that the use of this animal's skin, as well as the name, occurs in the eleventh century, in Bernardus Sylvester.

768 Lib. ii. ep. 2.

769 See a dissertation De l'Origine des Couleurs et des Métaux dans les Armoiries, added by Du Cange to his edition of Joinville. Paris, 1668, fol. p. 127. See also the article *Hermine*, in his Glossary to Geoffroy de Ville-Hardouin's Conqueste de Constantinople; or the same in Diction. Etymolog.

770 Mullers Samlung Russischer Geschichte, vi. p. 491. Fischers Sibirische Geschichte. St. Petersb. 1768, 8vo, p. 290.

771 Du Cange, in his observations on Joinville, p. 137, thinks that the *zebelinæ* or *sabelinæ pelles* came from Zibel or Zibelet, a maritime town in Palestine, formerly called *Biblium*, because the skins were sent from it to Europe. This author meant *Byblus*, at present *Gibelet* or *Gibeletto*; but this derivation appears to me highly improbable.

772 Epigram. x. 37, 18.

773 Trier's Wapen-Kunst, p. 62.—Gatterers Heraldik. p. 41.

774 *Grauwerk veh* or *feh* means properly a kind of fur, composed of that of the Siberian squirrel and the marten joined together.—Trans.

775 Antiquit. Ital. Medii Ævi, ii. p. 413.

776 See the passages quoted by Du Cange, and what Gesner has said in Histor. Animal. under the head *Cuniculus*.

777 Rapin's England.

778 See this article in Du Cange and Hoffmann's Lexicon.

779 Marco Polo.

780 Lib. ii. epist. 2.

781 Epig. 92: de birro castoreo.

782 De dignitate sacerdotali, cap. 5.

783 Lib. xvii. cap. 28. § 47; xxxii. cap. 9 and 10.

784 Lib. xix. cap. 27, p. 474.

[785] Lib. xix. cap. 22.

[786] Constantin. de Ceremoniis Aulæ Byzantinæ, i. p. 254: σκαραμάγγων καστώριον. The editor, Reiske, thinks that it may have been a pelisse, because Herodotus, iv. 109, speaks of the beaver's skin being used for clothing. But how different must the old Sarmatian manners have been from the Byzantine!

[787] Epist. 42.

[788] Eginhartus, Vita Caroli Magni, cap. 23.

[789] This anecdote is related by the monk of St. Gall, whose name is supposed to be Notker, in his book De Gestis Caroli Magni, ii. 27, printed in Bouquet, Historiens de la Gaule, v. p. 152. Whether Notker was the author of this chronicle or not, there can be no doubt that it was written after the year 883 and before 887, as has been proved by Basnage. *Pavontalis vestis*, a term used in this passage, does not always signify cloth wove or painted so as to resemble the colours of the peacock; the skin of the peacock was used for ornament; the people of all nations indeed decorated themselves with feathers till they became acquainted with dyeing. The art of those who prepared feathers was banished by that of the dyers.

[790] Carmen De Carolo Magno, in Op. ii. p. 453, v. 225.

[791] At the council of Aix-la-Chapelle in 817, where the dress of the monks was defined, it was ordered, "abbas provideat, unusquisque monachorum habeat ... *wantos* in æstate, *muffulas* in hieme vervecinas." See Sirmond's Concil. Antiq. Galliæ, Paris, 1629, fol. i. p. 442. *Wantus* is still retained in the Netherlandish dialect, where *want* signifies a glove without fingers, having only a place for the thumb; perhaps it is the same word as *want*, *wand*, or *gewand*, which formerly denoted every kind of woollen cloth. Hence is derived the French word *gand*; for *gwantus* and *gantus* were formerly used instead of *wantus*. It is equally certain that

muffula is of German extraction; *mouw* at present in Dutch signifies a sleeve. But at what time that covering came into use into which both hands are thrust at present to secure them from the frost, and which according to the size now fashionable covers the whole body and is called a *muff*, I am not able to determine.

792 Leges Wallicæ, ed. Wottoni. Londini, 1730, fol. p. 261.

793 Landulphus, lib. ii. c. 18, in Murat. Rer. Ital. Script., tom. iv.

794 Adam Bremensis in Lindenbrogii Script. Rer. Germ., p. 67.

795 Albertus Aquensis, in Gesta Dei per Francos, i. p. 203.

796 Ivo Carn. Epistolæ 104.

797 Canon 12.

798 Albertus Aquensis, in Gesta Dei per Francos, i. p. 321.

799 In Labbei Biblioth. Nova, tom. ii.

800 Wilhelmus Neubrigensis, lib. iii. cap. 22.

801 Wilhelmus de Nangis, p. 346. Gottfr. de Bello Loco, cap. 8. Joinville Hist. de St. Louis, p. 118.

802 Barrington's Obs. on the more Ancient Statutes, 4to, p. 216.

803 Constantini lib. de Ceremoniis Aulæ Byzantinæ, 1754.

804 Giulini, Mem. della Città di Milano, vi. p. 407.

805 Ib. viii. p. 443.

STEEL.

Steel is a carburet of iron, and possesses some remarkable properties, by which it is distinguished from common iron. It is of such a superior degree of hardness, that it is capable of filing the latter; it strikes fire with siliceous stones, and scratches the hardest glass; it is heavier, emits a stronger sound, exhibits on fracture a finer grain, assumes a brighter white lustre when polished, is susceptible of greater elasticity; becomes more slowly magnetic, but retains that power longer; does not so easily acquire rust; in the fire it assumes various strong tints, and when heated is speedily cooled in cold water, but is then harder, more brittle and less pliable. In consequence of these qualities it is fit for many uses to which common iron either cannot be applied, or is less proper.

It is certain that the invention of steel is of very great antiquity. In the Old Testament, however, the mention of it is very doubtful, according to Professor Tychsen, whose remarks on this subject I subjoin in a note below[806]; but it appears that it was used as early as the time of Homer, and that the Greeks gave to it different names, one of the most common of which was *stomoma*, though it seems certain that this word did not so much denote steel itself as the steeled part of an instrument, or the operation of steeling. The name *chalybs* was given to steel from the Chalybes, a people on the southern shore of the Pontus Euxinus, between Colchis and Paphlagonia, who had considerable mines, and in particular iron and steel works: though others, on the contrary, derive the name of the people from the principal article of their commerce. This derivation appears the more probable, as Justin says that a river of Spain, on which there were steel works, was named *Chalybs*, but at a much later period. Some also have ascribed to the Chalybes the invention of iron, which however is much older.

But it seems to be less known that *adamas* also at first denoted steel. This is expressly said by Hesychius, and many epithets derived from

adamas are applied to articles made of steel or of iron. Among these may be mentioned the helmet of Hercules, in Hesiod[807], and the so-called adamantine chains, gates, and bars of the poets, which in dictionaries are always explained as consisting of precious stones.

It was not till a late period that this word was applied to the most costly of all the precious stones. In this sense it occurs neither in Homer, Hesiod, Herodotus, Orpheus, nor Dioscorides, though the first of these writers often describes various kinds of valuable ornaments. Goguet and others thence conclude that the diamond was not then known. At present I cannot enter into the history of this stone; but I must own, that I consider the knowledge of it to be older, and suspect that it was first introduced under another name, and is mentioned by Orpheus and some others under that of jasper (jaspis). This poet compares his jaspis to rock crystal, and says that it kindles fire in the same manner. That he knew how to use rock crystal as a burning-glass, he expressly tells us himself; but he certainly could not procure a diamond of such a size as to be able to burn with it. From its vitreous nature however he conjectured, and very properly, that it might be employed for that purpose. He calls the jaspis transparent, compares it to glass, and says that it had that sky colour which at present is named *color hyalinus*. This is probably the reason why Dioscorides and others call some kinds of jasper transparent and sky-coloured. The jaspis in the Revelation of St. John[808], described as a costly transparent crystalline kind of stone, was perhaps our diamond, which afterwards was everywhere distinguished by that name.

The Romans borrowed from the Greeks the word *chalybs*; and in consequence of a passage in Pliny[809], many believe that they gave also to steel the name of *acies*, from which the Italians made their *acciajo*, and the French their *acier*. The word *acies*, however, denoted properly the steeled or cutting part only of an instrument. From this, in later times, was formed *aciarium*, for the steel which gave the instrument its sharpness, and also *aciare* to steel[810].

At present there are two methods of making steel; the first of which is by fusion either from iron-stone or raw iron, and the second by cementation. I have never found in the works of the ancients any traces of steel prepared by cementation; nor am I acquainted with the antiquity of

that process, though the ancients, without knowing it, employed it for brass. Spielman says[811], that Pliny in one part calls it *tostio*; but this word occurs neither in Pliny nor in any ancient writer. It is however possible that the word *torrere* may somewhere signify cementation, but I have not yet met with an instance of it.

The preparation however by fusion, as practised by the Chalybes, has been twice described by Aristotle; but as I have already given in another work[812] everything I was able to collect towards an explanation of these passages, I shall not here repeat it. I shall only remark, that the steel of the ancients, in consequence of not being cemented, suffered itself to be hammered, and was not nearly so brittle as the hardest with which we are acquainted at present.

On the other hand, the singular method of preparing steel employed by the Celtiberians, in Spain, deserves to be here described. According to the account of Diodorus[813] and Plutarch[814], the iron was buried in the earth, and left in that situation till the greater part of it was converted into rust. What remained, without being oxydized, was afterwards forged and made into weapons, and particularly swords, with which they could cut asunder bones, shields, and helmets. However improbable this may appear, it is nevertheless the process still used in Japan; and Swedenborg has introduced it among the different methods of making steel[815].

The art of hardening steel by immersing it suddenly, when red-hot, in cold water, is very old[816]. Homer says, that when Ulysses bored out the eye of Polyphemus with a burning stake, it hissed in the same manner as water when the smith immerses in it a piece of red-hot iron, in order to harden it[817]. Sophocles uses the comparison of being hardened like immersed iron[818]; and Salmasius[819] quotes a work of an old Greek chemist, who treats on the method of hardening iron in India. It is also a very ancient opinion, that the hardening depends chiefly on the nature of the water. Many rivers and wells were therefore in great reputation, so that steel works were often erected near them, though at a considerable distance from the mines.

Instances of this may be found in Pliny[820] and in Justin[821]. The more delicate articles of iron were not quenched in water, but in oil.

An opinion, it is well known, long prevailed, that there were various fluids and mixtures which communicate to steel different degrees of hardness, and every artist thought he knew a peculiar hardening kind of water, the preparation of which he kept a secret. This notion is by some still maintained[822]; because there are often found stones cut by the ancients, which the moderns, on account of their hardness, as is believed, have seldom ventured to touch. Of this kind is the hardest porphyry. There are people who still endeavour to find out that hardening kind of water, in which the ancients prepared their tools for cutting such stones. According to Vasari[823], that water was actually discovered by the archduke Cosmo, in the year 1555. Among a large collection of stones he had a block of porphyry, from which he wished a bason to be made for a well, but was told by the most experienced artists that it was impossible. On this, says Vasari, in order to render the work possible, he prepared from certain herbs, which he does not name, a water wherein the red-hot tools were quenched, and by these means so hardened, that they were capable of cutting porphyry. With tools tempered in this manner the artist Francesco del Tadda not only made the required bason, but various other curious articles[824].

Winkelman, therefore, does injustice to Vasari when he says, “Vasari, in pretending that Cosmo archduke of Tuscany discovered a water for making porphyry soft, betrays childish credulity.” On the contrary, he very properly asserts that there is no water of such a quality as to soften porphyry; though Porta and many old writers imagined that they were acquainted with one capable of producing on that stone, which they considered as a species of marble, the same effects as an acid does on the latter. But Vasari says nothing of the kind.

After Tadda’s death, the art of cutting porphyry came to Raphael Curradi, who communicated to Dominico Corsi this secret, which was afterwards employed by Cosimo Silvestrini[825]. I, however, agree in opinion with Winkelman and Fiorillo, our learned connoisseur in the arts, that the method of working porphyry was known in every age, even in the most

barbarous, though artists, no doubt, preferred working on other stones which were less brittle and hard. We know however from the latest researches, that all the kinds of hardening water hitherto invented are in nothing superior to common water; and that in hardening more depends on the nature of the steel, or rather on the degree of heat, than on the water; although it is true that the workman does right when he adds to the water a thin cake of grease, or pours over it hot oil, through which the steel must necessarily pass before it enters the water, for by these means it is prevented from acquiring cracks and flaws.

The invention of converting bar iron into steel by dipping it into other fused iron, and suffering it to remain there several hours, is commonly ascribed to Reaumur[826]. But this process is mentioned by Agricola, Imperati and others, as a thing well-known and practised in their time.

Pliny, Daimachus[827] and other ancient writers mention various countries and places which, in their time, produced excellent steel. Among the dearest kinds were the *ferrum Indicum* and *Sericum*. The former appears to be the *ferrum candidum*, a hundred talents of which were given as a present to Alexander in India[828]. Is it not probable that this was the excellent kind of steel still common in that country, and known under the name of *wootz*, some pieces of which were sent from Bombay in the year 1795 to the Royal Society of London? Its silver-coloured appearance when polished may have, perhaps, given occasion to the epithet of *candidum*. The method of preparing it is still unknown, but it is supposed to be a kind of fused steel[829]. This however is a mere conjecture, unsupported by any proofs[830]. At what time was damasked steel obtained from the Levant?

[Three kinds of steel are now principally manufactured; bar or blistered steel, shear steel and cast steel.

The bar or blistered steel is made by the process of cementation: this consists in putting bars of the purest malleable iron alternately with layers of charcoal or soot into a proper furnace; the air being carefully excluded and the whole kept at a red heat for several days. By this process the carbon combines with the iron, altering its texture from fibrous to granular or crystalline, and rendering the surface blistered. The action of the carbon

occasions fissures and cavities in the substance of the bars, rendering them unfit for tool-making, until they are condensed and rendered uniform by the operation of *tilting*, i. e. compression by a powerful hammer worked by machinery.

Shear steel is made by breaking up bars of blistered steel into lengths of about 18 inches, and binding four or six of them together with a steel rod, and then heating them to a full welding heat, the surface being covered with fine clay or sand to prevent oxidation. They are then drawn out into a bar, hammered, tilted and rolled. In this state it is susceptible of a much finer polish, and is also more tenacious and malleable, and fit for making strong springs, knives, &c.

Cast steel, which was first made by Mr. Huntsman at Attercliff, Sheffield, in 1770, is made by melting blistered steel, casting it into ingots and rolling it into bars. In this condition its texture is much more uniform, closer and finer grained. The different degrees of hardness required for steel are given by the process called tempering, which is effected by heating the steel up to a certain temperature, and then quenching it suddenly in cold water. Its hardness and brittleness are thus much increased, but it may be again softened by exposure to heat simply.]

FOOTNOTES

806 In regard to the hardening of iron and the quenching of it in water, nothing, as far as I know, occurs in the Hebrew text of the Scriptures. The passages where it seems to be mentioned are, Isaiah, chap. xliv. ver. 12. “The smith bends the iron, works it in a fire of coals, and forms it with the hammer; he labours on it with a strong arm,” &c. according to the translation of Michaelis. It may indeed be translated otherwise, but it certainly alludes to the formation of an image of metal. The words, chap. liv. ver. 16, are still more general.

Iron, *barzel*, often occurs, and in some passages indeed steel may be understood under this name; for example, in Ezekiel, chap.

xxvii. ver. 19, *ferrum fabrefactum*, or, according to Michaelis and others, sabre blades from Usal (Sanaa in Yemen). A pretty clear indication of steel is given in Jeremiah, chap. xv. ver. 12: “Iron from the north,” which is described there as the hardest. To the north of Judæa was situated Chalybia, the ancient country of steel. It appears that the Hebrews had no particular name for steel, which they perhaps comprehended under the term *barzel*, or distinguished it only by the epithet Northern, especially as the later Jews have for it no other name than אסטמא, *istoma*, which however is nothing else than the Greek στόμωμα, and signifies rather steeling or hardening.

Chalamisch is certainly a hard kind of stone; granite or porphyry, according to Michaelis, who treats expressly of it in Supplem. ad Lex. Hebr. N. 740.

807 Scutum Herculis, x. 137.

808 Chap. xxi. ver. 11, 18, 19.

809 Lib. xxxiv. sect. 41. p. 666. “Stricturæ vocantur hæ omnes, quod non in aliis metallis a stringenda acie vocabulo imposito. Et fornacum maxima differentia est; nucleus quidem ferri excoquitur in his ad indurandam aciem; aliquæ modo ad densandas incudes, malleorumve rostra.” According to my opinion, *stricturæ* was the name given to pieces of steel completely manufactured and brought to that state which rendered them fit for commerce. At present steel comes from Biscay in cakes, from other places in bars, and both these formerly were called *stricturæ*, because they were employed chiefly for giving sharpness to instruments or tools, that is, for steeling them. In speaking of other metals, Pliny says that the finished productions at the works were not called *stricturæ* (this was the case, for example, with copper), though sharpness could be given to instruments with other metals also. The words of Pliny last quoted are read different ways, and still remain obscure. I conjecture that he meant to say that some steel works produced things which were entirely of steel, and that others were employed only in steeling. I shall here remark that the

stricturæ ferri remind us of the *strigiles auri*: such was the name given to native pieces of gold, which without being smelted were used in commerce.—Plin. xxxiii. 3. p. 616.

[810] See Vossii Etymol. and Martinii Lex. Philolog.

[811] Institut. Chimiæ, p. 252. He refers to lib. xxxiii. cap. 4.

[812] In my observations on Aristot. Auscult. Mirab. cap. 49.

[813] Diod. lib. v. cap. 33.

[814] Plut. de Garrul.

[815] De Ferro, i. p. 194. See also Watson's Chem. Essays, i. p. 220. Of the iron works in Japan I know nothing further than what has been said by Thunberg in his Travels. That country possesses very little of this metal: but the sabres made there are incomparable; without hurting the edge one can easily cut through a nail with them; and, as the Japanese say, cleave asunder a man at one blow. These sabres are often sold for fifty, seventy, and even a hundred dollars.

[816] Lord Bacon seems not to have been of this opinion; see his Silva Silvarum, cent. i. § 86. But this method of hardening was usual in the eleventh or twelfth century; for it is described by Theophilus Presbyter, lib. iii. cap. 19.

[817] Odyss. ix. 391.

[818] Ajax, 720.

[819] Exercitat. Plin. p. 763.

[820] Lib. xxxiv. 14, p. 666.

[821] Lib. xliv. p. 620.

822 [There can be no question that the hardening or tempering effect produced by the sudden immersion of heated steel in fluids has no relation to the quality of the fluid, save as regards its conducting power of heat. The more suddenly the heat is abstracted from the metal, the greater is the amount of hardness and brittleness. Mercury has been found superior to any other fluid for this purpose, undoubtedly because it is so good a conductor of heat.]

823 Le Vite de Pittori. Bologna, 1681, 4to, i. p. 11.

824 Some account of this artist is given in J. C. Bulengeri de Pictura, lib. ii. cap. 7, in Gronovii Thesaurus Antiq. Græc. ix. p. 875. On the other hand, Sturm says, in that part of the Ritterplatzes which relates to architecture, p. 18: "An archduke at Florence discovered again the art of working porphyry, but suffered it to die with him in the year 1556."

825 Florillo Gesch. der Zeichnenden Künste, 8vo, i. p. 461.

826 Art de convertir le Fer en Acier, p. 245.

827 Stephanus de Urbibus, under the word Λακεδαίμων, p. 413.

828 Clemens Alexandr. in Pædagog. ii. p. 161, edit. Cologne, 1688, fol. says, speaking of luxury, "One can cut meat without having Indian iron."

829 Philos. Transact. 1795, ii. p. 322.

830 [The manner in which iron ore is smelted and converted into wootz or Indian steel, by the natives at the present day, is probably the very same that was practised by them at the time of the invasion of Alexander; and it is a uniform process, from the Himalaya Mountains to Cape Comorin. The furnace or bloomery in which the ore is smelted, is from four to five feet high; it is somewhat pear-shaped, being about two feet wide at bottom and one foot at top; it is built entirely of clay, so that a couple of men may finish

its erection in a few hours, and have it ready for use the next day. There is an opening in front about a foot or more in height, which is built up with clay at the commencement, and broken down at the end, of each smelting operation. The bellows are usually made of a goat's skin, which has been stripped from the animal without ripping open the part covering the belly. The apertures at the legs are tied up, and a nozzle of bamboo is fastened in the opening formed by the neck. The orifice of the tail is enlarged and distended by two slips of bamboo. These are grasped in the hand, and kept close together in making the stroke for the blast; in the returning stroke they are separated to admit the air. By working a bellows of this kind with each hand, making alternate strokes, a tolerably uniform blast is produced. The bamboo nozzles of the bellows are inserted into tubes of clay, which pass into the furnace at the bottom corners of the temporary wall in front. The furnace is filled with charcoal, and a lighted coal being introduced before the nozzles, the mass in the interior is soon kindled. As soon as this is accomplished, a small portion of the ore, previously moistened with water, to prevent it from running through the charcoal, but without any flux whatever, is laid on the top of the coals, and covered with charcoal to fill up the furnace. In this manner ore and fuel are supplied, and the bellows are urged for three or four hours, when the process is stopped, and the temporary wall in front broken down; the bloom is removed with a pair of tongs from the bottom of the furnace. In converting the iron into steel, the natives cut it into pieces to enable it to pack better in the crucible, which is formed of refractory clay, mixed with a large quantity of charred husk of rice. It is seldom charged with more than a pound of iron, which is put in with a proper weight of dried wood, chopped small, and both are covered with one or two green leaves; the proportions being in general ten parts of iron to one of wood and leaves. The mouth of the crucible is then stopped with a handful of tempered clay, rammed in very closely, to exclude the air. As soon as the clay plugs of the crucibles are dry, from twenty to twenty-four of them are built up in the form of an arch in a small blast furnace; they are kept covered with charcoal, and subjected to heat urged by a blast for about two hours and a half, when the process is

considered to be complete. The crucibles being now taken out of the furnace and allowed to cool, are broken, and the steel is found in the form of a cake, rounded by the bottom of the crucible.—Ure's Dictionary of Arts and Manufactures, art. STEEL.]

STAMPING-WORKS[831].

In order to separate metallic ores from the barren rock or stones with which they occur, and to promote their fusion, it is necessary that the pieces of rock or stone should be reduced to small fragments by stamping them. For those ores which occur in a sandy form, this is unnecessary; and in regard to rich silver ore, which contains very little or no lead and other metals, this process might be hurtful; for with dry stamping a great deal would fly off in dust, and with wet stamping a considerable part would be washed away by the water.

However imperfect the knowledge of the ancients may have been in regard to the fusion of ores, they were acquainted with the benefit of stamping; but the means they employed for that purpose were the most inconvenient and expensive. They reduced the ore to coarse powder, by pounding it in mortars, and then ground it in hand-mills, like those used for corn, till it acquired such a degree of fineness that it could be easily washed. This is proved by the scanty information which we find in Diodorus Siculus[832] and Agatharcides[833], in regard to the gold mines of the Egyptians; in Hippocrates, respecting the smelting-works of the Greeks[834], and in Pliny in regard to the metallurgy of the Romans[835]. Remains of such mortars and mills as were used by the ancients have been found in places where they carried on metallurgic operations; for instance, in Transylvania and the Pyrenees. The hand-mills had a resemblance to our mustard-mills[836]; and for washing the mud they employed a sieve, but in washing auriferous sand they made use of a raw hide. From the latter, Count von Veltheim has explained, in a very ingenious manner, the fable of the ancients concerning the ants which dug up gold[837].

Our works for pounding ore, at present, are stamping-mills, which consist of heavy stampers shod with iron. These stampers are put in motion

by a cylinder furnished with cogs, which is driven by a water-wheel, and pound the ore in troughs lined with iron. When the ore subjected to this operation is poor, water is introduced into the troughs, which running through grates in the bottoms of them, carries with it the pounded matter into a gutter, where it becomes purified, and deposits the mud mixed with sand.

One might conjecture that this apparatus was invented soon after the invention of cylinders with cogs; but this was not the case, though I am not able to determine the antiquity of these cylinders. At any rate, it is certain that mortars and sieves were used in Germany throughout the whole of the fifteenth century; and in France, to which the art of mining was conveyed in general from that country at a late period, they were still employed about the year 1579[838]. In the oldest times men were not acquainted with the art of employing water at mines in so advantageous a manner as at present. The bellows were worked by men; and those aqueducts raised on posts, by which distant water may be made to act on machines, was not yet invented. On this account, remains of ore are found in places where the moderns, in consequence of that indispensable article water, would not be able to maintain metallurgic works[839]. According to the researches which I have hitherto had an opportunity to make, our stamping-mills were invented about the beginning of the sixteenth century, and, as appears, in Germany; but I cannot determine with certainty either the name of the inventor or his country. Those who established or introduced the first stamping-works in Saxony and the Harz are only mentioned; and these, as usual, have been considered as the inventors.

In the year 1519 the processes of sifting and wet-stamping were established in Joachimsthal by Paul Grommestetter, a native of Schwarz, named on that account the Schwarzer, whom Melzer praises as an ingenious and active washer; and we are told that he had before introduced the same improvements at Schneeberg. Soon after, that is in 1521, a large stamping-work was erected at Joachimsthal, and the process of washing was begun. A considerable saving was thus made, as a great many metallic particles were before left in the washed sand, which was either thrown away or used as mortar for building. In the year 1525 Hans Pörtner employed at

Schlackenwalde the wet method of stamping, whereas before that period the ore there was ground.

In the Harz this invention was introduced at Wildenmann by Peter Philip, who was assay-master there, soon after the works at the Upper Harz were resumed by Duke Henry the younger about the year 1524. This we learn from the papers of Herdan Hacke or Hæcke, who was preacher at Wildenmann in 1572. As far as can be concluded from his imperfect information, the first stamping-work there consisted only of a stamper raised by means of two levers fixed to the axis of a wheel. The pounded ore was then thrown into a sieve, called in German the *sachs*[840], and freed from the coarser parts. But as this stamping was performed in the dry manner, it produced so much dust that the labourers were impeded by it, and the ore on that account could not be properly smelted. The business however was not given up; new improvements were made, and soon after Simon Krug and Nicholas Klerer introduced the wet method, and fortunately brought it to perfection[841].

It is said in several modern works that wet stamping was invented in 1505, by a Saxon nobleman named von Maltitz. This assertion has been so often repeated, that it was known to Gobet[842], who adopted it as truth. I have not however been able to find the historian on whose testimony it is founded; but it appears by Gauhen's Dictionary of Nobility that Sigismund Maltitz was chief surveyor of forests at the Erzgebürge, to the electorate of Saxony in the sixteenth century.

FOOTNOTES

[831] I shall refer those desirous of being acquainted with the nature of this labour, to Gatterer's Anleitung den Harz zu bereisen. Göttingen, 1785, 8vo. i. p. 101. [Figures of the stamping-works may be seen in Ure's Dictionary of Arts and Manufactures, pp. 818 and 1119.]

[832] Diodor. iii. 13, p. 182.

[833] Photii Bibl. p. 1342.

[834] Hippocrates de Victus Rat. lib. i. sect. 4.

[835] Plin. xxxiii. 4, sect. 21.

[836] Gensane Traité de la Fonte des Mines. Par. 1770, i. p. 14.

[837] Von d. goldgrabenden Ameisen u. Greiffen der Alten. Helmst. 1799. This dissertation may be found also in a valuable collection of different pieces by the same author, printed at Helmstadt, 1800.

[838] See François Garrault, Des Mines d'Argent trouvées en France, Paris 1579, where mention is made only of mortars, mills and sieves. This Garrault is the first French writer on mining. His work, which is scarce, was printed by Gobet in the first part of the Anciens Minéralogistes de France, Paris 1779, 8vo.

[839] At the Nertschinsk works in Siberia, the machinery must be still driven by men or cattle, because all the dams and sluices are destroyed by the frost, and the water converted into ice. Some of the works there however have machinery driven by water during the few summer months.

[840] *Sachs* or *sæx* in old times denoted a cutting or stabbing instrument, such for example as *schaar-sachs*, a razor; *schreib-sachs*, a penknife. See Fritsch's Wörterbuch, who derives *sachs* from *secare*. May not the word σάλαξ, which in Pollux means the sieve used at smelting-works, be of the same origin? I conjecture also that the coulter of the plough, which cuts the earth in a perpendicular direction, had the name of *sech*, and that the words *säge* and *sichel* have an affinity to it. If this derivation be right, the High but not the Low German must have of *sachs* made *sech*. The latter would have said *sas* or *ses*, as it says instead of *sechs*, *ses*; instead of *wachs*, *was*; instead of *flachs*, *flas*; and instead of *fuchs*,

fos. *Sech* is named also *kolter*, as in the Netherlands *kouter*, which words have arisen no doubt from *culter*.

841 Calvör Maschinenwesen, ii. p. 74.

842 Anciens Minéral., i. p. 225.

KITCHEN VEGETABLES.

The greater part of our kitchen vegetables, that is to say those plants which, independently of the corn kinds, are cultivated as food in our gardens, are partly indigenous and partly foreign. Of the former many at present grow wild, such as asparagus; but by continued cultivation, through a long series of years, they have produced numerous varieties, which differ as much from the wild plants as the European females from those of New Zealand. Many of our indigenous vegetables are collected for food, but are not reared expressly for that purpose; and these even, in all probability, might be improved by culture. Some indeed are here and there reared in an artificial manner, though we reckon them among our weeds; for example, dandelion, *Leontodon taraxacum*, the first leaves of which in spring are employed in the northern countries as salad. In some parts of England this plant is sown throughout the whole summer; and its leaves being blanched, it is used in winter as endive. Culture frees many plants from their harsh taste, makes them tender, larger and more pulpy, and produces them at a season when the wild ones have become unfit for use.

Our foreign kitchen vegetables have, for the most part, been procured from the southern countries, but chiefly from Italy; and the number of them has increased in an uncommon degree in the course of the last two centuries. Many of them require laborious attention to make them thrive in our severe climate. On the other hand, some grow so readily, and increase so much without culture, even in the open fields, that they have become like indigenous weeds, as is the case with hops, which at present abound in our hedges. Some plants, however, both indigenous and foreign, which were formerly raised by art and used at the table, are no longer cultivated, because we have become acquainted with others more beneficial. Many of them served our forefathers in the room of foreign spices, to the use of which trading companies have accustomed us, much to their advantage and to our hurt. It is true also that many have been banished merely by fashion; for this tyrant, which rules with universal sway, commands the taste as well

as the smell to consider as intolerable articles to which our ancestors had a peculiar attachment.

In the oldest times mankind were so fond of sweet things, that the goodness and agreeable taste of every kind of food was determined according to the degree of its sweetness; and such is the manner of judging even at present throughout all the East, in Africa, and in America. This is the case also among us with the greater part of the lower classes, who are not able to follow the mode of richer tables. In the northern countries this taste is almost everywhere prevalent. Thus the Swedes spoil, by the addition of sugar, costly Rhenish wine, sour kraut, and other articles, the agreeable tartness of which is gratifying to other nations. In proportion to their population and luxury, the Swedes seem to use more sugar than the Germans, and the Germans more than the English or French; and one might almost suspect that a taste for sweet things were in the inverse ratio of civilization[843]. At any rate, one can thus explain why many vegetable productions, which some centuries ago were reckoned among the most agreeable dishes, appear to us to be nauseously sweet. Skirret, which the emperor Tiberius caused to be brought for the use of his table from the Rhine, is little relished at present; and the case is the same with parsnips, some kinds of apples, and several other things.

Fashion sometimes recalls into use species long forgotten, and with the greatest success, when they are introduced under a different name. Thus, after an interval of many years, some began to cultivate again monks-rhubarb[844], and to recommend this sourish plant instead of the more savoury spinage. According to Bock, it was transplanted in the middle ages by the monks from the woods into gardens, to which it has been again brought back under the imposing appellation of English spinage.

Before the commencement of the Christian æra, when the use of sensual enjoyments was not so well-regulated and modified by religious and political principles, many vegetables and other dishes were praised and recommended by writers on agriculture and cookery, as well as by the most favourite poets and eminent authors, on account of effects which cannot at present be named, except in the writings of physicians, without disgusting the reader and incurring the imputation of indelicacy. When this mode of thinking began to prevail, people detested to see in their gardens or on their

tables plants which, in consequence of indecent properties, were generally known; and by being thus disused, the knowledge of them was at length so much lost, that we know only their old names, and what the ancients have related respecting them. In this manner, many receipts in Apicius are totally unintelligible, because we are no longer acquainted with the things for the preparation of which he gives directions. Of this kind are the numerous bulbous roots (*bulbi*), which formed the most favourite dishes of the Greeks and the Romans, and which at present no botanist, much less commentator, would be able to determine. They belong to the lost arts, but not to those which were abandoned because better ones were found to supply their place. The American vanilla, which perhaps was indebted only to its high price for the permission of being mixed with chocolate, does not certainly supply the place of the ancient Megarean bulbs, as our gunpowder does that of the Greek fire.

Among those kitchen vegetables which were formerly cultivated, but at present are no more esteemed, are the following:—Winter-cresses[845], an indigenous plant, the young leaves of which, like water-cresses, may be eaten in winter as salad; also common alexanders[846], which in the seventeenth century was used instead of celery; bulbous chærophyllum[847], the roots of which are still brought to market at Vienna, where people well know what is good, and where they are boiled and eaten as salad with vinegar and oil. Rampion[848] was formerly used in the like manner. The earth-nut[849], which grows wild in many parts of Germany, is still cultivated in Holland and in some districts on the Rhine. Rocket (*Eruca sativa*), the young leaves of which were readily eaten by our forefathers as salad, is no longer esteemed, partly on account of its harsh taste, and partly on account of its nauseous smell, which resembles that of rancid bacon; it has however been still retained in Italy, "excitet ut Veneri tardos eruca maritos[850]." Vetches (*Lathyrus sativus*, and *Cicer*) are now banished from our gardens, as experience has shown that they are prejudicial to the health. When pepper was so dear, that to promise a saint yearly a pound of it was considered as a liberal bequest, economical housewives seasoned their dishes with the leaves of pepper-wort (*Lepidium latifolium*), which on this account is called at present in England *poor man's pepper*.

Borage (*Borago officinalis*), since the fourteenth, or at least the fifteenth century, has been sown not only for medicinal purposes, but for the use of the kitchen. The young leaves, which however soon become hard, rough, and unfit for the table, were used in soup, and the beautiful blue flowers were put into salad and wine. This plant was not known to the ancients; for the conjecture that it was what they called *buglossum*, is not very probable. As far as I have been able to learn, Nicholas Myrepsus, who lived in the beginning of the fourteenth century, is the first who uses the name πουράκιον, which certainly means *borago*. But who knows whence this writer, who introduces in his works a great many new inexplicable names, some of them formed from the Greek, Latin, and Italian, obtained that appellation? Some of the old botanists have conjectured that it is derived from the word *corago*, which Apuleius, whose period is uncertain, gives as a synonym of *buglossum*. Some think that the reading in Apuleius ought to be *borago*; and others assert that *corago* is the true name, and arose from the quality which the plant has of strengthening the heart; consequently we ought properly to read *corago*, and not *borago*[851]. It is probable that our forefathers, under the idea that their borage was the *buglossum* of the ancients, and therefore had the property of strengthening the heart, threw the flowers into wine, that their spirits might by these means be more enlivened. Our borage is certainly a foreign plant, and Cæsalpinus said that it was brought from other countries to Italy. Linnæus[852] positively states that it first came from Aleppo; but I have not yet been able to find on what authority this assertion is founded. At present borage, at least in the German cookery, is no longer used.

Among the kitchen vegetables of which no certain traces are to be found in the works of the ancients, is spinage (*Spinacea oleracea*). Its native country is unknown; but the name is new, and certainly derived from the nature of its prickly seeds. As far as I know, it first occurs in the year 1351, among the food used by the monks on fast-days[853]; and at that time it was *Spinargium* or *Spinachium*. Meursius found in the middle ages σπινάκιον, in a poem which he has often mentioned, but not defined with sufficient accuracy[854]. This plant seems to have been made known from Spain; for many of the old botanists, such for example as Bock, call it *olus Hispanicum*. Ruellius and others name it *Atriplex Hispaniensis*; and the

latter adds, that the Arabians or Moors called it *Hispanach*, which signifies Spanish plant; it is however well known that formerly everything foreign was styled Spanish. None of the kitchen vegetables of the ancients seem to approach nearer to spinage than their *Blitum*, which Rondolet considered to be the same. But all the properties assigned to this vegetable production, namely, that it was insipid, and that on this account it was necessary to render it palatable by the addition of vinegar, pepper, and other things; that it readily multiplied; that it was indigestible and gently aperient; perfectly correspond, not only with our spinage, but with many other plants, such, for example, as our beet and orach, and the good king Henry (*Chenopodium bonus Henricus*), the young leaves of which are still dressed as spinage. It is also possible that the *blitum* of the ancients may have been a kind of *Amaranthus*, some species of which are certainly eatable. *Blitum*, therefore, will remain as difficult to be defined as the *malva*, which was used at the same time.

The *Brassicæ* of the ancients belonged certainly to the cabbage genus; yet no one, as far as I know, has examined botanically what is said of them, and completely proved their identity. It would however be fruitless labour to attempt to apply our modern names to the cabbage kinds of the ancients, and search out in the writings of the Greeks and the Romans those which we use at present; for by continued culture, through so many ages and in so many countries, new varieties have from time to time arisen, and old ones must have become lost; so that it is impossible for us to have all the varieties of the ancients, as it was for them to be acquainted with the whole of those produced in our times. I cannot therefore venture to assert that we still possess that kind of cabbage which the ancients, to prevent intoxication, ate raw like salad[855]. We can dress in this manner cabbage heads when they are chopped fine, but we do not know with certainty whether the ancients were acquainted with our cabbage; though Ruellius, not without probability, considered as such that species which in the time of Pliny was known under the name of *lacuturris*[856].

But even if this be admitted as true, we nowhere find any traces of that excellent preparation of cabbage called by the Germans sour kraut; though the ancients were acquainted with the art of preparing turnips in the same manner[857]. I should have been inclined to consider sour kraut as a German

invention, first made in Lower Saxony, which our neighbours learnt from us in modern times, had not Bellon[858] related that the Turks are accustomed to pickle cabbage for winter food. It appears, however, that these people take the whole heads, as in Germany, but particularly in Upper more than Lower Saxony, some preserve *kumskohl*, a name which, as well as *compost* and the French word *compote*, Frisch derives with great probability from *compositum* (preserved).

The ancients were acquainted with curled cabbage, and even with some of those kinds which we call *broccoli*. Under this term is understood all those species, the numerous young flowery heads of which, particularly in spring and autumn, can be used like cauliflowers. Such young shoots are called *cymæ*, but not *turiones*; for the latter term denotes the first shoots that arise, like those of hops, asparagus, and other esculent plants. The *broccoli* used at present was however first brought from Italy to France, together with the name, about the end of the sixteenth century[859].

Our cauliflower, about the end of the same century, was first brought from the Levant to Italy; and in the end of the seventeenth was transplanted thence to Germany. For a long time the seeds were procured annually from Cyprus, Candia, and Constantinople, by the Venetians and Genoese, who sent them to every part of Europe, because at that time the art of raising seed was not understood[860]. Prosper Alpinus, in the year 1588, found abundance of this vegetable in Egypt, and from his account there is reason to conjecture that it was then very little known in Europe. Conrad Gesner seems not to have been acquainted with it; at any rate it is not mentioned by him in a list of the cabbage kind of plants[861]. Even in the time of Bauhin it must have belonged to those vegetables which were scarce; because he has been so particular in naming the garden in which he saw it. Von Hohberg, who wrote about 1682, says that cauliflower, a few years before, had been brought to Germany for the first time[862].

It would be difficult to define all the species of the cabbage kind, the leaves and flowers of which were used by the ancients as food; but it would be a task still more arduous to determine those which have esculent roots. To render this clear, and to show what information I have been able to

obtain on the subject by my researches, I must venture to indulge in a little botanical criticism. Our plant-connoisseurs have unfortunately not yet condescended to examine the class of kitchen vegetables; though it would certainly be rendering a far greater service to botany, and promote its utility much more, to describe and delineate all the species, varieties, and deviations, than to give new names to a dozen of new genera from Polynesia. According to the Linnæan system, we have at present the following species of the cabbage, which have been adopted by all botanists, without further observation.

First, *Brassica oleracea*, to which belong all those kinds the leaves and flowers of which are eaten. It is certainly probable that all these have been gradually produced from one parent stock, which it is now impossible perhaps to find in its original wild state. A similarity is remarked between all these kinds; and with a little ingenuity one might form a genealogical tree of them, as Buffon has done in regard to the race of dogs; but a genealogical tree without proofs is of as little value in natural history as in claims for hereditary titles or estates. At present, in our system, we must admit that such plants as always grow up from their seeds, without variation, and do not pass into other forms, are peculiar species; but this will not prove that these supposed species were not originally produced from one maternal stem; for the variation of the succeeding plants took place gradually; and the later ones always deviated more and more from the parent stock. Who knows how many steps and gradations were necessary before cabbage, savoys, and cauliflower were produced from our common colewort? Not fewer, perhaps, than were required to produce white men from Moors, or the terrier and lap-dog from the bull-dog.

I shall call the mother plant, or original species, A, which by unknown causes has produced B, and the latter by continued and frequently changed culture has become C; from this has been produced D, and from this E, and from this F, &c. Now as we are unacquainted with the art of changing A into F, and F into A, we believe that F is a species really different from A. As we here compare two distant links of a chain, the various parts of which increase very gradually, we find them so different, that it is impossible for us to consider them as the same. But sometimes, perhaps, F changes again into E; E into D; D into C; and C into B or into A. Perhaps also B may be again produced from A, or F from E. Had a botanist observed this by

experience, he probably would have no hesitation to consider B, C, D, E, and F as varieties of A. But such observations seldom occur; we have not the power of making them according to our pleasure, for we do not know all the causes by which these numerous variations are produced. The few observations which have been made no one has yet collected, compared, and employed for establishing any certain conclusions. The division, therefore, of the cultivated plants into species and varieties would be a fruitless and uncertain undertaking, respecting which one ought not to dispute without sufficient proofs.

It is needless to refer to the form, colour, smell, and taste of the leaves, flowers, and roots. That the indented leaves, such as those which all the cabbage species have, are most liable to change, is shown by experience. The colour is no less variable; and Reichard, who had a great belief in the perpetuity of the species of plants, asserts, that in the same country and climate he could produce from the seeds of red cabbage and black radishes, white cabbage and white radishes[863]. The production and change of the hermaphrodite plants is so well known that it is only necessary to mention them. The smell, for example; but the musky smell of cabbage establishes no essential difference. Nay, a plant may entirely lose its odorous principle, *spiritus rector*, and yet retain its old form, as well as all its other component parts and properties[864]. In sandy soil the smell of plants is often entirely lost; and the taste is frequently changed, according to the nature of the land and the manure. The most powerful medicinal plants are those which grow wild in their native country, and not those reared in rich gardens, where many poisonous plants become eatable. Even the duration does not always determine the difference of the species. Thus it is certain that winter and summer rape are the same plants, though the former is a biennial and the latter an annual. Where then are the proofs in regard to the cabbage kind, and, in general, those which show that different plants are species of one genus, and others only varieties? Precision or certainty in systems can be expected only by novices; but in botany the case is the same as in every other science, mathematics excepted; the more we learn, the more uncertainty we discover, and the more circumscribed is the real knowledge which we acquire. It is necessary that this should be known to those who may take the trouble to examine the history of kitchen vegetables and other

œconomical plants; and therefore I shall offer no apology for having entered into this botanical disquisition.

To the *Brassica oleracea* belong two plants which are used in the same manner as turnips or roots. The first is the turnip-cabbage, *kohlrabi* above the earth (*Brassica gongylodes*), the stem of which swells out, above the earth, into a thick pulpy turnip-like tubercle, which is dressed and eaten in the same manner as turnips. It is a monstrous excrescence of the stem, which is hereditary, like the broad stem of the Italian fennel. This turnip-cabbage was certainly not known to the ancients; it occurs for the first time among the botanists of the sixteenth century. Spielmann conjectures that it was brought from the Levant during the crusades; but it was known at too late a period to warrant this opinion.

Still newer is that variety called *kohlrabi*, subterranean or turnip-rooted cabbage, the stem of which produces a similar tubercle at the surface of the earth or immediately under it. In my opinion, it was first described by Caspar Bauhin, in the year 1620, under the name *napo-brassica*, which it still retains, as a new species, to which he was not able to assign any synonyms. He says that this turnip was cultivated on the Bohemian frontiers, where it was called *Dorsen* or *Dorschen*; and the same name is given to it there at present, as is confirmed by Mehler, in whose work there is a good figure of it[865]. In Germany it is commonly called *Steckrübe*, and, as is said, was first made known there about the year 1764 by the Bohemian glass-dealers.

The second cabbage species in the Linnæan system is the *Brassica napus*, a plant which grows wild on the sandy sea-coasts of England, as well as in the island of Gothland, and which in many of the northern countries is cultivated for the oil obtained from the seeds, under the name of winter and summer rape. When thinly planted in a nourishing soil it produces esculent roots, which have a somewhat harsh taste, and properly in German it ought to be called *Steckrübe*. Such is the name given to it in the works of all the old writers by whom it was first mentioned; and it is called so at present in Bohemia, where it is cultivated, as well as *kohlrabi* under the earth, which in some parts of Germany is improperly named *Steckrübe*, and a proper distinction is made between the two species[866]. This kind, the real *Steckrübe*, is never very thick, being only of the size of

those which grow in the Mark. The leaves arise immediately from the roots, but in the *gongylodes* and *napo-brassica* they proceed from the stem.

This species of turnip I did not expect to find among the ancients. I conceived that it might perhaps have been produced in the northern countries, since rape began to be cultivated for oil. Afterwards this plant may have become so much domesticated among us, as to be found not unfrequently in a wild state. Some person may then have easily remarked the pulpy roots of plants growing in a manured soil, and making a trial of them found them well-tasted. When first cultivated, it must have been observed that their harsh taste was moderated, sometimes more and sometimes less, in a sandy soil, and rendered in some degree aromatic; by which means they acquired so great a superiority to the common and almost insipid rape, that they were brought to the first-rate tables under the name of the Markish, Teltow, Borsfeld, Bobenhäuser and Wilhelmsburg rapes. In each country they were named after those places where they acquired the best savour; and this was the case only where the soil consisted of clay mixed with more or less sand. From such districts large quantities of them were sent to a great distance; but perhaps never in more abundance than from Teltow, in the Middle Mark, which small town sold to the amount of more than two thousand dollars, chiefly to Berlin and Hamburg; and from Hamburg these agreeable roots were frequently sent to both the Indies. Around Stendal also, in the Old Mark, they were raised in considerable quantity, but the seeds are procured there from Teltow[867]. If we wish to introduce them into our gardens, we must either mix much sand with the soil, or procure fresh seeds annually.

The Greeks and the Romans had little occasion for cultivating rape. They had other vegetables, from the seeds or fruit of which they could obtain a better oil, and in more abundance. Where the olive would not thrive, they cultivated, as at present, sesamum; or expressed oil from the nuts and seeds of the turpentine tree[868], without speaking of the many essential oils which they used for salves.

But however probable this may appear, I am inclined to suspect, that under βουνιὰς and *napus* our *steckrüben* are to be understood, as most of the old botanists have admitted; and that the roots of them were used for food, before the seeds were employed for making oil. The *napus* of the

ancients had long thin roots, which were so small that they could be preserved without being cut into slices; on the other hand, the *rapa* had large conical roots, which could not be preserved till they were sliced. The *napus*, because the roots grew chiefly downwards, were sown thicker than the *rapum*. The *napus* was cultivated only for the use of man; but the *rapum* was raised in great abundance as fodder for cattle. Of the *napus* there were many known varieties, of different degrees of goodness, which, as is the case at present with *steckrüben*, were named from the place where they chiefly grew. When sown late in the season, they were injured by the earth-flea; to prevent which, the young plants were strewed over with soot. Both the *napi* and *rapa* were buried in the earth, where they were kept in a fresh state during the winter. The former, to prevent them from degenerating, required careful cultivation; and indeed there are few kitchen vegetables which so easily change their state, according to the nature of the soil, as the *steckrüben*.

But what opinion can be formed of the assertion, often repeated, that *brassica napus*, and *rapum*, or *rapa*, readily change into each other; consequently are only varieties or deviations of the same species[869]? I am not disposed to declare this assertion to be altogether false; though I will not vouch for the possibility of converting our Markish rapes into turnips or cabbage. I conjecture that in the oldest times, when these three plants were not so far separated from each other by intermediate species or degrees of degeneration, as they had a greater resemblance to each other, and were all nearer to the original species, such transitions were easier than they possibly could be at present.

The third species of cabbage in the Linnæan system, belonging to this place, is the *Brassica rapa*, or turnip, the roots of which, more or less conical, differ in figure, colour and taste[870]. That these roots are the same as those called by the Romans *rapa*, and by the Greeks γογγύλη or γογγυλὶς, appears to be subject to no doubt, though at present we may have a greater number of varieties.

[The turnip was well-known to the Romans, and all that can be gathered on this subject from the writings of the ancients renders it probable that it occupied nearly the same place in Roman culture as it does in British

husbandry at the present day. Columella[871] recommended that the growth of turnips should be abundant, because those which were not required for human food could be given with much advantage to cattle; and both he and Pliny concur in their testimony, that this produce was esteemed next to corn in utility and value. The best grew in the country of the Sabines, and were worth at Rome a sestertius, or 2*d.* each[872].

It is stated that the Roman method of cultivation must have been superior to that of the moderns, since Pliny relates that some single roots weighed as much as forty pounds, a weight far surpassing any which has been obtained by the most skilful modern agriculturists. It is very probable that the garden culture of the turnip was introduced by the Romans into this country, and that, like some of the fruit trees which they had transplanted here, though neglected, it was never altogether lost. There is no doubt that this root was in cultivation in the sixteenth century. Whether revived by native industry, or introduced at that period by the Flemings, is a question differently answered by different writers. Towards the latter end of the sixteenth century it is mentioned by more than one writer. Cogan, in his Haven of Health, published in 1597, says, that "although many men love to eat turnips, yet do swine abhor them." Gerarde, who published in the same year, and who had rather more rational views on the subject of plants, leads us to conclude that more than one variety was cultivated in the environs of London at that time. "The small turnips," says he, "grown by a village near London, called Hackney, in a sandie ground, and brought to the crosse in Cheapside by the women of the village to be solde, are the best that I ever tasted." Gerarde is silent concerning the field culture of turnips; neither is this mentioned by Parkinson, who wrote in 1629. We do not find any account of the root being grown in any part of the country until the close of the seventeenth century (*loc. sup. citat.*). Turnips sometimes attain a very large size in this country; Tull[873] speaks of some weighing as much as nineteen pounds, and of often meeting with others of sixteen pounds. One was dug up in Surrey, in July 1828, which weighed twenty-one pounds, and was one yard in circumference[874]. Our more immediate ancestors appear to have applied the turnip to more extensive uses as an esculent than is done at present. It is stated, that in 1629 and 1630, when there was a dearth in England, very good, white, lasting and wholesome bread was made of

boiled turnips, deprived of their moisture by pressure, and then kneaded with an equal quantity of wheaten flour. The same was had recourse to in Essex in 1693[875].]

The question whether the Greeks and the Romans were acquainted with our carrots[876], seems to be attended with more difficulties than might be expected. Whoever wishes to answer it fully, and at the same time explain the information of the ancients, and examine the opinions of the botanists of the sixteenth and seventeenth centuries (for the modern botanists give themselves very little trouble in regard to such researches), must enter into a disquisition of such length as might be agreeable perhaps to few readers. I shall however here state what I think I know, and however little it may be, it will perhaps afford some assistance to those who are desirous to illustrate the works of the ancient physicians and agriculturists.

Dioscorides, who, next to Theophrastus among the Greeks, possessed the greatest share of botanical knowledge, was certainly acquainted with our carrot, and gave it the name of *staphylinos*. For this plant, he says, like dill, bears *umbellæ* consisting of white flowers, which in the middle are of a purple red or almost saffron red colour. Our carrots, it is well known, have these characteristics, before the *umbellæ*, towards the time of their ripening, form themselves into a *nidus*. The plant meant by Dioscorides grew wild, but was reared in gardens, on account of its esculent root; and our carrots are certainly descended from plants which grew wild, though Miller, author of the Gardener's Dictionary, could not succeed in rendering the small pungent roots eatable by culture.

We must believe Columella and Pliny, that the *staphylinos* of the Greeks was, in their time, called *pastinaca*; though they give no information from which it can be concluded that their *pastinaca* was our carrot. The former speaks of it as a plant useful to bees, which is the case also with our wild and cultivated carrots. Afterwards he tells us that it was cultivated like *siser*. Those therefore have erred who consider *siser* and *pastinaca* as the same plant, and believe it to be our liquorice.

That *staphylinus*, or *patinaca*, or our carrot, was by the Greeks called also *daucus*, is asserted by Pliny, as well as Galen; and in the Geoponica, *daucon* is named among the kitchen vegetables. But Dioscorides seems to

make a difference between *staphylinus* and *daucon*, as he treats of them in different sections. He however says that *daucon* is like *staphylinus*, and has also a white umbella. *Daucon* perhaps may have signified a peculiar variety of carrot.

In the last place, that the *pastinacæ*, or carrots, were named also *carotæ*, is mentioned by Apicius. This word is derived perhaps from κάρτον, which in Athenæus denotes the large roots of the *staphylinus*, and also from κέρας, which occurs in Hesychius and Apuleius as a synonym of *pastinaca*, *staphylinus*, and *daucion*; but it is possible that all these words may have been corrupted by transcribers. The Germans and French however have thence formed the appellation *carrottes*. But κάρος, a plant which Galen[877] names along with the roots of the *staphylinus* and *daucus*, signified, undoubtedly, our caraway (*Carum Carvi*). Dioscorides says that the spicy aromatic seeds of the κάρος were used, and that the roots also were boiled and eaten like carrots. Pliny calls the plant *careum*. The Greeks and the Romans therefore were acquainted with our carrots; but in my opinion they were far less used in cookery and as fodder for cattle than they are at present, otherwise they must have more frequently occurred in the works of the ancients.

But whether, under the term *pastinaca*, the ancients did not sometimes understand our parsnip, I will not venture to determine. I can only assert, with some degree of probability, that the latter is by Dioscorides called *elaphoboscon*, a name which occurs also in Pliny. The former says expressly that this plant had *umbellæ* with yellow flowers, and large white sweet roots fit to be eaten. Now among our umbelliferous plants, besides dill, fennel and lovage, the parsnip is the only one which has yellow flowers; at any rate I know of no other with yellow flowers and esculent roots. If the parsnip had no other names among the Greeks and the Romans, it must have been very little used by them; for it is mentioned only by Dioscorides and Pliny. At present we know that it forms excellent fodder for black cattle, sheep and swine.

It needs however excite little wonder that it is so difficult to discover these plants in the works of the Greeks and the Romans. They all belong to one natural order, the species of which can with difficulty be distinguished by the most expert botanist. I mean to say, that all the umbelliferous plants

are so like to each other, that they may be readily confounded. This difficulty is still further increased by the old physicians, who used a great many plants of this kind, and named them after the kitchen vegetables to which they had a resemblance, so that by these means plants totally different occur under the same name. To distinguish these, it is necessary first to examine which of them was a kitchen vegetable, and which was used in medicine.

Among our kitchen vegetables, as among the spices, there are many kinds which, at first, were known only on account of their medicinal properties, but afterwards were esteemed and cultivated on account of their good taste. Of this kind is the scorzonera[878], which became first known in the middle of the sixteenth century, in Spain, where it was considered as an antidote to the poison of a snake called there *scurzo*. A Moor, who had learnt this property of it in Africa, cured with the juice of the leaves and the roots a great many peasants bitten by snakes while mowing; but he would not discover the plant, that he might retain all the advantage to himself. Some persons, however, who followed him to the mountains, where he collected it, observed that it was the *Scurzonera*, or *Scorzonera hispanica*, so called from the name of the snake. Petrus Cannizer transmitted the plant, together with a drawing of it, to John Odorich Melchior, physician to the queen of Bohemia; and the latter sent what he had obtained to Matthioli, who at that time was not acquainted with it[879]. Soon after the roots were extolled in a particular tract by Nicholas Monardes, as a powerful remedy for the poison of snakes[880]. It is probable also that these roots were first used in Spain as food, and about the beginning of the sixteenth century were carried thence to France. The anonymous author of the well-known work Le Jardinier François, who was a gardener, and dealt in trees and seeds at Paris, boasts of having been the first who introduced these roots into the French gardens. The first edition of his book, which greatly contributed to improve gardening in France, was printed in 1616. At present the roots of the scorzonera are to be found in most gardens, but no one places faith in their medicinal virtue; and when they are occasionally prescribed by any physician for a ptisan perhaps, the other kind, the *Scorzonera humilis*, is preferred, though in the apothecaries' shops the Spanish, taken from the gardens, is used in its stead[881].

Among our species of the *Allium* genus, shallots, in consequence of their mild taste, are preferred. There can be no doubt that this name, as well as the French *échalotte*, is derived from *Ascalonia*; and the above species in the system is called *Allium ascalonicum*[882]. Theophrastus, Pliny, Columella, Apicius, and others, speak of a species called *ascalonia*, brought from the city of Ascalon, in Palestine, as we are told by Pliny, Strabo, and Stephanus. The last-mentioned author states it as a report, that the first bulbs were observed in that neighbourhood. These names are found in the oldest catalogues of the German garden vegetables. There is sufficient reason also to conjecture that our shallots were the *ascaloniæ* of the ancients, and that they came originally from Palestine; especially as Hasselquist found the same species growing there wild. An important doubt, however, against this opinion arises from what is said by Theophrastus and Pliny; namely, that their *ascaloniæ* could not be propagated by bulbs, but by seeds[883]; on the other hand, our shallots in Germany, and perhaps in every other part of Europe, never come to flower, and are obtained only by the bulbs; so that Linnæus procured the first flowers, through Hasselquist, from Palestine. But why should not all the other allium species be propagated by planting the bulbs?

[The kitchen-gardens of England were as scantily supplied with vegetables, until about the end of the sixteenth century, as the pleasure-grounds were with shrubs and flowers. “It was not,” says Hume, “till the end of the reign of Henry VIII. that any salads, carrots, turnips or other edible roots were produced in England; the little of these vegetables that was used was imported from Holland and Flanders. Queen Catherine, when she wanted a salad, was obliged to despatch a messenger thither on purpose.” Hume is not however quite correct in this point. Our ancestors, before Henry VIIIth’s time, had always their winter-cresses and water-cresses, and common Alexanders, which served them for celery; they had rampion and rocket; borage for their cool tankard, and amaranthus and goose-foot, or good Henry with sprout-kales, which they used as greens. Their fruits were neither numerous nor good, being chiefly confined to gooseberries, currants and strawberries; the apples and pears were generally indifferent, and their plums and cherries bad; although the latter are supposed to have been planted in this country so early as the year 800, at which time they were brought from Italy.

The most important of kitchen vegetables of the present day is certainly the potato. There is scarcely a doubt of the potato being a native of South America, and its existing in a wild state in elevated places in the tropical regions and in the more temperate districts of the western coast of that country. It appears probable that it was first brought into Europe from the mountainous parts of South America in the neighbourhood of Quito, to Spain, early in the sixteenth century; they were here called *papas*. From Spain they were carried to Italy, and there received the same name as the truffle, *taratoufli*. From Italy they went to Vienna, through the governor of Mons in Hainault, who sent some to Clusius in 1598. The potato arrived in England from North America, being brought from Virginia by the colonists sent out by Sir Walter Raleigh in 1584, and who returned in July 1586, and in all probability brought back the potato with them. Such is the opinion of Sir Joseph Banks; moreover, in De Bry's Collection of Voyages[884], he describes a plant called *openawk*, which is in all probability identical with the potato. Gerarde, in his herbal, published in 1597, figures the potato, under the name of the potato of Virginia, whence he says he received the roots. The potato was first cultivated in Ireland by the grandfather of Sir Robert Southwell, from tubers given him by Sir W. Raleigh. Some time after, they were grown in Lancashire, as some say, being conveyed there through a shipwreck; thence their culture has gradually diffused itself throughout the country.

The great dependence for nourishment placed in the potato by so many of the poor, has been lately exhibited in the great distress caused by the disease of the crops. In addition to its use as a direct article of food, the potato is applied to furnish starch, which is not unfrequently substituted for arrow-root and sugar.

In the year 1619, the common market-price of the potato was 1*s.* per lb.]

FOOTNOTES

843 [The very reverse of this is now generally admitted, and the prosperity of a country may be judged of from the amount of sugar consumed in it.]

844 Rumex patientia. Kerner, tab. 720.

845 Barbarea plantaginea. Kerner's Œkonom. Pflanzen, tab. 562.

846 Smyrnium olusatrum. Kerner, 356.

847 Chærophyllum bulbosum. Kerner, tab. 299. Jacquin, Flora Austriaca, i. tab. 63.

848 Phyteuma spicata. Kerner, tab. 153.

849 The tuberous roots of the Lathyrus tuberosus. Kerner, tab. 328.

850 Columella. x. 109. Virgil, Moretum, 85.

851 Apuleius de Virtute Herbar. cap. 41. Plinius, xxv. 8.

852 Spec. Plantarum.

853 Du Cange.

854 Meursii Glossar. Anonymus de vulpe et lupo. In p. 657, he says that this poem was printed, but where we are not told.

855 See the passages quoted by Niclas in Geopon. v. 11. 3, p. 345.

856 Plin. xix. 8. sect. 41. The same species is mentioned by Columella, x. 138. But of red cabbage no account is found in any ancient author.

857 Columella, xii. 54. Pallad. Decem. 5. Nicander in Athenæus, iv.

858 Bellonii Obs. Itin. iii. 27.

859 Menage, Dict. v. Broccoli.

860 This is stated in Vincenzo Tanaro Economica del Cittadino in Villa. This book, written about the year 1642, was often printed; but I have never been so fortunate as to meet with a copy. The eleventh edition, being the latest, was printed at Venice in 1745, 4to. In Nonnii Diæteticon, p. 49, the first edition of which was printed in 1627, it is said that the seeds of cauliflower were brought from Italy to Antwerp, where no seed was raised, or such only as produced degenerate plants.

861 In Horti Germaniæ, at the end of Cordi Opera, p. 250, B.

862 Georgica Curiosa, Nurnberg, 1716, fol. i. p. 643.

863 Land- und Gartenschatz, p. 84.

864 See the ingenious experiments of Dalibert in Mémoires présentées sur les Mathématiques et la Physique, tom. i. Strong-smelling plants lose their smell in a sandy soil, and do not recover it when transplanted into a rich soil. On this Rozier founds his proposal for improving rape-oil.

865 Mehler, p. 16, tab. vi.—Kerner, tab. 312.

866 A good figure is given by Mehler, tab. viii.

867 See a figure of the Teltow rapes in Kerner, tab. 534.

868 Geopon. lib. ix. 18, p. 611. The oil of turpentine of the present day is obtained from the resin by distillation, a process with which the ancients were unacquainted.

869 Columella, ii. 10, 22–25; xi. 3, 60; xii. 54.—Plinius, xx. 4; and xix. 10 and 5. That I may not be too prolix, I shall leave the confusion which occurs in the works of the ancients untouched.

870 See the figure of the *Mayrübe* in Kerner, tab. 553; of the *Guckelrübe*, tab. 516; and Mehler's tab. vii. (or 37.)

871 De Re Rustica, lib. ii. cap. 10.

872 Hist. Nat. lib. xviii. c. 13; lib. xix. c. 5.

873 Tull's Horse-Hoeing Husbandry.

874 Gard. Magaz.

875 Lib. Entert. Knowledge, VEGETABLE SUBSTANCES.

876 Kerner's Œkonom. Pflanzen, tab. 319.—Mehler, tab. x. (or 40.)

877 De Aliment. Facult. ii. 67. Galen has ἡ καρὼ, not κάρος.

878 Kerner, tab. 91.

879 Matthioli Epist. Med. v. p. 209; in Opera, Basil. 1674, fol.

880 A translation, printed for the first time in Spanish in 1569, is in Clusii Exotica, p. 15.

881 Murray, Apparat. Med. i. p. 160.

882 Kerner, tab. 307.

883 *Cepæ fissiles*, or *scissiles*, or *schistæ*, are leeks, as Theophrastus tells us himself, which, when the leaves become yellow, are taken from the earth, and being freed from the leaves, are separated from each other, then dried, and in spring again put into the ground. If we believe that the *ascaloniæ* can be propagated only by seed, we must certainly read in Theophrastus μόνα γὰρ οὐ σχιστὰ, as Scaliger has already remarked.

884 Vol. i. p. 17.

KNITTING NETS AND STOCKINGS. STOCKING-LOOM.

In the art of weaving, the woof is thrown or made to pass through the numerous threads of the warp[885], and is retained by them; but in knitting there is only one thread, which is entwined in so ingenious a manner that it produces a tissue approaching near to cloth, both in its use and appearance, though it cannot be called cloth, because it is formed without warp and woof. I will not, however, quarrel in regard to names: the spider's web is produced by only one thread, but in a manner indeed which differs as much from weaving as it does from knitting; and it is not known with certainty whether Arachne found out the art of weaving cloth or of making nets[886].

There are two methods of knitting, essentially different from each other; the one employed in making nets, and the other in knitting stockings. In the former the twine is knotted into meshes by means of a knitting-needle; whereas in the knitting of stockings the meshes are produced without knots. Hence it may be readily comprehended why knit stockings can be so easily and so speedily un-knit, in order that the thread may be employed for new work; and why in nets this is impossible. The knots which prevent it render it on the other hand possible for nets to be cut or torn asunder, without destroying more meshes than those immediately exposed to the force applied. One may easily see also the cause why things knit in the same manner as stockings can be stretched without being torn, and, like elastic bodies, again contract as soon as the action of the distending force ceases. On this account no kind of cloth has yet been found fitter for gloves, stockings, garters and bandages. When not too closely knit, single parts can be extended without injury, as the threads in the neighbouring meshes give way, and the meshes become narrow or contracted. This, on account of the knots, is not possible in knitting of the first kind, which however produces the best nets, as the meshes suffer the

water and mud, together with the fish that are too small, to pass through them, and retain only the fish that are larger. A captured fish, in order to escape, must tear to pieces, after each other, as many meshes as are equal to the circumference of its body. Were the net formed in the same manner as a stocking, a single mesh, if torn, would suffer it to pass through[887].

It is to be reckoned among the advantages of the present age, that a readiness in knitting is required as a part of female education in all ranks; and it may be easily acquired even by children, with the assistance of an expert and indulgent instructress. It is however astonishing that this art has not been banished by the refinement of modern manners, especially as so much of the time of young females is employed in the reading of novels and romances. But it is to be observed, that this occupation, which, with a little practice, becomes so easy that it may be called rather an amusement, does not interrupt discourse, distract the attention or check the powers of the imagination. It forms a ready resource when a vacuity occurs in conversation, or when a circumstance takes place which ought to be heard or seen, but not treated with too much seriousness: the prudent knitter then hears and sees what she does not wish to seem to hear or to see. Knitting does no injury either to the body or the mind, the latter of which suffers from romances. It occasions no prejudicial or disagreeable position, requires no straining of the eye-sight, and can be performed with as much convenience when standing or walking as when sitting. It may be interrupted without loss, and again resumed without trouble; and the whole apparatus for knitting, which is cheap, needs so little room, and is so light, that it can be kept and gracefully carried about in a basket, the beauty of which displays the expertness, or at any rate the taste, of the fair artist. Knitting belongs to the few useful occupations of old persons, who have not lost the use of their hands. Those who wish to reproach the fair sex for the time they waste in endeavouring to please the men, ought not to forget that the former know how to occupy those moments which the latter devote, not to labour, but to social enjoyment or pleasure, or which would be otherwise lost—the time in which the male sex are able to do nothing that is useful. No one, however, will seriously object this to the male sex, whose daily occupations tend so much to exhaust the spirits; but is it not to be regretted that those who, in consequence of their situation, perform properly no work, who are scarcely under the necessity of thinking, and who rather become

corrupted through idleness, do not employ their vacant hours in knitting, in order to gain money? What I mean to say is, should not servants, soldiers, shepherds, and the male children of the peasants who are unfit for hard labour, learn to knit, that they might earn something for themselves and their families? A sale for knit articles, stockings, mitts, caps, nets and fine lace can never be wanting. My panegyric, however, on knitting is applicable, strictly speaking, to the second kind only, which surpasses the first in utility, but is a much more modern invention; for fishing and hunting were the oldest occupations, and mention of nets occurs in the earliest writings.

It is not improbable that the people who resided on the banks of rivers abundant in fish, endeavoured to catch them at first with baskets, such as those which most of the Indians know how to make, or with other vessels which suffered the water to run through them; but that in the course of time a piece of thin cloth was employed, and at a still later period, what was far more convenient, nets. Mention however of fishing and hunting nets occurs very often in the Scriptures; and in some passages it is clearly proved that we are to understand by them such as were knit. But I shall leave commentators to determine whether gins composed of ropes or cords[888] are not often meant where the translators have introduced nets. The former are certainly older than the latter; they were long used both in hunting and in war, and are still employed among some savage tribes who are not acquainted with fire-arms.

That nets, however, should be invented at an early period needs excite no wonder, for they have been found in modern times among very rude nations. Wafer[889] saw some among the American savages which were made of the bark of a tree; and the Greenlanders made some of the same kind of the hair of the whale's beard, and of the sinews of other animals. I shall omit here what has been said in regard to nets in the works of the ancients, and particularly in those which treat on fishing and hunting. The Latins say *texere retia*; and Pliny calls the yarn or twine of which nets were made *stamen*; yet I am inclined to believe, that both the Greeks and the Romans made their nets in the same manner as we do at present.

Weaving, properly so called, is out of the question; and it appears that these words were used in a very general sense, because there was then no

term of art to denote knitting. At any rate, I cannot believe that the far more ingenious process by which our lace-weavers prepare the netted scarfs used by military officers was then known, as Braun seems to think[890]. Meshes were called by the Latins *maculæ* and *nodi*; but I as little understand what Pliny says, "retia succino nodantur," as the supposed explanation of Hardouin, "retia nodos e succino habebant[891]." The author alludes here perhaps to some ornament added to those nets which were drawn round the boxes or seats of the senators. Some manuscripts read *notantur*: I should have preferred *ornantur*.

The art of making nets of fine yarn, silk, or cotton, by the process of knitting, and employing them as articles of dress or ornament, is not an invention of modern luxury. I remember to have seen in old churches retiform hangings, and on old dresses of ceremony borders or trimming of the same kind, which fashion seems alternately to have banished and recalled. That in the middle ages the mantles of the clergy had often coverings of silk made in the same manner as fishing-nets, has been proved by Du Cange[892]. I suspect also that the transparent dresses used by the ladies, more than four hundred years ago, to cover those beauties which they still wished to be visible, were nets of this kind[893].

Far more ingenious and of much later invention is that art which was undoubtedly first employed in making stockings, and on that account called stocking-knitting. That the Romans and most of the ancient nations had no particular clothing for the lower part of the body, is so well known, that it is unnecessary for me to repeat the proofs. Their legs however did not suffer more from the cold than our hands when they are not covered by gloves, or than the feet of the Franciscans at present; and what is common is not indecent. It is well known that the northern nations first had hose or trowsers, which covered not only the legs but the thighs and loins; and it was not till a few centuries ago, that from this article of dress people began to make two; the upper part retained the old name, and the lower, that which covered the legs, was called in German *strumpf*, *truncus*, which word Maler in his Dictionary explains by *halbhosen*, half-hose, and *hosenstrumpf*. The diminutive *strümpfle* signifies, according to this author, hose that reach to the calf of the leg. The first stockings were of cloth, and made by the

tailors; consequently they were not so commodious as our knit-stockings, which, for the reason already mentioned, become closely contracted, without pressing the foot or impeding a person in walking.

It is more than probable that the art of knitting stockings was first found out in the sixteenth century, but the time of the invention is doubtful; it is also uncertain to what people we are indebted for it, and the name of the inventor is entirely unknown. Savary appears to be the first person who hazarded the conjecture[894], that this art is a Scottish invention, because the French stocking-knitters, when they became so numerous as to form a guild, made choice of St. Fiacre, a native of Scotland, to be their patron; and besides this, there is a tradition, that the first knit stockings were brought to France from that country. However this may be, it is certain that the first letter of foundation for this guild, named "la Communauté des Maitres Bonnetiers au Tricot," is dated the 16th, or, as others say, the 26th of August 1527. St. Fiacre, I shall here remark, was the second son of Eugenius, who is said to have been king of Scotland in the beginning of the seventh century; he lived as a hermit at Meaux in France, and his name in the sacred calendar stands opposite to the 30th of August[895]. It must however be acknowledged that Savary's conjecture rests only on a very slight foundation.

Somewhat more probable is an opinion, which has been long prevalent in England, and is supported by the testimony of respectable writers. Howell, in his History of the World, printed in 1680, relates that Henry VIII., who reigned from 1509 to 1547, and who was fond of show and magnificence, wore at first woollen stockings; till by a singular occurrence he received a pair of knit silk stockings from Spain. His son Edward VI., who succeeded him on the throne, obtained by means of a merchant named Thomas Gresham, a pair of long Spanish knit silk stockings; and this present was at that time highly prized. Queen Elizabeth, in the third year of her reign, that is in 1561, received by her silk-woman, named Montague, a pair of black silk knit stockings, and afterwards would not wear any other kind[896].

This information is confirmed by another account. It is related in Stow's Chronicle, that the earl of Pembroke was the first nobleman who

wore worsted knit stockings. In the year 1564, William Rider, an apprentice of Master Thomas Burdet, having accidentally seen in the shop of an Italian merchant a pair of knit worsted stockings, procured from Mantua, and having borrowed them, made a pair exactly like them, and these were the first stockings knit in England of woollen yarn.

From this testimony, it has been hitherto believed in England that knit stockings were first made known there under Henry VIII.; that they were brought from Spain to that country; and that the invention belongs, in all probability, to the Spaniards. Were this really the case, one might conjecture that the first knit stockings known in England were of silk, though the imitations made by Rider were of wool. For under Henry VIII., Edward VI., and Elizabeth, silk stockings only are mentioned; and at that period silk, and not woollen articles, were imported from Italy and Spain. Did the invention belong to the Spaniards, I should be inclined to conjecture that these people obtained it from the Arabians, to whom we are indebted for many useful and ingenious arts. But at any rate the conjecture of Savary falls to the ground; for as the French had a stocking-knitters' guild as early as 1527, it is highly improbable that the English, forty years after, or about the year 1564, should have been unacquainted with the invention of their nearest neighbours, the Scots.

Some years ago, however, several learned men in England were led, by a singular circumstance, to collect information in regard to the antiquity of the art of knitting stockings. I here allude to the forgeries of Thomas Chatterton, who was born on the 20th of November 1752, and terminated his unfortunate life by suicide on the 24th of August 1770. This ingenious youth published some poems which he pretended were written by Thomas Rowley, who lived in the reign of Edward IV., that is about the year 1461. Many literary men denied the authenticity of these poems, though they possessed great beauty; proclaimed Chatterton to be a second Psalmanasar; and justified their opinion by the circumstance of knit stockings being mentioned in them. This they said was an anachronism, as the invention of knitting stockings, according to Howell and Stow, must be a century later than the supposed poet Rowley. Others, who supported the genuineness of these poems, endeavoured on that account to make the invention older, and collected information in regard to the history of it, from which I have made the following extract[897].

In the beginning of the sixteenth century the people of Scotland had breeches, in the proper sense of the word, and wore a kind of stockings; for Hector Boethius, who was professor at Aberdeen in 1497, relates that the Scots wore hose which reached only to the knee, consequently stockings made of linen or woollen, and breeches chiefly of hemp[898].

These particular articles of dress were usual at that time even in England; for in the year 1510 king Henry VIII. appeared, on a public occasion, with his attendants, in elegant dresses, in the description of which breeches and hose are particularly mentioned[899].

In the year 1530, the word *knit*, applied to stockings, must have been common in England; for at that time John Palsgrave, French master to the Princess Mary, daughter of Henry VIII., published a grammar, in which he stated that this word in French was applied to the making of nets as well as of caps and stockings.

From a household book of a noble family in the time of Henry VIII., we learn that knit stockings, both for grown-up people and children, were sold at so low a price that it cannot be supposed they were foreign articles[900].

In the reign of Edward VI. various kinds of knit articles must have been made in England, as appears by some regulations relating to trade and manufactures issued in 1552[901].

It nevertheless can be proved, that in the fifth year of the reign of queen Mary, that is in 1558, there were many who wore stockings of cloth; for Dr. Sands, who was afterwards archbishop of York, sent for a tailor to measure him for a pair of hose[902]. This might serve to confirm the assertion of Stow, that stockings were not knit in England till six years after. But according to the testimonies already produced, this cannot be true. It is much more credible, that the clergy and old people, who are not ready to adopt new modes, wore some years later the old-fashioned stockings of cloth, which in all probability were similar to our gaiters.

It might be mentioned, as a further proof, if necessary, of breeches and stockings being considered, long before the reign of queen Elizabeth, as

separate parts of dress, that in the catalogue then drawn up of the revenue of the bishop of St. Asaph, it is stated that he received as a perquisite, on the death of every clergyman who had a living, his best breeches and stockings[903].

About 1577, that is ten years after the period of the invention as given by Stow, knitting must have been common throughout all England, and practised even in villages. The bark of the alder was used by the wives of the peasants for dyeing the stockings which they had knitted[904].

According to the well-known poet George Gascoigne[905], the greatest ornaments in dress, about the year 1576, were knit silk stockings and Spanish leather shoes.

About 1579, and not 1570 as stated in the Gentleman's Magazine, when queen Elizabeth was at Norwich, several female children appeared before her, some of whom were spinning worsted yarn, and others knitting worsted yarn hose[906].

The art of knitting stockings would be much older in Germany than in France or in England; and Chatterton, at any rate, would be freed from the charge of committing an anachronism, were it true, as Micrælius wrote in the year 1639, that the consort of the duke of Pomerania, who died in 1417, when she could no longer sew or embroider amused herself with knitting[907]. But it is very probable that this good man committed an anachronism, like Chatterton; and, in order to show the industry of the duchess, named those occupations which were usual in his own time.

In Germany, as far as I know at present, stocking-knitters occur for the first time about the middle of the sixteenth century, under the name of *hosenstricker*, a term which in Lower Saxony is still not uncommon. At Hamburg the people say *hasenknütter*, and use the word *hase* for stockings. In Berlin there were stocking-knitters about the year 1590. In many countries they had a particular guild; and this is the case at present in the duchy of Wirtemberg, where they are entirely different from those who work at the loom, and who are called *stocking-weavers*. Each have their own regulations, in which it is ordered that the stocking-knitters shall wear no articles wove, that is knit, in a loom, and the stocking-weavers no

articles knit with the hand. That knitting however may be left free, as an occasional occupation to every one, the following words are inserted in the regulations of the stocking-knitters:—"Poor people, who through want of other means procure a subsistence by knitting stockings, and those who at the gates keep watch for themselves or others, and at the same time knit, shall be at liberty to wear whatever they make with their own hands."

The German terms of art which relate to knitting are older than the art itself, for they are all borrowed from the making of nets; *knütten*, *knüteisen*, *knütholz*, *knütspan*, *stricken* and *stricknadel*, and also *maschen*, are all terms which occur in the fishing-regulations of Brandenburg for the year 1574, and no doubt earlier. The *tricoter* of the French had the same origin as the German word *stricken*: *Trica* was a lock of hair, a noose; and *tricare* signified to entangle, and deceive. *Lacer* is derived from *laqs*, a rope, a noose; and this comes from *laqueus*. The English word *stocking* is derived from *stock*, *truncus*, the trunk of a tree, a word still retained by the German foresters, who in the Low German speak of rooting out *stocks*.

Silk stockings, however, in consequence of their high price, were for a long time used only on very grand occasions. Henry II., king of France, wore such stockings for the first time at the marriage of his sister with the duke of Savoy in 1559[908]. In the reign of Henry III., who ascended the throne in 1575, the consort of Geoffroy Camus de Pontcarre, who held a high office in the state, would not wear silk stockings given to her by a nurse, who lived at court, as a Christmas present, because she considered them to be too gay. In the year 1569, when the privy-counsellor Barthold von Mandelsloh, who had been envoy to many diets and courts, appeared on a week-day at court with silk stockings which he had brought from Italy, the margrave John of Custrin said to him, "Barthold, I have silk stockings also; but I wear them only on Sundays and holidays." The celebrated Leonard Thurneisser, however, who lived at the court of Brandenburg about the end of the sixteenth century, wore silk stockings daily, and in general dressed very magnificently in silk and velvet.

Knitting with wires, the method of which I have hitherto spoken, has always appeared to me so ingenious, that I conceived the inventor of it must have had a pattern to serve as a guide. This pattern I think I have discovered. Wire-workers, and other artists who used wire, exercised their

ingenuity some centuries ago, more than at present, in making wire-screens in various ways; and it must be confessed that many of them produced articles, which even at present, though not suited to the modern taste, deserve admiration. Works of this kind may still be found in old churches. The art of making them has often been considered as too difficult for human hands; and hence popular tradition has asserted that the artists were assisted by the devil. A tale of this kind is still related, though no longer believed, to those whose curiosity induces them to view the wire-screen which surrounds the baptismal font in St. Mary's church at Wismar, and which is plaited or wove in so ingenious a manner, as if with ropes, that neither the beginning nor end of the wires can be observed. A similar legend is told to strangers when shown the screen around the pulpit in the cathedral of Lubec, which, according to the inscription, was made in 1572. It is not improbable that, among works of this kind, some may be found made with meshes, as if formed by knitting. Our pin-makers can construct some much more ingenious. That I might be better able in my technological lectures to convey to my pupils an idea of knitting, I made a drawing on the subject, and caused a pin-maker to weave for me a small screen of brass wire. This work is easy, because it is executed in a frame of strong but pliable wire. I suspect therefore that some one first tried to make an imitation of such a wire-net with yarn, and in one expanded piece, for which only two or three small sticks would be necessary. Instead of having a frame, the inventor, it is probable, fastened to his clothes the stick on which the meshes were made, or on which he knitted; but afterwards employed a sheath to perform that service. Thus, most of the Wirtemberg stocking-knitters, at present, knit with two wires and a sheath. Hence their stockings, like those wove in the stocking-loom, are sewed or have a seam behind.

Among the master-pieces of the Wirtemberg stocking-knitters, a carpet of beautiful flower-work and figures is mentioned in their regulations. It is milled, and when spread out measures three ells in length and one and a half in breadth. It is probable that some person, by repeated trials, found out the method of knitting in a circular form; but for this purpose several wires would be necessary. In order to render this improved art of knitting similar to the old method, the meshes were so arranged that the stockings seemed to have a seam, for which however there was no occasion. The sheath, which was fastened to the left side, was long retained by our knitters; but as it retarded the work, and as it was necessary to keep the body in an uneasy

posture, injurious to the growth of young and industrious persons, means were devised to dispense with it and to knit with much less restraint. In this manner the art was brought to its present perfection; and it must excite no small astonishment when it is considered that it was invented all at once, and by one person.

The invention of the stocking-loom is worthy of more admiration, when one reflects that it was not a matter of accident, like most of the great discoveries, but the result of talents and genius. It is a machine exceedingly complex, consisting of two thousand parts, which, in a moment almost, can make two hundred meshes of loops, without requiring much skill or labour in the workman. There are few descriptions of this machine; and those published do not fully answer the purpose[909]. But my object is merely the question, Who was the inventor, in what country, and at what time did he live? and I can say, that after the most diligent research, it does not appear subject to any doubt, as some have hitherto believed.

Under the administration of Cromwell, the stocking-knitters of London presented a petition, in which they requested permission to establish a guild. In this petition they gave to the Protector an account of the rise, progress, and importance of their art or trade; and there can be no doubt that this well-written document contains the oldest authentic information in regard to this invention, which was then scarcely fifty years old. Every thing must then have been fresh in the memory of those by whom it was drawn up; every circumstance could easily be examined; and the petitioners must have been sensible that their misrepresentations, for which however they had no reason, could easily be contradicted. However unimportant my research may appear, it gave me much pleasure to find a copy of this petition in Deering's Account of Nottingham, already mentioned, in which the author has collected many authentic circumstances from the records of that town, where the loom was first employed and enriched many families, and whence the use of it was spread all over England and Europe[910].

From these it appears that the real inventor was William Lee, whose name in the petition is written Lea, a native of Woodborough, in Nottinghamshire, a village about seven miles distant from the town of Nottingham. He was heir to a considerable freehold estate, and a graduate of St. John's College, Cambridge. It is reported, that being enamoured of a

young country-girl, who during his visits paid more attention to her work, which was knitting, than to her lover and his proposals, he endeavoured to find out a machine which might facilitate and forward the operation of knitting, and by these means afford more leisure to the object of his affection to converse with him. Love indeed is fertile in inventions, and gave rise, it is said, to the art of painting; but a machine so complex in its parts and so wonderful in its effects, would seem to require longer and quieter reflection, more judgement, and more time and patience, than can be expected in a lover. But even if the cause should appear problematical, there can be no doubt in regard to the inventor, whom most of the English writers positively assert to have been William Lee.

Aaron Hill seems to make the stocking-loom younger, and relates the circumstance in the following manner. A student of Oxford was so imprudent as to marry at an early period, without money and without income. His young wife, however, was able to procure the necessaries of life by knitting; but as the natural consequences of love, an increase of family, was likely to render this soon insufficient, the husband invented a machine by which knitting could be performed in a speedier and more profitable manner. Having thus completed a stocking-loom, he became by its means a man of considerable wealth[911]. But Hill, in his account, gives neither names, date, nor proofs; and as he seems to have formed it from an imperfect remembrance of what he had heard or read in regard to Lee, it is not worthy of further examination.

Deering says expressly, that Lee made the first loom in the year 1589; and this account has been adopted by Anderson and most of the English writers. In the stocking-weavers' hall, at London, is an old painting, in which Lee is represented pointing out his loom to a female knitter, who is standing near him; and below it is seen an inscription with the date 1589, which was the year of the invention[912]. Other accounts make it somewhat later. Thus Howell, after relating that Queen Elizabeth obtained the first stockings in 1561, says that thirty-nine years after the loom was invented by Lee, in which case the period would be 1600[913]. In the petition of the stocking-knitters it is stated, that the loom, at that time, had been found out about fifty years. It is to be regretted that this document has no date; but as Cromwell reigned from 1653 to 1658, the invention would fall in the

beginning of the seventeenth century. It is more probable, however, that it belongs to the end of the sixteenth.

Lee instructed his brother James in the use of the loom, and took apprentices and assistants, with whom he carried on business for some years at Calverton, a village five miles distant from Nottingham. On this account, Calverton has by some been considered as his birth-place. He showed his work to Queen Elizabeth, who died in 1603, and requested from that princess some support or remuneration; but he obtained neither, and was impeded rather than assisted in his undertaking. Under these circumstances, Lee accepted an invitation from Henry IV. king of France, who had heard of this invention, and promised to give a handsome reward to the author of it. He therefore carried nine journeymen and several looms to Rouen in Normandy, where he worked with great approbation; but the king being assassinated, and internal commotions having taken place, Lee fell into great distress, and died soon after at Paris. Two only of his people remained in France, one of whom was still alive when the before-mentioned petition was presented to Cromwell. Seven of them returned to England; and these, with a person named Aston, who at first was a miller at Thoroton, the place of his birth[914], but afterwards an apprentice of Lee, by whom he had been left behind in England, where he made some improvements in the loom, laid the foundation of the stocking-manufactory in that country. The number of masters increased there in the course of fifty years so much, that it was found necessary to unite them into one guild; for which Cromwell, however, in consequence of reasons not known, refused the proper sanction; but in 1663 they received letters patent, which gave them certain privileges to the extent of ten miles round London.

In the year 1614, the Venetian ambassador, Antonio Correr, persuaded an apprentice, Henry Mead, by the promise of five hundred pounds sterling, to go with a loom to Venice for a stated time, and to teach there the use of it. Mead met with a favourable reception in that city, and was much admired; but the loom becoming deranged, and no person at Venice being able to repair it, when the time of his agreement was expired, he returned to England. The Venetians had not resolution enough to continue the attempt; and sent the damaged loom, together with some bad imitations of it, to London, where they were sold for a mere trifle. Such is the account given in the petition before-mentioned.

Zano, however, an Italian writer[915], asserts, on the authority of information preserved in manuscript among family documents, that Correr carried two stocking-weavers with looms to Venice; that he immediately placed under them four apprentices, and when they went back to England sent with them a boy, who returned to Venice well-instructed in the art, and who continued to carry on business there with great success. Giambattista Carli of Gemona, a smith who worked in steel, saw the loom at Venice, which had been made after the model of those brought from England and sold to Francesco Alpruni of Udina. In a short time a great many stockings were manufactured there, and sent for sale, chiefly to Gradisca in Austria. But, in consequence of the poverty of the Venetian stocking-knitters, an order was issued that Carli should make no more looms; and this productive branch of business at Udina was so much deranged, that the masters removed with their looms to Gradisca, where the inhabitants of Udina were obliged to purchase such stockings as they had occasion to use.

Some years after the stocking-loom had been introduced at Venice, Abraham Jones, who understood stocking-weaving and the construction of the loom, though never regularly taught, went with some assistants to Amsterdam, where he worked on his own account two or three years, till he and his people were carried off by a contagious disease. The looms, because no one could use them, were sent to London and sold for a low price. In the petition to Cromwell the masters state, with great satisfaction, that in this manner the trade had remained in England; and, that it may be exclusively retained in their native country, they wish for the establishment of a privileged company.

It appears to me therefore proved beyond all doubt, that the stocking-loom was invented by William Lee, an Englishman, about the end of the sixteenth century; and this is admitted by some French writers, such as Voltaire[916] and the editor of the first Encyclopédie, whom the author of the Encyclopédie Méthodique however finds fault with. Other French writers, who are the more numerous party, wish to ascribe the honour of this invention to one of their own countrymen; but the proofs they bring are so weak that they scarcely deserve notice. Savary perhaps is the first person who publicly ventured to support this instance of Gallic vanity; at any rate

he is quoted by the more modern writers as their authority when they wish to contradict the English.

According to his account, a Frenchman, of whom however he knows nothing further, invented the stocking-loom; but not being able to obtain the exclusive privilege of using it in his own country, went with it to England. The utility of it being soon discovered there, it was forbidden, under pain of death, to carry a loom or a model of it out of the kingdom. But another Frenchman, respecting whom he is equally ignorant, having seen the loom, the form of it made so deep an impression on his memory, that on his return he copied it exactly; and from this loom all the others used in France and Holland were constructed. Savary adds, did the invention belong to the English, who are accustomed to pay due honour to those who discover useful things, they undoubtedly could tell the name of the inventor, which however they are not able to do. It is very strange that this should be written by a Frenchman, who himself did not know the name of the French inventor, or of the person who carried back the invention. No order to prevent the exportation of the stocking-loom was issued in England so early, else it would certainly have been mentioned in the petition presented to Cromwell. It was not till the eighth year of the reign of William III., that is 1696, when looms were everywhere common, that the exportation of them was forbidden; probably because the best were made in England, and it was wished that the gradual improvement of them should be kept secret. The penalty also was not death, but a fine and confiscation of the looms.

Some have endeavoured to give an air of probability to this assertion of Savary, by the relation of an apothecary in the Hotel-Dieu at Paris. This person is said to have declared that the inventor was a journeyman locksmith of Lower Normandy, who gave a pair of silk stockings, his own workmanship, to Colbert, in order that they might be presented to Louis XIV.; but as the *marchands bonetiers*, who dealt in articles knit according to the old manner, caused several loops of these stockings to be cut by some of the servants at court, whom they had bribed for that purpose, they did not meet with approbation. The inventor was so hurt by this disappointment, that he sold the loom to an Englishman, and died an old man in the Hotel-Dieu, where the apothecary became acquainted with him. It was necessary to expose the lives of many workmen, and even of some men of learning, in order to bring back a loom to France. Romè de la Platière adds, that he

heard at Nimes, that in the time of Colbert a person of that place, named Cavellier, carried the first loom to France; and that, in the course of fifty years, the number of the looms in that town and neighbourhood increased to some thousands. It appears much more certain that the stocking manufactory, as Savary asserts, was established at the castle of Madrid in the Bois Boulogne near Paris, in the year 1656, under the direction of John Hindret.

I do not know at what time the first loom was brought to Germany; but it is certain that this branch of manufacture was spread chiefly by the French refugees who sought shelter in that country after the revocation of the edict of Nantes. Winkelmann says expressly, that they carried the first looms to Hesse. This is not at all improbable, because our stocking manufacturers give French names to every part of their looms, as well as to their different kinds of work. Becher boasts of having introduced the loom at Vienna, and of having first constructed looms of wood. At present many wooden ones are made at Obernhau in the Erzgebürge, and sold at the rate of twenty-eight dollars; whereas iron ones, of the most inferior kind, are sold in Vogtland for sixty or seventy.

[In 1663 a charter was granted by Charles II. to the Frame-work Knitters' Society of London (stocking-makers), which had been refused to them a few years before by Oliver Cromwell. Six years afterwards the number of stocking-frames in England amounted to 700, employing 1200 workmen, three-fifths of whom made silk stockings, and the others worsted; for cotton was not then ranked among English manufactures. By 1714 the number of frames had increased to 8000 or 9000. Some years after this, the Frame-work Knitters' Company attempted to control both the manufacture itself, and the making and selling of the stockings; but the project failed. By the year 1753 the number of frames in England was 14,000. In 1758 a machine for making ribbed stockings was patented by Mr. Strutt of Belper.

In 1838 stocking-frames with a rotatory action, and worked by steam, were successfully brought into use in Nottingham. Of the present extent and value of the hosiery manufacture, perhaps the best estimate is that made a few years ago by Mr. Felkin of Nottingham. This gentleman calculates the value of cotton hosiery annually made at £880,000, that of worsted at £870,000, and that of silk at £241,000. He estimates the number of stockings annually manufactured at 3,510,000 dozens; and in the production

of these there are used 4,584,000 lbs. of raw cotton, value £153,000; 140,000 lbs. of raw silk, value £91,000; and 6,318,000 lbs. of English wool, value £316,000; making the total value of the materials £560,000, which are ultimately converted into the exchangeable value of £1,991,000. The total number of persons employed is 73,000.]

FOOTNOTES

885 [It is scarcely necessary to inform the reader that the *warp* consists of the *longitudinal* threads of a woven fabric, which are crossed by the *transverse* threads or woof.]

886 Ovidii Metamorph. vi. 5–145. Plin. Hist. Nat. vii. 56.

887 An Englishman, named J. W. Boswel, invented a machine on which sixty-eight meshes, with perfect knots, could be knit at the same time: it could be adapted also to fine works, and to lace. A description of it may be seen in the Transactions of the Society for the Encouragement of the Arts, vol. xiv.

888 Many commentators on the Greek and Roman writers have fallen into mistakes respecting these noose-ropes, because they were not acquainted with the nature of them. Their use among the Parthians is confirmed by Suidas, under the word σειραὶ, p. 303; where he says that on that account they were called σειροφόροι. Josephus asserts that they were employed by the Alani, and relates that Tiridates would have been caught in this manner, had he not quickly cut to pieces the rope. Under the same head may be comprehended the *retiarii* and *laquearii*, in the bloody spectacles of the Romans, whose method of fighting is said to have been found out by Pittacus. See Diogen. Laert. i. 74. To this subject belong the snares of the devil, pestilence, and death, in the Scriptures, and particularly in Psalm xviii. ver. 5. The *laquei mortis* of Horace, Carm. iii. 24, 8, were hence to be explained, and not by a Hebraism, as some of the old commentators have

imagined. In the ordeals of the ancient Germans, when a man was obliged to combat with a woman, the latter had a rope with a noose, which she threw over her antagonist, who stood in a pit, in order that she might more easily overcome him. That such ropes are still employed among various nations is proved by Vancouver. In Hungary the wild horses at present are said to be caught by ropes of this kind.

889 Wafer's Voyage. Anderson's Iceland. The author says that the beards are cut into slips; but these slips were fish-bone, which could be made into baskets but not into nets. He certainly meant the hair on the beard, which in Holland is used for wigs.

890 De Vest. Sac. Hebr. p. 100.

891 Hist. Nat. lib. xxxvii. cap. 3.

892 Rete, id est ornamentum sericum ad instar retis contextum.—Acta S. Deodati, tom. iii. Junii, p. 871.

893 In the Limpurg Chronicle, which may be found in Von Hontheim, Hist. Trevirensis, vol. ii. p. 1084, is the following passage: "The ladies wore new *weite hauptfinstern*, so that the men almost saw their breasts;" and Moser, who quotes this passage in his Phantasien, conjectures that the *hauptfinstern* might approach near to lace. I never met with the word anywhere else; but Frisch, in his Dictionary, says, "*Vinster* in a Vocabularium of the year 1492 is explained by the words *drat*, *schudrat*, thread, coarse thread." May it not be the word *fenster*, a window? And in that case may it not allude to the wide meshes? *Fenestratum* meant formerly, perforated or reticulated; and this signification seems applicable to those shoes mentioned by Du Cange under the name of *calcei fenestrati*. At any rate it is certain that the article denoted by *hauptfinstern* belonged to those dresses mentioned by Seneca in his treatise De Beneficiis, 59. Pliny says that such dresses were worn, "ut in publico matrona transluceat."

894 Dict. de Commerce. Copenh. 1759, fol. i. pp. 388, 576.

895 Gentleman's Magazine, vol. liii. 1783, p. 38. In the Heiligen Lexicon St. Fiacre is improperly called the son of an Irishman of distinction.

896 Howell, in speaking of the trade in the oldest times, says, p. 222, "Silk is now grown nigh as common as wool, and become the cloathing of those in the kitchin as well as the court; we wear it not onely on our backs, but of late years on our legs and feet, and tread on that which formerly was of the same value with gold itself. Yet that magnificent and expensive prince, Henry VIII., wore ordinarly cloth-hose, except there came from Spain, by great chance, a pair of silk stockins. K. Edward, his son, was presented with a pair of long Spanish silk stockins by Thomas Gresham, his merchant, and the present was taken much notice of. Queen Elizabeth in the third year of her reign was presented by Mrs. Montague, her silk-woman, with a pair of black knit silk stockins, and thenceforth she never wore cloth any more."

897 The lines which allude to this subject are in the tragedy of Ella:—

> "She sayde, as herr whytte hondes whyte hosen were knyttinge,
> Whatte pleasure ytt ys to be married!"

898 In his Description of Scotland, according to the old translation, in Hollingshed, "Their hosen were shapen also of linnen or woolen, which never came higher than their knees; their breeches were for the most part of hempe."

899 "The king and some of the gentlemen had the upper parts of their hosen, which was of blue and crimson, powdered with castels and sheafes of arrows of fine ducket gold, and the nether parts of scarlet, powdered with timbrels of fine," &c.... There is reason however to suppose that the upper and nether parts of the hose were separate pieces, as they were of different colours. This description stands in the third volume of Hollingshed's Chronicles, p. 807, where it is said, speaking of another festival, "The garments of six of them were of strange fashion, with also strange

cuts, everie cut *knit* with points of fine gold, and tassels of the same, their hosen cut in and tied likewise." What the word *knit* here signifies might perhaps be discovered if we had an English Journal of Luxury and Fashions for the sixteenth century.

900 Gentleman's Magazine, 1782, vol. lii. p. 229. From an authentic and curious household book kept during the life of Sir Tho. L'Estrange, Knt. of Hunstanton in Norfolk, by his lady Ann, daughter of the lord Vaux, are the following entries:—

1533. 25 H. 8. 7 Sept.	Peyd for 4 peyr of knytt hose	VIII s.
1538. 30 H. 8. 3 Oct.	..... two peyr of knytt hose	I s.

It is to be observed, that the first-mentioned were for Sir Thomas and the latter for his children.

901 The act made on this occasion is not to be found in any of the old or new editions of the Statutes at Large. It is omitted in that published at London, 1735, fol. ii. p. 63, because it was afterwards annulled. Smith, in Memoirs of Wool, Lond. 1747, 8vo, i. p. 89, says it was never printed; but it is to be found in a collection of the acts of king Edward VI., printed by Richard Grafton, 1552, fol. The following passage from this collection, which is so scarce even in England that it is not named in Ames's Typographical Antiquities, is given in the Gentleman's Magazine, vol. liii. part 1, p. 127:—"In this acte limitinge the tymes for buieing and sellyng of wolles, mention is made of chamblettes, wolstende, saies, stamine, *knitte hose*, *knitte peticotes*, *knitte gloves*, *knitte slieves*, hattes, coives, cappes, arrasse, tapissery, coverlettes, girdles, or any other thing used to be made of woolle."

902 This account is to be found in Hollingshed's Chronicles. "Dr. Sands at his going to bed in Hurleston's house, had a paire of hose newlie made, that were too long for him. For while he was in the Tower, a tailor was admitted to make him a pair of hose. One came in to him whose name was Beniamin, dwelling in Birchin-lane; he might not speak to him or come to him to take measure of him, but

onelie to look upon his leg; he made the hose, and they were two inches too long. These hose he praied the good wife of the house to send to some tailor to cut two inches shorter. The wife required the boy of the house to carrie them to the next tailor, which was Beniamin that made them. The boy required him to cut the hose. He said I am not the maister's tailor. Saith the boy, because ye are our next neighbour, and my maister's tailor dwelleth far off, j come to you. Beniamin took the hose and looked upon them, he took his handle work in hand, and said, these are not thy maister's hose, but Dr. Sands, them j made in the Tower."

903 "Item, his best coat, jerkin, doublet and breeches. Item, his hose or nether stockings, shoes and garters."—Survey of the Cathedral of St. Asaph, by Browne Willis, 1720, 8vo.

904 Hollingshed's Chronicle, 1577, p. 213.

905 In his satyre called The Steel of Glass:—"In silk knitt hose, and Spanish leather shoes."

906 In Hollingshed, third part, p. 1290:—"Upon the stage there stood at the one end eight small women children, spinning worsted yarne, and at the other as manie knitting of worsted yarn hose."

907 Buch des Alten Pommerlandes, 1639, 4to, p. 388:—"Duke Bogislaus VIII. suffered himself at length to be overcome by love, and married Sophia, daughter of Procopius margrave of Moravia, who was a very prudent and moderate lady. In her old age, when her sight became bad, so that she was incapable of sewing or embroidering, she never put the knitting-needle out of her hands, as is written in our chronicles. The rhymes which she always had in her mouth are remarkable:—

Nicht beten, gern spatzieren gehn,
Oft im Fenster und vorm Spiegel stehn,
Viel geredet, und wenig gethan,
Mein Kind, da ist nichts Fettes an.

‘Never to pray; to be fond of walking; to stand often at the window and before the looking-glass; to talk much and do little; is not, my child, the way to be rich.’”

908 Mezeray, where he speaks of the silk manufactories under Henry IV.

909 The first description of the stocking-loom illustrated by figures, with which I am acquainted, is in Deering’s Nottingham, 1751, 4to, but it is very imperfect. A much better is to be found in the second volume of the Encyclopédie, printed at Paris, 1751, fol. p. 94–113. The figures are in the first volume of the second part of the Planches, and make eleven plates, eight of which are full sheets. [The reader will also find a very good description of the stocking-loom illustrated with woodcuts in Ure’s Dictionary, art. HOSIERY.]

910 The following passage occurs in the petition, p. 302: “Which trade is properly stiled framework-knitting, because it is direct and absolute knit-work in the stitches thereof, nothing different therein from the common way of knitting (not much more antiently for publick use practised in this nation than this), but only in the numbers of needles, at an instant working in this, more than in the other by an hundred for one, set in an engine or frame composed of above 2000 pieces of smith, joiners, and turners work, after so artificial and exact a manner, that, by the judgement of all beholders, it far excels in the ingenuity, curiosity, and subtility of the invention and contexture, all other frames or instruments of manufacture in use in any known part of the world.”

911 This account is given by Aaron Hill in his Rise and Progress of the Beech-oil Invention, 1715, 8vo.

912 The inscription may be found in Seymour’s Survey of London, 1733, fol. vol. i. p. 603: “In the year 1589 the ingenious William Lee, Master of Arts of St. John’s College, Cambridge, devised this profitable art for stockings (but being despised went to France) yet

of iron to himself, but to us and others of gold; in memory of whom this is here painted."

913 In his History of the World, already quoted, p. 171: "Nine and thirty years after was invented the weaving of silk stockings, westcoats, and divers other things, by engines, or steel looms, by William Lee, Master of Arts of St. John's College in Cambridge, a native of Nottingham, who taught the art in England and France, as his servants in Spain, Venice, and Ireland; and his device so well took, that now in London his artificers are become a company, having an hall and a master, like as other societies."

914 Of this Aston the following account is to be found in Thoroton's Nottinghamshire, 1677, fol. p. 297: "At Calverton was born William Lee, Master of Arts in Cambridge, and heir to a pretty freehold here; who seeing a woman knit, invented a loom to knit, in which he or his brother James performed and exercised before Queen Elizabeth, and leaving it to ... Aston his apprentice, went beyond the seas, and was thereby esteemed the author of that ingenious engine, wherewith they now weave silk and other stockings. This ... Aston added something to his master's invention; he was some time a miller at Thoroton, nigh which place he was born."

915 Dell' Agricoltura, dell' Arti, e del Commercio. Ven. 1763, 8vo.

916 Le Siècle de Louis XIV.

HOPS.

My object, in this article, is not to give a history of beer, because for that purpose it would be necessary to define accurately the different kinds of grain mentioned in the writings of the Greeks and the Romans; and this would be a tedious, as well as difficult, and to me a very unpleasant labour; as I should be obliged to controvert a great many received opinions. I shall only endeavour to answer the question, Where and at what time did hops begin to be used as an addition to beer? This subject has already engaged the attention of two learned men[917], whose researches I shall employ and enlarge by my own observations.

Hops at present are so well known, that a formal description of them would be superfluous. I think it necessary, however, for the sake of perspicuity, to state what follows. This plant at present grows wild in the greater part of Europe, and in Germany is common in the hedges and fences. It clings to the trunks of trees, and often climbs round poles, if long enough, to the height of twenty or thirty feet. It is almost everywhere rough and sharp to the touch, and sometimes clammy. The leaves are generally divided into three, and often into five indented lobes; but the upper ones are shaped like a heart and undivided. The male plants bear flowers, like those of the currant-bush or of the male hemp; the female plants produce their flowers in cones, which are not unlike those of the fir, except that the latter are woody, while the former are foliaceous. These cones only are used for beer; on that account the female plants alone are cultivated, and from these they are picked and dried as soon as they begin to become pulverulent. They are transplanted or propagated by means of seedlings, in hop-grounds properly prepared, where the cones become larger and better than those of the wild plants, which however are not entirely useless. They are added to beer to render it more palatable, by giving it an agreeable bitter taste; and, at the same time, to make it keep longer; and it must indeed be confessed, that of the numerous and various additions which since the earliest periods

have been tried, none has better answered the purpose, or been more generally employed.

Among the botanists of the last two centuries, who perused the writings of the Greeks and the Romans, and endeavoured to discover those plants which they meant to describe, many imagined that they found in them hops. But when one takes the trouble to examine without prejudice their opinions, nothing appears but a very slight probability; and some even of these learned botanists, such as Matthioli and others, have acknowledged that it cannot be proved that the Greeks and the Romans were acquainted with our hops.

The plant which perhaps has been chiefly considered as the hop is the *Smilax aspera*[918] of Dioscorides[919], the same no doubt as that described by Theophrastus under the name of *smilax*, without any epithet[920]. That the description agrees for the most part with our hops cannot be denied; but it is equally true that it might be applied, with no less propriety, to many other creeping plants, and certainly with the greatest probability to that which in the Linnæan system has retained the name *Smilax aspera*. What the Grecian writer says of the fruit is particularly applicable to this plant; but, on the other hand, it differs from the fruit of the hop.

One might with more probability conjecture that hops occur in Pliny[921], under the name *Lupus salictarius*. But the whole of what he says of this plant is, that it was esculent, and grew in the willow plantations. This is undoubtedly true of hops, for that the young shoots are eaten in spring as salad is well known; but the name *lupus* alone has induced the commentator to apply all this, though equally applicable to other plants, to our hop, which at present is called *lupulus*. Much more unfounded is the conjecture, that the hop is that wild plant which, according to the account of Cato, was used as fodder for cattle[922]. But the word in manuscripts is differently written, and consequently uncertain; besides, there are many plants which might be employed in the place of straw.

It is certainly possible that hops might have been in use among the northern nations, at the time of these writers, without their having any knowledge of them; for the Romans were acquainted with beer only from

the accounts given of the Germans and their manners[923], and they considered that beverage merely as an unsuccessful imitation of their wine. But I agree in opinion with Conring, Meibomius, and others, that hops were not used till a much later period. The names *humulus* and *lupulus* also are of no great antiquity. The former is the oldest, and seems to belong to the people who first added this improvement to beer. The *humble* and *humle* of the Swedes and Danes, the *chumel* of the Bohemians, the *houblon* of the French and the Spanish, Hungarian and Persian appellations, all seem to be derived from the same origin, as well as the Latin names of later times, *humelo*, *humolo*, *humulo*, *humlo*[924]. *Lupulus* does not occur till a much later period. The German word, which the English also have adopted, appears first to have been written *hoppe*, from which was formed afterwards in High German *Hopfen*, by converting, as it commonly does, the double *p* into the harder *pf*. Thus from *toppe* it has made *topf*, and from *koppe*, *kopf*, &c. As far as I know, this word is found, for the first time, in a dictionary which seems to be of the tenth century[925], and which has *Timalus*, *Hoppe* and *Brandigabo Feldhoppe*. According to my conjecture, *timalus* has been erroneously printed for *humulus*; but in regard to *brandigabo* I can give no explanation. It is derived perhaps from *brace* or *bracium*. The former was known to Pliny[926]; and the latter occurs in the same dictionary along with the translation, malt.

No mention is made of hops either in Walafrid Strabo, who died in 849, or in Æmilius Macer, who cannot have lived earlier than the year 850; in the laws of the old Franks, in which beer and malt are often mentioned, or in the Capitulare de Villis Imperatoris, which are ascribed to Charles the Great. Had beer been then used and brewed in Germany, it would certainly have been at any rate mentioned by the emperor. Haller says[927] it is related by Isidorus that the experiment of adding hops to beer was first made in Italy. Were this the case, it would be the oldest mention of that circumstance, for Isidorus died in the year 636. It is however not only highly improbable that the use of hops should be discovered in Italy, which is a wine country, but it can be proved to be false. Not the smallest notice of it is to be found in the whole work of Isidorus; and in the Bibliotheca Botanica, when Haller had the book before him and extracted from it many

things remarkable, he does not repeat this assertion[928]. The passage which has given rise perhaps to this error, appears to be that where the author describes a kind of beer called by him *celia*, and where the germination of corn, the shooting of malt, and the sweet wort made from it, together with its fermentation, are clearly mentioned, but not hops[929]. Some one perhaps thought that hops also ought to be supposed in this passage, else beer would not acquire that strong taste and intoxicating quality spoken of by Isidorus, who very properly ascribes both to fermentation. The same account has been repeated by Vincentius[930], without any change or addition. But as Isidorus scarcely contains anything which is not borrowed from earlier writers, I endeavoured to discover the source of that information, and at length found it in the history of Orosius[931], who, as is well known, lived in the fifth century.

In the Latin translation of the works of the Arabian physician Mesue[932] is a description, but as is commonly the case, a defective one, of a creeping plant, with rough indented leaves under the name of *lupulus*, which indeed corresponds exceedingly well with our hops. The cones in particular are exactly described. The author, however, speaks there only of the medicinal qualities of the plant, and makes no mention of its application to beer. Mesue lived about the year 845, consequently is the first who uses the term *lupuli*. But we have only a wretched old translation of the writings of this physician; it is probable that the word *lupulus* comes only from the translator. This passage therefore can prove nothing.

It is however certain that hops were known in the time of the Carolingian dynasty, for a letter of donation by King Pepin speaks of *humolariæ*, which without doubt must have been hop-gardens[933]. In like manner Adelard, abbot of Corbey, in the year 822, freed the millers belonging to his district from all labour relating to hops, and on this occasion employed the words *humlo* and *brace*, by which is to be understood corn and malt used for beer. In the Frisingen collection of ancient documents, there are many which were written in the time of Ludovicus Germanicus, consequently in the middle of the ninth century; and in some of these, hop-gardens, which were then called *humularia*, are

mentioned[934]. In the tax registers of the two following centuries, among the articles delivered to churches and monasteries, *modii* and *moldera humuli* are very often named[935]. Hop-fields and the delivery of hops occur much oftener in the thirteenth century, under the appellations *humuleta*, *humileta*, and *humularia*[936]. In the Sachsenspiegel[937] and the municipal law of Magdeburg (Weichbildsrechte[938]), there is an order in regard to the hop-plants which grew over hedges. I shall omit the still more numerous instances where they occur in the fourteenth century as well as the proofs that hops were then cultivated in many parts of Germany; and it is perhaps true, as said by Möhsen, and after him by Fischer, on whose bare word however I do not entirely rely, that many towns in Germany were indebted for the great sale of their beer to the use of hops (which undoubtedly appears to be a German discovery), and to their peculiar goodness. However, it is certain that this method of seasoning beer was adopted at a much later period by our neighbours the English, Dutch, Swedes, and others.

If the two passages above quoted, where the word *lupuli* occurs, be rejected because they are doubtful, I must consider this name of hops to be more modern than the word *humulus*; and if this be true, it is impossible to believe, with Du Cange, that the latter was formed from the first by throwing away the initial letter. As yet I had not found the name *lupulus* given to hops earlier than the thirteenth century.

About this time lived Simon of Genoa, commonly called *Johannes de Janua* or *Januensis*, who also had the surname of *Cordus*. He was physician to Pope Nicholas IV.; afterwards chaplain and sub-deacon to Pope Boniface VIII.; and therefore flourished at the end of the thirteenth century. Of his writings none is better known, or was formerly more esteemed, than his Catholicon, a book in which he describes, in alphabetical order, all the substances then used in medicine, and on which, as he says himself, he was employed thirty years. In this dictionary, which is commonly considered as the first of the Materia medica, there is an article under the head *lupulus*, copied however from the before-mentioned Latin translation of Mesue, but with the addition, that this plant by the French and Germans is named *humilis*, and that the flowers of it were used in a beverage which he calls

medo[939]. This Italian, however, does not seem to have been properly acquainted with the subject; for he tells us himself[940], that under the name *medo* or mead, is understood a beverage made of diluted honey, for which hops are never employed. In Italy also, at that time, hops were not in use. About the same period, Arnold de Villanova, in his commentary on the work on Regimen, published by John of Milan, in the name of the celebrated school of Salerno, mentions *lupuli*, and the use of them in brewing beer[941].

Professor Tychsen, to whose friendship I have been frequently indebted for assistance in my researches, suggested to me the conjecture that *lupulus* perhaps is derived from *lupinus*, because Columella says that the bitter seeds of this plant were added, in Egypt, to beer in order to moderate its sweetness[942]. This use is confirmed also by G. W. Lorsbach, from the Arabic historian Ebn Chalican[943]. At any rate, this proves that in Egypt at that time bitter things began to be added to beer. It is also well known that in Italy lupines were rendered fit for the use of man as well as of animals, by macerating them in water[944]; and I am of opinion, that on this account Varro required water to be in the neighbourhood of a farm-yard[945]. Lupines softened in water are still employed for making dough. But if *lupulus* was formed from *lupinus*, it must however be proved that the use of it for beer was common beyond the boundaries of Egypt. Even if we admit with Schöttgen, that the poet employs *zythum* for beer in general, this beverage was never used in Italy, and I have met with no other mention of lupines in brewing.

In the breweries of the Netherlands, hops seem to have been first known in the beginning of the fourteenth century; for about this time we find many complaints that the new method of brewing with hops lessened the consumption of *gruit*, and also the income arising from *gruitgeld*. The word *gruit* seems to have many meanings: in the first place it signifies malt; but though I formerly considered this as the proper meaning, and though some approved my opinion, I must confess that on further examination I am not able fully to prove it. In the second place, it signified a certain tax paid at each time of brewing: thirdly, a certain addition of herbs used for beer in

the fourteenth century: and in the last place, the beer brewed with it was itself sometimes called *gruit*.

That this word always denoted malt is impossible; for it is said that after hops were introduced, less *gruit* was used and sold than formerly had been the case. But how could hops be employed instead of malt? John, bishop of Liege and Utrecht, complained to the emperor Charles IV., that for thirty or forty years a new method of brewing, that is to say, with the addition of a certain plant called *humulus* or *hoppa*, had been introduced, and that his income arising from *gruitgeld* had been thereby much lessened. The emperor, therefore, in the year 1364, permitted him, for the purpose of making good his loss, to demand a *groschen* for each cask of hops; and this right was confirmed to bishop Arnold by pope Gregory[946]. By this and similar accounts I am induced to conjecture that a beverage composed of different herbs was at that time prepared, and that the sale of this mixture and of *gruit* was converted into a so-called *regale*. Nay, it almost appears that *gruit* was a fermenting substance, indispensably necessary to beer, instead of the yeast used at present.

According to every appearance the ancient beer could not be long kept; and beer fit to be preserved seems to have come into use after the introduction of hops. The oldest writers who treat of the good and bad effects of hops, reckon among the latter, that they dried up the body and increased melancholy; but among their good qualities, they praise their property of preserving liquors from corruption[947]. It was soon remarked also, that the keeping of beer depended a great deal on the season in which it was brewed; for M. Anton quotes from the Ilm statutes of 1350, that people were permitted to brew only from Michaelmas to St. Walpurgis' day[948]; at other times it was forbidden under certain penalties. At that period various kinds of beer seem to have been in use, and perhaps became fashionable instead of wine, coffee, and tea. Thus M. Anton quotes, from a Hervord document of the year 1144, *cervisia mellita* and *non mellita*. However, even at present, honey is used for many kinds of beer; such for example as that brewed at Nimeguen, which has an extensive sale under the name of *moll*, a word derived no doubt from *mollig*, mild; which is applied also to wine. In the same manner the English used liquorice.

In England, the use of hops seems to have been introduced at a much later period; but it is said that they were at first considered as a dangerous production, and that the planting of them was forbidden in the reign of Henry VI., about the middle of the fifteenth century[949]. This I will not venture to deny, though I very much doubt it. I have found no proof of it in any English writer, and I have searched in vain for the prohibition among the orders of that prince, in which however there occurs one in regard to malt[950]. On the contrary, many English historians assert that the use of hops was first made known in England by some people from Artois, in the reign of Henry VIII., or about the year 1524[951]. It is nevertheless true, that this sovereign, in an order respecting the servants of his household, in the twenty-second year of his reign, that is in 1530, forbade brewers to put into ale hops and sulphur[952]. But perhaps his majesty was not fond of hopped beer. Even at present, most of the dictionaries call ale, beer brewed without hops; and an English physician says expressly that the difference between ale and beer is, that hops are not employed for the former[953]. But according to the English instructions for brewing, hops are required for ale also.

In the English laws hops are mentioned for the first time in the fifth year of the reign of Edward VI., that is in 1552, at which period some privileges were granted to *hop-grounds*. The cultivation of hops however, which, like the art of brewing, has in England been carried to the greatest perfection, was very limited even in the beginning of the seventeenth century; for James I., in the fifth year of his reign, that is in 1603, found it necessary to forbid, under severe penalties, the introduction and use of spoilt and adulterated hops. At that time, therefore, England did not produce a quantity sufficient for its own consumption.

In Sweden, at least in the fifteenth century, hops seem not to have been very common[954]; for at that time sweet gale (*Myrica gale*) was employed for beer; and so generally, that king Christopher, in 1440, confirmed the old law, that those who collected this plant before a certain period, on any common or on another person’s land, should be subjected to a fine. A similar punishment however was appointed for the too early picking of hops; and the cultivation of them was so strongly enforced, that every

farmer who had not forty poles with hops growing round them was punished, unless he could show that his land was unfit for producing them[955].

But it was long doubted in Sweden whether this plant would thrive in the cold climate of that country; in which however it grows wild. In the time of Gustavus I., who became king in 1523, Sweden was obliged to give for the foreign hops it used 1200 *schifpfunds* of iron, which was about the ninth part of all the iron made in the kingdom. In the year 1558 the king complained, in an edict, that a pound of hops cost as much as a barrel of malt, and on that account was desirous to encourage the cultivation of the hop-plant. But his exertions were attended with so little effect, that even under the reign of queen Christina, that is, in the middle of the seventeenth century, all the hops used in the kingdom were imported from Germany, and particularly from Brunswick and Saxony. The queen had some hop plantations as rarities in her garden; yet the cultivation of hops was begun under this princess, and carried so far that German hop farmers, who before had been accustomed to travel to Sweden every three years, to receive payment and take new orders, returned very much dissatisfied, and suffered a part of their hop-grounds to run to waste. Under Charles XI., however, who reigned from 1660 to 1697, the cultivation of hops was first brought to a state of considerable improvement.

In the year 1766, Linnæus hazarded a conjecture that hops, spinage, chenopodium, tarragon, and many other garden vegetables were brought to Europe by the Goths, during their periods of emigration, from Russia and particularly the Ukraine, because the old writers make no mention of these plants, and because in those districts they all grow wild at present[956]. It however appears certain that hops belong to our indigenous plants, as they grow everywhere wild in Germany, Switzerland, England, and Sweden, and even in countries into which the cultivation of them has never yet been introduced, and where it cannot be supposed that they accidentally became wild by being conveyed from hop-fields and gardens. The want of information in works older than the emigrations of the northern tribes, is no proof that a plant did not then exist. At that time there was no Linnæus to transmit plants to posterity, as Hipparchus, according to the expression of Pliny, did the stars. Such vegetable productions only as had become

remarkable on account of their utility or hurtful qualities, or by some singular circumstance, occur in the works of the ancients. Many others remained unknown, or at least without names, till natural history acquired a systematic form; and even at present botanists have often the satisfaction to discover some plant not before observed.

Is it probable that the Chinese even are acquainted with our hops? They have a kind of beer made from barley and wheat, which is called *tarasun*; and according to the account of J. G. Gmelin, who purposely made himself acquainted with the preparation of it, hops formed by pressure into masses, shaped like a brick, are added to it[957]. It is well known that the Chinese have also a kind of tea formed into cakes by strong pressure. Our hops are compressed in the same manner in Bohemia; and in that state will keep without losing any of their strength for fifty years. They are put into a sack or bag of coarse canvass, and subjected to a press. A square sewed bag, each side of which is two ells, contains fifty bushels of hops prepared in this manner; and when any of them are required for brewing, the bag is made fast to a beam, and as much as may be necessary is cut out with an axe. The whole mass is of a brown colour, and has a resemblance to pitch, in which not a single hop-leaf can be distinguished. Whether the Chinese conceived the idea of employing our common hops for the like purpose, is a question of some importance in regard to the history of them; but at present I am not able to answer it.

[Hops are extensively cultivated in Kent, Sussex, and Herefordshire; and to a less extent in Worcestershire, Wiltshire, Hampshire, Gloucestershire, Surrey, and several other counties.

From 50,000 to 60,000 acres of land are covered in England with hop-gardens, about one-half being in Kent; an excise duty of 18*s.* 8*d.* per cwt. is levied upon their produce. British hops are exported to Hamburg, Antwerp, St. Petersburg, New York, Australia, and other places. A trifling quantity is also imported, principally from Flanders. The duty on hops of the growth of Great Britain produced in 1842, £260,979.]

FOOTNOTES

[917] One of these, in particular, is J. F. Tresenreuter, in A Dissertation on Hops, which was printed at Nuremberg, 1759, 4to, with a preface by J. Heumann.

[918] Σμίλαξ τραχεῖα.

[919] Dioscor., iv. 244.

[920] Hist. Plant. iii. 18.

[921] xxi. 15, sect. 50.

[922] Cato De Re Rustica, xxxvii. p. 55.

[923] Most of the passages in ancient authors which relate to beer have been collected by Dithmar in his edition of Tacitus De Moribus German. cap. xxiii.; and by Meibom De Cerevisiis Veterum in Gronovii Thes. Antiq. Græc., ix. p. 548.

[924] [The word *humulus* is derived from *humus*, fresh earth, the hop only growing in rich soils.—Loudon and Sir W. Hooker.]

[925] This valuable monument of antiquity is to be found in (Nyerup) Symbolæ ad Literaturam Teutonicam, sumtibus A. F. Suhm, Havniæ 1787, 4to, pp. 331, 404.

[926] Lib. xviii. cap. 7.

[927] Histor. Stirpium, ii. p. 290.

[928] Biblioth. Botan. i. p. 161.

[929] Originum lib. xx. 3, p. 487.

[930] Speculum Naturale, lib. xi. 109.

[931] Lib. v. cap. 7.

[932] Joh. Mesuæ Opera. Venetiis, 1589, fol.

[933] Du Cange Doublet Hist. Sandionys. i. 3, p. 669.

[934] In C. Meichelbeck's Histor. Frising. I. Instrument. p. 359.

[935] See the works quoted by Tresenreuter, p. 15: Pezii Thesaur. Anecdot. i. P. 3, pp. 68, 72.—J. C. Harenberg Histor. Gandersheim. p. 1350.—Eccard Origin. Saxon. p. 59.—Leukfeld Antiquit. Poeldens. p. 78.

[936] F. G. de Sommersberg Silesiac. Rer. Scriptor. i. pp. 801, 829, 857. —Von Ludwig Reliq. Histor. v. p. 425.—Tresenreuter, p. 20, quotes later information in the fourteenth century.

[937] L. ii. art. 52.

[938] Art. 126.

[939] For an account of the author and his works, which are now scarce, see Haller's Bibliotheca Botan. i. p. 222.

[940] Article Ydromel.

[941] This celebrated work, known as the Schola Salernitatis, was first printed in 1649, and has since been frequently republished and translated into various languages. A very complete edition, with an English version and a history of the book, was given by the late Sir Herbert Croft. The history of this book may also be found in Giannone's History of Naples.

[942] [Loudon observes in his Encycl. Plants, that *lupulus* is a contraction of *Lupus salictarius*, the name by which it was, according to Pliny, formerly called, because it grew among the willows, to which, by twining round and choking up, it proved as destructive as the wolf to the flock.]

943 Columella, x. 116. The root (radish?) was sliced and put into the Egyptian beer along with steeped lupines, in order to render it more palatable. Lorsbach über eine Stelle des Ebn Chalican. Marburg, 1789, 8vo, p. 21.

944 Plin. xviii. 14, sect. 36.—Geopon. ii. 39, p. 189, and the passages quoted there by Niclas: Galen. de Fac. Simpl. Med. vi. 144: and Alim. Fac. i. 30.

945 De Re Rustica, i. 13, 3.

946 This document is in Matthæi Analecta Vet. Ævi, iii. p. 260. See also Du Cange, under the word *Grutt*, and its derivatives.

947 St. Hildegard in Physicæ, lib. ii. cap. 74. Petro Crescentio d'Agricoltura, lib. vi. cap. 56. This writer lived in the thirteenth century.

948 A celebrated female saint of the eighth century, said to have been a native of England, but canonised in Germany, where she was abbess of a nunnery at Heidensheim in Thuringia.—TRANS.

949 This is asserted in the Götting. Gel. Anzeigen, 1778, p. 323.

950 Statutes at Large, vol. i. p. 591.

951 Husbandry and Trade Improved, by J. Houghton. Lond. 1727, 8vo. ii. p. 457.—Anderson's Hist. of Commerce. [The fermented liquor anciently in use in this country is usually termed ale, but we have in fact no certain account of its composition, and all that is now known respecting it is, that it was a pleasant but intoxicating liquor. Our Saxon ancestors were so far addicted to its use, that so far back as the time of king Edgar, it was found necessary to order marks to be made in their cups at a certain height, beyond which they were forbidden to fill, under a severe penalty. This probably gave rise to the *peg tankard*, of which there are a few still remaining. It held two quarts, and had on the inside a row of eight

pegs, one above the other, from top to bottom, so that the space between each contained half a pint. The law of compotation was, that every one who drank was to empty the exact space between peg and peg, and if he either exceeded or fell short of his measure, he was bound to drink down to the next. In archbishop Anselm's canons, made in the council of London, A.D. 1102, we find an order, by which priests were enjoined not to go to drinking bouts, nor to drink to pegs.]

952 Archæologia, vol. iii. p. 157. [Indeed, at a much later period, the common council of the city of London petitioned parliament against the use of hops, "in regard that they would spoyl the taste of drinks and endanger the people."—See Walter Blithe in his Improver Improved, published in 1649.]

953 Hamburgisches Magazin, xxxiii. p. 465.

954 Instead of this plant, which grows wild in Sweden, another wild plant in Germany called *post*, and by botanists *Ledum palustre*, was in old times used for beer by poor people in its stead; but it occasioned violent headaches.—See Linnæi Amœnitat. Acad. viii. p. 270. [This plant is still extensively used in the northern parts of Germany for imparting a bitter flavour to beer, although, owing to its deleterious nature, it is strictly forbidden by the laws. In this country *Cocculus indicus* is sometimes employed for a like purpose.]

955 This law is said to have been made as early as the reign of Magnus Smeek; but it was confirmed by king Christopher in 1440, and by the command of Charles IX. was printed at Stockholm, in folio, in 1608, in a work entitled Swerikes Rijkes Landz-lagh. The passage which belongs to this subject stands in Bygninga Balker, cap. 49 and 50, p. xl. a.

956 Linnæi Amœnitat. Academ. vii. p. 452.

957 Gmelin's Reise durch Sibirien. Gött. 1752, 8vo, iii. p. 55.

BLACK LEAD.

To ascertain how old the use of black lead is for writing might be of some importance in diplomatics, as the antiquity of manuscripts ruled or written with this substance, or of drawings made with it, could then be determined.

I allude here to pencils formed of that mineral called, in common, *plumbago* and *molybdæna*, though a distinction is now made between these names by mineralogists. The mineral used for black-lead pencils they call *reissbley*, *plumbago*, or *graphites*; but under the term *wasserbley* and *molybdæna* they understand a mineral once considered to be the same as the former, but which, however like it may be in appearance, differs from it in being heavier, occurring much seldomer, and containing a new metal, almost of a steel-grey colour, exceedingly brittle, and named *molybdænum*. Plumbago, which is the substance here meant, when exposed to an open fire, is almost entirely consumed, leaving nothing but a little iron and siliceous earth. It contains no lead; and the names *reissbley* and *bleystift* have no other foundation than the lead-coloured traces which it leaves upon paper. The darker, finer, and cleaner the lines it makes are, the fitter it is for drawing and writing. These lines are durable, and do not readily fade; but when one chooses, they may be readily rubbed out. Black lead, therefore, can be used with more convenience and speed than any coloured earth, charcoal, or even ink.

It is well known that transcribers, more than a thousand years ago, when they wished their writing to be in a particular manner beautiful and regular, drew fine parallel lines, which they followed in writing. These lines may be still clearly distinguished in old manuscripts. In many instances, they have only been impressed on the parchment by some hard, sharp body; but they often exhibit a leaden colour; from which one might suppose that they had been drawn with our plumbago, and consequently believe that the use of this substance is as old as we must consider, from certain marks, the

oldest ruled manuscripts. But, on a little reflection, one will be convinced that this would be a very fallacious conclusion. For lines so like those made with plumbago, that the eye can scarcely perceive the difference, may be made with lead[958].

It can be proved that the ancients drew their lines with lead; and this could be done with more convenience, as this soft metal was easily rubbed off by the parchment, which, being harder and rougher than our paper, had therefore more body. It is well known that, formerly, when people wished to draw lines, a small round plate of lead, which could not so readily cut the parchment or become bent as a leaden style, was employed[959].

Old manuscripts, ruled with lead-coloured lines, have been pointed out by modern diplomatists. Our learned Professor Schönemann, who was unfortunately hurried off by a premature death, has given a description of the Codex Berengaris Turonensis, of the eleventh or twelfth century, and the Codex Theophyli Presbyteri de Temperamento Colorum of the latter century, both preserved in the library of Wolfenbuttel; and remarks that lines are drawn on the first partly with a style and partly in a light manner with lead; but he says of the other, that it exhibits very fine lines drawn with a black-lead pencil[960]. Le Moine quotes a document of the year 1387, which is ruled with black lead, and at the same time says that the custom of ruling ceased about the year 1421 and 1424. The lines, therefore, after that period, became crooked and oblique[961].

But the antiquity of black-lead pencils cannot be determined by the help of diplomatic documents. It might be traced out with more ease were it known by what mineralogical writer *plumbago*, and the uses of it, were first mentioned. The following is what I have remarked on this subject; but I suspect that there must be some older mention of it than any I have yet been able to find. I do not, however, believe that those who require more than bare conjecture will discover this mineral in the works of the Greeks and the Romans; for it cannot possibly be proved that it is to be understood under the terms *plumbago*, *galena*, *molybdæna*, and *molybdoides*, as has been confidently asserted by many, who, were it not superfluous, might easily be refuted. But in whatever obscurity these names may be involved,

one can with certainty discover that they sometimes denote *galena*, or a real lead ore, or else some production of lead works.

The first author in whose writings I have as yet found certain mention of *plumbago* is Conrad Gesner, whose name I can never pronounce without respect. In his book on fossils, printed at Zurich in 1565, he says that people had pencils for writing which consisted of a wooden handle, with a piece of lead, or, as he believed, an artificial mixture, called by some *stimmi Anglicanum*. Such pencils must at that time have been scarce, because he has given a figure of them in a wood-cut. To judge by this, the pencil seems to have had a wooden sheath or covering.

Thirty years after, Cæsalpinus gave a more complete account of this mineral, which he calls *molybdoides*, because he thinks it was so named by Dioscorides. He says that it was a lead-coloured shining stone, as smooth as if rubbed over with oil; it gave to the fingers an ash-grey tint, with a plumbeous lustre, and pointed pencils were made of it for the use of painters and draftsmen. He adds, that it was called Flanders' stone, because it was brought from the Netherlands to Italy[962].

Three years after Cæsalpinus, a still better description was given by Imperato. The latter calls the black lead *grafio piombino*, and says that it is much more convenient for drawing than pen and ink, because the marks made with it appear not only on a white ground, but, in consequence of their brightness, show themselves also on black; because they can be preserved or rubbed out at pleasure; and because one can retrace them with a pen, which drawings made with lead or charcoal will not admit[963]. This mineral is smooth; appears greasy to the touch, and has a leaden colour, which it communicates with a sort of metallic lustre. It can resist for a long time the strongest fire; it even acquires in it more hardness, and therefore has been considered as a kind of talc. Sometimes it is foliaceous, and may be crumbled to pieces in scales; but it is frequently found denser and stronger, and in this case writing-pencils are made of it. The first kind was mixed with that clay called *rubrica*, and manufactured into crucibles, which were exceedingly durable in the fire. It is here seen that these Italians, at that time, were well acquainted with this mineral. It has been reckoned a species of talc by Justi, by Wallerius in the first edition of his mineralogy, and also by others. Its durability in resisting heat is certainly manifested,

when it is kept in a close fire and between coals. But it is proved by the experiments of modern mineralogists, that in an open, strong, and long-continued fire, it becomes almost entirely consumed.

Bartholomew Ambrosinus, in the continuation of Aldrovandi's Musæum Metallicum, printed at Bologna in 1648, uses the name *lapis plumbarius*. The short account which he gives of it has been borrowed from the two Italians last mentioned; but it deserves to be remarked, that even then he thought it worth his while to give Gesner's figure enlarged.

In the works of Albertus Magnus, George Agricola, Encelius, Cæsius, Kircher, and many other old mineralogists, I have found no mention of black lead. But as the advantageous use of it for crucibles was known to Imperato, and as the crucibles made at Ips, which till very lately were employed by all the mints in Europe, and even in other parts, derived their superiority from plumbago being mixed with the blue clay, and as these crucibles are introduced more than once by Agricola without any mention of the addition, it must either at that time have not been usual, or it must have escaped the notice of this diligent man. How old then are the pits at Leizersdorf, which furnish plumbago for the crucibles of Ips or Passau? I know of one mineralogist only who has described that district, but on this subject he has given us no information.

I am equally unacquainted with the time when the pits in Cumberland, which, as is well known, produce the best plumbago, were discovered. They are situated on the Borrowdale mountains, about ten miles from the town of Keswick. The families to whom these pits belong, according to an established regulation, can open them only once every seven years, and take out but a certain quantity of the mineral, in order to keep up the price, and prevent the pits from being exhausted[964]. This production is called there *black lead*, *kellow* or *killow*, *wad* or *wadt*, which words properly mean black[965]. I have found no older information in regard to these pits than that of Merret, who wrote in the year 1667, and who calls this mineral *nigrica fabrilis*, because it had then no Latin name[966]. Pettus remarked, in his Fleta Minor, published 1683, that the pencils made from it were inclosed in fir or cedar. It is related by Robinson[967] and others, that at first the country-people around Keswick marked their sheep with it. Afterwards the art was

discovered of employing it for earthenware, and for preserving iron from rust. The last-mentioned author says also, that it is used by the Dutch in dyeing, in order to render black more durable, and that it is bought up by them in large quantities for that purpose. But this is only a pretence. I am inclined to think that they prepare from it black-lead pencils.

The greater part of the plumbago at present used in commerce, but which, as far as I know, is fit only for iron-black, comes from Spain, where it is dug up in the neighbourhood of Ronda, a town in Grenada, a few miles distant from the sea; but, in regard to the antiquity of these pits, I have found no information. In commerce, it is called *potloth*; and the mills, such as those at Bremen, where it is ground fine, are named *potloth* mills, an appellation which in all probability has been borrowed from the Dutch, among whom *potloot* signifies as much as potters' lead. From this word the French have made *potelot*, which however in many dictionaries is omitted. If I am not mistaken, this mineral was first found in France at a very late period in Upper Provence, near Curban, and not far from the river Durance, between Sisteron and Gap, from which it is sent to Marseilles.

It appears to me probable, that in the sixteenth century the use of plumbago was first introduced into Italy, a country which abounds with draftsmen and drawing-schools; where other minerals had been long used for drawing, and where the best kinds had been carefully sought out. It is likely, therefore, that some one may have made a trial with plumbago, induced by its appearance; and indeed nothing but a trial was necessary to show its superiority to charcoal, and to black and red chalk. I am inclined to think also, that the earliest mention of it will be found in the oldest Italian works on drawing, rather than in those on mineralogy, to the authors of which this substance first became known by its use. For a long time, all the black-lead pencils employed in Germany and in the neighbouring countries were made at Nuremberg. I shall here observe, that the very convenient method of wiping out writing made with a black-lead pencil, by means of Indian rubber, was discovered about twenty or thirty years ago, and, as I believe, first in England.

After I had completed this article, Professor Fiorillo, who as an artist has studied the master-pieces, and as a man of letters the writings of the Italians, communicated to me, at my request, the following information, which at any rate will form an additional fragment towards the history of

drawing. The pencils first used in Italy for drawing were composed of a mixture of lead and tin fused together, and the proportion was two parts of the former and one of the latter[968]. To obliterate a drawing or piece of writing, it was rubbed over with crumbs of bread. A pencil of this kind was called *stile*. Petrarch has immortalized a painter named Simone Memmi by a couple of sonnets, out of gratitude for a picture of his beloved Laura[969]. In these he says that the artist made the drawing with a *stile in carte*. The author here evidently alludes to a drawing-pencil, and not to a graver, as some have supposed. Boccacio, a scholar of Petrarch, celebrates an artist who was equally expert at drawing with the *stile*, the pen, and the pencil. Michael Angelo also, who died in 1564, says, in a sonnet on Vasari, quoted by Fiorillo, "Se con lo stile e co' colori avete." Such pencils were long used also in Germany; and formerly they were found at the most common writing-desks.

The use of red and black chalk seems to be more modern. The former is called by the Italians *matita rossa*, and the latter *matita nera*. This name is derived from *hæmatites*. Vasari celebrates Baccio Bondinelli, who died in the middle of the sixteenth century, because he could handle equally well *lo stile, e la penna, e la matita rossa e nera*. Baldinucci says, that the best red chalk comes from Germany; good black chalk from France; but the very best from Spain, whence that of the first quality is obtained at present.

I can, however, point out no mention of our plumbago in the works of the old Italian artists. Armenini, who wrote at the end of the sixteenth century, relates how pupils were taught to draw a hundred years before his time[970]. He says that they made the first sketches with *piombo over cannella col lapis nero*, and afterwards filled them up with a pen. But when his whole description is read, there can remain no doubt that the substance here meant is black chalk. Baldinucci, who did not write till 1681, has introduced particularly into his dictionary *matita rossa*, *nera*, and also *lapis piombino*; and says that the last-mentioned is an artificial production, which gives a leaden colour, and is employed for drawing. It is evident therefore that the author here alludes to plumbago, which was then very common. But when Bottari says[971] that artists first began to use red and black chalk in the time of Vasari, whereas *lapis piombino* only was employed before

that period, he has named *plumbago*, commonly used in his time, instead of the metallic pencil which was called *stile*. If I am not mistaken, the Italians have no proper appellation for black lead, but call it sometimes *matita* and sometimes *piombino*.

[Great difficulty was formerly experienced in protecting the Borrowdale black-lead mine from robbery. At present, the treasure is protected by a strong building, consisting of four rooms upon the ground floor; and immediately under one of them is the opening, secured by a trap-door, through which workmen alone can enter the interior of the mountain. In this apartment, called the dressing-room, the miners change their ordinary clothes for their working-dress as they come in; and after their six hours, post or journey, they again change their dress, under the superintendence of the steward, before they are allowed to go out. In the innermost of the four rooms two men are seated at a large table, sorting and dressing the plumbago, who are locked in while at work, and watched by the steward from an adjoining room, who is armed with two loaded blunderbusses. In some years the net produce of the *six weeks'* annual working of the mine has, it is said, amounted to from 30,000*l.* to 40,000*l.*

An inferior kind of plumbago is imported from Mexico and Ceylon; and a composition with which more common pencils are manufactured is made of a mixture of plumbago-powder, lamp black and clay.

A useful and convenient application of the black lead in the form of minute cylinders which slightly projected from a cylindrical cone, and which was fitted to a pencil-case, was patented in 1822 by Mr. Mordan, and has come into general use: the cylindrical form of the plumbago is produced by passing square strips of it through holes in a ruby, somewhat in the manner of wire-drawing. It is stated that the supply of plumbago from the Cumberland mine is almost exhausted; fortunately, a process has been devised by which the same firmness and equality may be communicated to the powder by compression. This is effected by carefully washing and grinding the dust obtained in sawing plumbago into thin plates, sifting it through spaces less than the 1/50000th part of an inch, and placing it under a powerful press, on a strong die or bed of steel, with air-tight fittings. The air is then pumped from the dust, and while thus freed from air, a plunger descends upon it and it becomes solidified. The power employed to perform this operation is estimated at 1000 tons, several blows having been given,

each of this power. This process was invented by Mr. W. Brockedon, the talented draftsman of Alpine and Italian scenery.]

FOOTNOTES

[958] Plin. lib. xxxiii. 3, sect. 19.

[959] A plate of this kind was called παράγραφος, also τροχαλὸς, γυρὸς, κυκλοτερὴς, which last appellation denotes the form. The Romans, at least those of later times, named this lead *prædictal*. The ruler by which the lines were drawn was called κανὼν and κανονίς. Thus the ruled sheet which Suffenus filled with wretched verses is styled by Catullus *membrana directa plumbo*. Pollux has παραγράφειν τῇ παραγραφίδι. See Salmasius ad Solinum, p. 644, where some passages, in which these leaden plates are described, are quoted from the Anthologia.

[960] Versuchs e. System d. Diplomatik. Hamb. 1802, 8vo, ii. p. 108.

[961] Diplomatique-pratique: à Metz, 1765, 4to, p. 62.

[962] De Metallicis, lib. iii. Rome, 1596, or Norib. 1602.

[963] This, however, is not exactly the case. With ink somewhat thick one may indeed write on a piece of paper which has been rubbed over with black lead.

[964] [This was formerly the case, but for a considerable number of years past the mine has been constantly open. The whole of the produce is sent up to London (Essex Street, Strand), where it is disposed of by public auction, held once a month.]

[965] In the Cumberland dialect, *killow* or *collow*, as well as *wad*, means black. Therefore when the manganese earth, which is found chiefly at Elton not far from Winster, and when burnt is employed as an

oil-colour, but particularly for daubing over ships, is called *black wad*, that expression signifies as much as *black black*. See Pennant's Tour in Scotland, i. p. 42. Gentleman's Magazine, 1747, p. 583.

966 Pinax Rerum Natural. London, 1667, 8vo, p. 218.

967 Natural Hist. of Westm. and Cumberland, 1709, 8vo, p. 74. See also Gent.'s Mag. xxi. 1751, p. 51, where there is a map of this remarkable district.

968 Borghini, il Riposo. Artists used sometimes also silver pencils. Baldinucci's Vocab. dell' arte del Disegno: Stile.

969 These sonnets are the 57th and 58th. Of Simon and his drawings an account may be found in Fiorillo Gesch. der zeichnenden Künste, Gött. 1798, 8vo, i. p. 269.

970 De' veri precetti della pittura. Ravenna, 1587, 4to, p. 53.

971 In his observations on Vasari, iii. p. 310.

SAL-AMMONIAC.

It is not very probable that Dioscorides, Pliny, and others who lived nearly about the same time, were acquainted with sal-ammoniac, or mentioned it in their works; for no part of mineralogy was then so defective as that which is the most important, and which treats of salts. The art of lixiviating earths and causing saline solutions to crystallize was then so little known, that, instead of green vitriol, vitriolic minerals, however impure, were employed in making ink, dye-liquors, and other things. Places for boiling vitriol were not then established, and therefore Pliny beheld with wonder blue vitriol, which in his time was made only in Spain, as a thing singular in its kind, or which had not its like. On this account those salts only were known which occur in a native state, or which crystallize as it were of themselves, without any artificial preparation, as is the case with bay salt. But that neutral salt, formed of muriatic acid and ammonia, occurs very seldom in a native state, and almost exclusively among the productions of volcanoes. I do not, however, suppose that this volcanic sal-ammoniac was the first known, but that it was first considered to be sal-ammoniac after that salt had been long obtained by another method, and long used.

But even if it should be believed that our sal-ammoniac was known to the ancients, how are we to discover it with certainty in their writings? This salt has little or nothing by which these writers could characterize it. Neither its external form nor taste is so striking that it could be described by them with sufficient precision. The use of it also could not at that time be so important and necessary, as to enable us to determine whether they were acquainted with it; whereas, on the other hand, green vitriol and alum can easily be distinguished among the materials for dyeing.

Nay, if this salt had been then made, as it is made at present in Egypt, and if any allusion to it were found, one might readily conjecture that sal-ammoniac were really meant. But even though it must be admitted that traces of sublimation being employed occur in the writings of Dioscorides

and others, who lived nearly at the same period, we are not authorized to suppose that the knowledge of it was sufficient for the preparation of this salt.

Besides, there are two properties with which the ancients might have accidentally become acquainted, and which in that case would have been sufficient to make known or define to us this salt. In the first place, by an accidental mixture of quicklime, the strong smell or unsupportable vapour diffused by the volatile alkali separated from the acid might have been observed. In the second place, it is very possible that the complete volatilization of this salt on burning coals may have been remarked; for it had been long known that common salt decrepitates in the fire. This excited wonder, and in examining other salts people were accustomed to observe whether they possessed that property also. Had any one, with this view, thrown a bit of sal-ammoniac on a burning coal, he must have seen with astonishment that instead of decrepitating it became entirely volatilized. For this experiment, however, very pure sal-ammoniac would have been necessary. Had a little common salt been mixed with it, decrepitation would not have been altogether prevented; and if the sal-ammoniac had been rendered impure by earthy particles, as is almost always the case with the volcanic, some earth at least would have remained behind on the coals.

The name *sal-ammoniacus* is indeed old; but as those who, in consequence of the name, considered the *alumen* of the ancients to be our alum, and their *nitrum* to be our saltpetre, were in an error, we should be equally so were we to consider their sal-ammoniac to be the same as ours. Our forefathers believed that the ancient writers were acquainted with all minerals, as well as with all plants; and when they discovered a new one, they searched in old books till they found a name which would suit it, or which at any rate had not been given to another. Our sal-ammoniac, in all probability, acquired in the same manner its name, which is not often to be found in the writings of the ancients[972].

When everything they have said of it is collected and impartially examined, no proofs will be found that under that name they understood our sal-ammoniac. On the contrary, one will soon be convinced that *sal-ammoniacus* was nothing else than impure marine salt. As the ancients were not acquainted with the art of separating salts, of refining and crystallising

them, they gave to each variety or kind in the least different, which was distinguished either by the intermixture of some foreign substance or by an accidental formation, a particular name; and, considering the wants of that period, this method was not so bad. For among the impure saline substances, there were always some which were found to be fitter than others for certain purposes. On this account they distinguished with so much care *misy*, *sory*, *chalcitis* and *melanteria*, instead of which we use a substance contained in all these minerals, that is to say, green vitriol. Our apothecary shops however have at present the lixivious salt under the name of various plants, from which it is extracted, with different degrees of purity.

When this is known, it will excite no wonder that the *sal-ammoniacus* of the ancients was nothing else than our common salt. Dioscorides and Pliny speak of it expressly as a kind of this salt; and Columella[973], in a prescription for an eye-salve, recommends rock-salt, either Spanish, Ammoniacal, or Cappadocian. Pliny says[974] that *sal-ammoniacus* was found in the dry sandy deserts of Africa, as far as the oracle of Ammon. It is stated, both by him and Dioscorides[975], that this salt can be split or broken into smooth pieces; and the former adds, that the best are white and transparent; that it however has an unpleasant taste, but can be used in medicine. In like manner later physicians, when they wish to prescribe common salt, recommend in particular the ammoniac. Thus Aetius, who lived in the fifth century, remarks, that when fossil, or as we say at present native salt, is employed, ammoniac or Cappadocian ought to be chosen.

From what is said by Pliny, it may with certainty be concluded that this salt was dug up from pits or mines in Africa; for he relates, that it appeared wonderful that a piece of it, which in the pit was very light, became, on exposure to the open air, much heavier. Without repeating the explanation which he gives of this phænomenon, I shall only remark, that many kinds of rock-salt, taken from the mines of Wieliczka, experience the same change in the air; so that blocks which a labourer can easily carry in the mine, can scarcely be lifted by him after they have been some time exposed to the air. The cause here is undoubtedly the same as that which makes many kinds of artificial salt to become moist and to acquire more weight. In this case it is owing to some impurity, such as muriate of lime, which is called *sal-*

ammoniacus fixus[976], and which attracts from the atmosphere so much moisture, that it deliquesces in it to the so-called oil of lime.

Synesius, who was born in Egypt in the fifth century, in the Pentapolitan town Cyrene, and who resided as bishop in Ptolemais, the capital of the district, says, in a letter wherein he describes many rarities of his native country, that what was called *sal-ammoniacus*[977], both according to its appearance and taste, was a salt of a good quality, fit for use; that it lay under a soft kind of stone which covered it like a crust, and that it could be easily dug up when this stone was removed.

Herodotus, Strabo, Arrian, and others, speak of rock-salt which was dug up in Ammonia, and carried thence as an article of merchandise. The first mentions a hill of salt; and we are told by the last, that native salt was brought to Egypt as a present to the king and others, from the neighbourhood of the oracle of Ammon, by the priests of that place, in boxes made of palms worked together. Many pieces were three inches in length; and because this substance was purer than bay salt, and as clear as crystal, it was particularly employed in sacrifices. This salt is certainly that which, under the name of *sal-ammoniacus*, was sent from Egypt to the king of Persia, like the water of the Nile, as is related by Athenæus from an historian long since lost[978].

It is also certain that the old Arabian physicians, Avicenna and Serapion, who both lived in the eleventh century, under the name *sal-ammoniacus* understood nothing else than rock-salt. The former says that it ought to split easily, and to be clear and transparent like crystal; and the latter states that this salt is cut from the solid rock, and that it is sometimes clear as crystal, sometimes reddish, sometimes blackish, sometimes of another colour, sometimes hard, and sometimes friable, or, as the translator expresses it, pulverulent. All these colours and properties are not uncommon in rock-salt, and always proceed, no doubt, from an admixture of ferruginous earth. Serapion says that this salt was obtained from Corasini. I shall leave it to others to determine where this country was situated. He often names it, and says that *mala granata* and *bezaar* were obtained from it. But who knows how the name was written in the original?

And the Arabian author perhaps did not mention the place where the salt was dug up, but that from which, in his time, it was procured[979].

In regard to the purpose to which the ancients applied their *sal-ammoniacus*, it appears that it required only common salt and not sal-ammoniac. It is oftenest mentioned by the physicians, because it was the purest table salt that could then be procured. On that account it has been praised by Scribonius Largus, who lived in the first century, and by Aetius who lived in the fifth, as well as by Avicenna, Serapion, and others. I have however not yet met with it in the writings of Hippocrates or Galen. In the works of the Greek agriculturists it occurs in a recipe for the preparation of a cement employed to close up wine vessels[980]. According to a recipe of Apicius, in his book on cookery, *sal-ammoniacus* was to be roasted. By these means this rock-salt lost its water of crystallization and became stronger. On this account, in Transylvania, Siberia, and other countries, before it is brought to the table it is pounded and roasted. Of our sal-ammoniac, however, were it roasted, very little would remain. But whether the *ammonium* which Palladius recommends for a cement[981] be that salt, I will not pretend to determine. On the other hand, I have no hesitation to contradict the old commentator on Ovid, who, in a passage where the poet recommends *sal-ammoniacus* in making a cosmetic water, understands the resin or gum of that name. Ovid however had no intention that young women should lacker themselves.

For the reasons therefore already mentioned, I am convinced that the *sal-ammoniacus* of the ancients was rock-salt, and not our *sal-ammoniac*. The oldest commentators also on these writers had no idea of any other than rock-salt; and it was not till a later period, when our sal-ammoniac was introduced into commerce, and acquired that name, that the most learned commentators began expressly to remark, that the new sal-ammoniac, notwithstanding its appellation, was different from the *sal-ammoniacus* of the ancients. As this could not then be obtained, people used the former, which they considered only as an artificial substitute for the latter, though it was incapable of supplying its place. But in more modern times, when our sal-ammoniac became common, and physicians and mineralogists no longer took the trouble to read the works of the ancients, some of them, if not the greater part, spoke in such a manner as if our sal-ammoniac had been the

sal-ammoniacus of the ancients; and it was then generally believed that it had been, at any rate, known and used since the time of Dioscorides and Pliny.

No one has maintained this with greater confidence and zeal than F. I. W. Schröder[982], whose judgement however was perverted by alchemistic conceits. According to his assertion, the Egyptians practised from the earliest periods the art of making sal-ammoniac, but they kept it a secret; and he obscurely hints at the purpose for which these great chemists used so much salt. He refers, on this occasion, to what Pliny says of *flos salis*[983], in which he thinks he can find the martial sal-ammoniac[984] flowers of our chemists, or the so-called *flores salis ammoniaci martiales*. Those who cannot make this discovery he declares to be ignorant and blind. This decision, however, when the character of the person who gives it is considered, cannot dissipate a single doubt. It is certain that what Dioscorides and Pliny call *flos salis* has never yet been defined. It was moist, oily, and saline; and in the vessels, in which it was sent from Egypt, was grey at the top, saffron-coloured at the bottom, and emitted a bad smell. The most ingenious conjecture was that of Cordus[985], who thought that it might be *sperma ceti*; but though I should prefer this opinion to that of Schröder, I must confess that, on the grounds adduced by Matthioli and Conrad Gesner, it has too much against it to be admitted as truth.

The first distinct traces of our sal-ammoniac which I have yet met with are to be found in the works of the Arabians[986]. In a writing of Geber, there is a prescription how to purify sal-ammoniac by sublimation, and in another a receipt for making it; so that there can be no doubt that the author was acquainted with our salt. But this furnishes very little towards the history of it. The period when that celebrated chemist lived is uncertain. If, as Leo says[987], he flourished a hundred years after Mahomet, that is to say in the eighth century, his works must have been interpolated with many additions, which criticism has not yet been able to separate. Many of them cannot be of great antiquity; and the uncertainty is increased by some of the editions differing from each other in important passages. Whole sections, which some have, are wanting in others; and the titles and order of the books and sections are different almost in each. When the same circumstances are

found in several editions, it is observed that they essentially differ. What, therefore, is now found in the writings of Geber, as they are called, was certainly not all known in the eighth century.

The same uncertainty prevails in regard to the chemical works of Avicenna, who lived in the beginning of the eleventh century, and who certainly treats of sal-ammoniac. But when these are compared with the medical works of this author, which are subject to no doubt, it is evidently perceived that the former must have been the production of a very different and much younger writer. In the works of the physician Avicenna, *sal-ammoniacus* means always rock-salt. It is worthy of remark, that Avicenna the chemist says, that sal-ammoniac comes from Egypt, India, and Forperia.

We know with more certainty that Albucasis, or Bulcasis, was acquainted with sal-ammoniac, as well as the method of preparing it, which he describes, and also the preparation of medicines in general, in his book often printed under the title of *Liber servitoris*[988]. However unintelligible the translation often is, one can easily discover in what manner sublimation was formerly performed in earthen vessels. But the period when this Arabian writer lived is doubtful, though it is generally admitted that he died in the year 1122.

But whence did Europe obtain this salt, in the twelfth and succeeding centuries? When and in what manner was the preparation of it found out in Egypt? For what purpose was it first used by our ancestors? I have not yet met with any information to enable me to answer these questions, though it is probable that it might be found in old books of travels, and particularly in the works of Arabian writers. In the valuable but not altogether intelligible book of Pegolotti[989], from which I have learned many things respecting the trade of the fourteenth and fifteenth centuries, nothing is said in regard to the place where it was obtained, but that it was procured in white, hard, and opake cakes. It is mentioned in the custom-house tariff of Pisa for the year 1408.

Biringoccio, who lived in the end of the fifteenth and beginning of the following century[990], knew nothing more than that, according to report, it came from Cyrene or Armenia. Cæsalpin, his contemporary, gave, for the preparation of it, a prescription which is undoubtedly borrowed from the

Arabians. This author says, very properly, that it is obtained in white transparent cakes, blackish on the outside; but adds, erroneously, that it comes from Germany, though the same thing has been repeated by Brasavolus and Matthioli. Porta says, with more truth, that it comes from the East. He asserts also, that he was the first person who found real sal-ammoniac on volcanic mountains, and he wishes that his discovery might be confirmed by skilful naturalists[991]. This may serve as an additional proof, were such necessary, in opposition to those who think that the first real sal-ammoniac introduced into commerce was the volcanic. Imperato considers Porta's observation as generally acknowledged, but without naming him. The former has described, in a fuller and more correct manner than any of his predecessors, the properties of sal-ammoniac[992]; and he states, as does also Agricola[993], that it is entirely dissipated in the fire. He adds, that it promotes the production of a celestial blue colour, and in all probability he here alludes to a solution of copper.

Without attempting to examine at what time the art was discovered of converting the nitric acid into aqua regia by the addition of sal-ammoniac, I shall only remark that, at any rate, it was known in the sixteenth century; for Imperato says that sal-ammoniac is employed in the solution of gold; and Biringoccio[994], who is older, recommends nitrous acid prepared with sal-ammoniac for dissolving metals, and particularly gold. I will not either determine how old the use of this salt is in soldering and tinning; but I must observe, that it was known to Agricola[995] and Imperato. I however doubt whether it was very common, because Biringoccio[996] recommends borax for that purpose, without so much as mentioning sal-ammoniac; though it is possible that I may have overlooked it.

We are now arrived at the modern history, which I shall give in as brief a manner as I can, because it has been already fully treated on by others. What was long ago shown by the celebrated Mr. Boyle was proved in the year 1716 by Geoffroy the younger, that sal-ammoniac was composed of the muriatic acid and volatile alkali, and that it could be thence prepared in Europe by sublimation[997]. In the same year the jesuit Sicard gave the first certain account of the sal-ammoniac manufactories at Damayer, in the

Delta, and described in what manner this salt was prepared there, by sublimation in glass vessels, from the soot of the burnt dung of camels and cows, which is used in Egypt for fuel, with the addition of sea salt and urine[998]. In the year 1719, the Academy of Sciences at Paris received from Lemere, the French consul at Cairo, an account of the process employed; but it contained no mention either of sea salt or of urine[999]. Afterwards this information was in part confirmed, and in part rectified and enlarged, by Paul Lucas[1000], Granger, or, as he was properly called, Tourtechot[1001], and the celebrated travellers Shaw, Pocock, Norden, Hasselquist, Niebuhr, and Mariti.

Several writers have asserted that sal-ammoniac comes also from the East Indies. It is mentioned by Tavernier among the wares which in his time were brought from Amadabat, in the territories of the Mogul, to Surat; and Geoffroy states, that when the trade of Marseilles was interrupted by the plague, the French obtained from Holland sal-ammoniac, which was shaped like a truncated cone, and was given out to be Indian[1002]. Pomet also says, that some of the same kind was formerly procured from Venice and Holland. But Gaubius asserts that he was never able to hear of any such sal-ammoniac in Holland[1003]; nor is it to be found in the price currents of the East India Company. I am almost inclined to suspect that these truncated cones were formed by the merchants from broken pieces or fragments of the Egyptian sal-ammoniac, by solution and imperfect crystallization or sublimation. In this manner the merchants at Marseilles convert the refuse of the Egyptian sal-ammoniac into cakes by a new sublimation, in order that it may become more saleable, though it is not readily purchased by artists. Gaubius, however, has described a kind of sal-ammoniac which he obtained from India, with the information that it was made in Hindostan from the soot of animal dung; but in my opinion this requires further confirmation[1004].

Where and at what time the first works for making sal-ammoniac were established in Europe, I am not able to determine. The account given by Thurneisser, that the first sal-ammoniac was made in the Tyrol in the ninth century, is truly ridiculous. It is not worth the trouble to inquire where he or

Paracelsus found this foolish assertion. One might be almost induced to believe, that in the time of Boyle there were manufactories of sal-ammoniac in Europe[1005]. But perhaps there may be no other foundation for all this than the before-mentioned assertion of Cæsalpinus, that this salt came from Germany. At Bamberg, the Germans were long accustomed to boil the sediment of the salt-pans with old urine, and to sell it cheap for sal-ammoniac; and Weber asserts that some of the same kind is still made at Vienna. The hundred weight costs from twenty to thirty florins, but the refuse may be purchased for a mere trifle. If I am not mistaken, the first real manufactories of sal-ammoniac were established in Scotland; and the oldest of these, perhaps, was that erected by Dovin and Hutton at Edinburgh in 1756, and which, like many in England, manufactures this salt on a large scale[1006]. Among the later undertakings of this kind is Gravenhorst's manufactory at Brunswick, and that which in the neighbourhood of Gothenburg manufactures sal-ammoniac from the refuse left in making train oil.

[Sal-ammoniac is now prepared either by the destructive distillation of bones or coal. The gas-liquor supplies, we believe, the largest part. This fluid contains hydrosulphuret and carbonate with some other salts of ammonia. It is decomposed with sulphuric acid, and on evaporation the sulphate of ammonia is obtained in a crystalline state. This is then mixed with common salt and the mixture heated in iron vessels, whereupon the muriate of ammonia sublimes.

Sal-ammoniac is exported in considerable quantities to Russia and other parts of the continent and to the United States.]

FOOTNOTES

[972] It is indeed a matter of indifference whether the name be derived from αμμος, *arena*, or rather from *Ammonia*, the name of a district in Libya, where the oracle of Jupiter Ammon was situated. The district had its name from sand. An H also may be prefixed to the

word. See Vossii Etymol. p. 24. But *sal-armoniacus*, *armeniacus*, sal-armoniac, is improper.

973 De Re Rust. vi. 17, 7.

974 Lib. xxxi. cap. 7, sect. 39.

975 Lib. v. cap. 126.

976 This name was first used by Js. Holland.

977 Synesii Opera, ep. 147.

978 Athen. lib. ii. cap. 29, p. 67.

979 I am fully of opinion that a town named in the new maps Kesem, and which lies in Arabia Felix, opposite to the island of Socotora, is here meant. It has a good harbour. See Büsching's Geography, where the name *Korasem* also occurs.

980 Geopon. lib. vi. cap. 6.

981 Pallad. i. tit. 41.

982 Bibliothek d. Naturwiss. u. Chemie. Leip. 1775, 8vo, i. p. 219.

983 Lib. xxxi. cap. 7, sect. 42.

984 [The double chloride of ammonium and iron].

985 Liber de holosantho in C. Gesner's treatise De omni Rerum Fossilium Genere. Tiguri 1565, 8vo, p. 15.

986 What a noble people were the Arabs! we are indebted to them for much knowledge and for many inventions of great utility; and we should have still more to thank them for were we fully aware of the benefits we have derived from them. What a pity that their works should be suffered to moulder into dust, without being made available! What a shame that those acquainted with this rich

language should meet with so little encouragement! The few old translations which exist have been made by persons who were not sufficiently acquainted either with languages or the sciences. On that account they are for the most part unintelligible, uncertain, in many places corrupted, and besides exceedingly scarce. Even when obtained, the possessors are pretty much in the same state as those who make their way with great trouble to a treasure, which after all they are only permitted to see at a distance, through a narrow grate. Had I still twenty years to live, and could hope for an abundant supply of Arabic works, I would learn Arabic. But ὁ βίος βραχὺς, ἡ δὲ τέχνη μακρή.

987 Africæ Descriptio, iii. p. 136, b.

988 This book is often printed along with Mesue. See Haller's Biblioth. Botan. i. p. 201. Biblioth. Chirur. i. p. 137.

989 Della decima, iii. pp. 298, 373; and iv. pp. 59, 191.

990 Pirotechnia, 1550, 4to, p. 36, a.

991 Magia Natur. lib. x. cap. 20. Porta was born in 1545, and died in 1615.

992 Lib. iii. cap. 8.

993 De Natura Fossil, lib. iii. p. 212.

994 Lib. ix. cap. 6, p. 131, b: also lib. ix. cap. 10, p. 141, b.

995 De Natura Fossil. lib. iii. p. 215; in which he speaks of iron pins with tinned heads.

996 Page 135, a and b, pp. 136, 375.

997 Mémoires de l'Acad. 1720, p. 195. Basil Valentine had before taught how to separate the volatile alkali from sal-ammoniac by means of the fixed alkali.

998 Nouveaux Mémoires des Missions de la Compag. de Jesus, ii.

999 Mémoires de l'Acad. 1720, p. 191.

1000 Voy. au Levant.

1001 Mémoires de l'Acad. 1735, p. 107.

1002 Mém. de l'Acad. 1723, p. 221, where a figure is given of it.

1003 Gaubii Adversaria. Leidæ 1771, 4to, p. 138.

1004 [As Dr. Royle observes, in his Essay on the Antiquity of Hindoo Medicine, p. 41, this salt must have been familiar to the Hindoos ever since they have burnt bricks, as they now do, with the manure of animals; as some may usually be found crystallized at the unburnt extremity of the kiln.]

1005 Though the sal-ammoniac that is made in the East may consist in great part of camel's urine, yet that which is made in Europe (where camels are rarities) and is commonly sold in our shops, is made of man's urine.—Nat. Hist. of the Human Blood (Works, iv. p. 188).

1006 Arnot's History of Edinburgh. Ed. 1779, 4to, p. 601.

FORKS.

At present forks are so necessary at table among polished nations, that the very idea of eating a meal without them excites disgust. The introduction of them, however, is of so modern a date, that they have scarcely been in use three centuries. “Tam prope ab origine rerum sumus,” says Pliny, in speaking of a thing which, though very new, was then exceedingly common. Neither the Greeks nor the Romans have any name for these instruments; and no phrase or expression which, with the least probability, can be referred to the use of them, occurs anywhere in their writings. But had forks been known, this could not have been the case, since so many entertainments are celebrated by the poets or described by other writers; and they must also have been mentioned by Pollux, in the very full catalogue which he has given of articles necessary for the table.

The Greek word *creagra* signified indeed a fork, but not a fork used at table. It meant merely a flesh-fork, or that instrument employed by cooks to take meat from a boiling pot, as is proved by the connexion of the words in all those passages where it occurs. It is mentioned by Pollux, and by Anaxippus, in Athenæus[1007], among the utensils of the kitchen; and the scholiast on Aristophanes says that this fork had a resemblance to the hand, and was used to prevent the fingers from being scalded. Suidas quotes a passage where the word denotes a hook at the end of a long pole, with which people, even at present, draw up water-buckets from wells and other deep places. This instrument, therefore, appears sometimes to have had only a hook, but sometimes two or more prongs. *Creagra* occurs once in Martianus Capella, a Latin writer, but in a passage which is not intelligible.

Equally inapplicable to our forks are the words *furca*, *fuscina*, *fucilla*, *fuscinula*, and *gabalus*, which are given in dictionaries. The first two were undoubtedly instruments which approached nearly to our furnace and hay forks. The trident of Neptune also was called *fuscina*. The *furcilla* even was large enough to be employed for a weapon of defence, as is proved by the

expressions *furcillis ejicere* and *expellere*. *Fuscinula*, which in modern times is used chiefly for a table fork, is not to be found even once in any of the old Latin writers. The old translation of the Bible only explains the word κρεάγρα by *fuscinula*. *Gabalus*, according to every appearance, has given rise to the German word *gabeln*, but it denotes the cross or gallows, which last word Voscius deduces from it.

A learned Italian, who asserts also that the use of forks is very new, is of opinion that the Romans often used *ligulæ* instead of forks[1008]. This I shall not deny; but the *ligula* certainly had more resemblance to a small spatula, or tea-spoon, than to our forks. According to Martial, many spoons at the other end seem to have been *ligulæ*[1009]. But the two epigrams must be read in conjunction, so that the second may appear a continuation of the first; for the epithets *habilis* and *utilis* can be applied to no other term than *ligula*. Besides, it is certain that the titles of the epigrams, or at least the greater part of them, were not added by the poet, but by transcribers. The name also, which originally was *lingula*, gives an idea of the form. We read likewise that this instrument was used for scumming, for which purpose nothing is less fit than a fork[1010].

I have, I know not how, a great unwillingness to represent the tables of our ancestors as without forks; yet this was certainly the case: and when we reflect on their manner of eating, it will readily be perceived that they could much easier dispense with the use of them than we can. All their food, as is still customary in the East, was dressed in such a manner as to be exceedingly tender, and therefore could be easily pulled to pieces. It appears however that people, though not in the earliest periods, employed the same means as our cooks, and suffered meat to lie some time that it might be easier dressed. We often read that cooks, in order to provide an entertainment speedily, will kill an animal, and having cleaned and divided it, roast it immediately, and then serve it up to their guests. But it is well known that the flesh of animals newly killed, if cooked before it has entirely lost its natural warmth, is exceedingly tender and savoury, as we are assured in many books of travels.

Formerly all articles of food were cut into small morsels before they were served up; and this was the more necessary, as the company did not sit

at table, but lay on couches turned towards it, consequently could not well use both their hands for eating. For cutting meat, persons of rank kept in their houses a carver, who had learned to perform his duty according to certain rules, and who was called *scissor*, *carpus*, *carptor*, and by Apuleius is named *diribitor*[1011]. This person used a knife, the only one placed on the table, and which in the houses of the opulent had an ivory handle, and was commonly ornamented with silver[1012].

Bread also was never cut at table. In former times it was not baked so thick as at present, but rather like cakes, and could easily be broken; hence mention is so often made of the breaking of bread. Juvenal, when he wishes to describe old bread, does not say that it could not be cut, but that it could not be broken[1013]. The ancient form of bread is still retained in the paschal cake of the Jews, and in the *knæckbröd*[1014] of the Swedes. The latter, which is almost as brittle as biscuit, is not cut when used, but broken.

The Chinese, who also use no forks, have however small sticks of ivory, which are often of very fine workmanship, and inlaid with silver and gold. A couple of these is placed before each guest, who employs them for putting into his mouth the meat which has been cut into small bits. But even this resource was not known two centuries ago in Europe, where people, as is still done by the Turks, everywhere used their fingers. As a proof, I shall not quote passages where mention is made of persons putting their hands or fingers into the dish[1015]; for such a mode of speaking is yet employed, though forks, as is well known, are in common use. I shall refer only to one passage in Ovid, which admits of no doubt[1016], and where the author would certainly have mentioned these instruments, or rather have communicated to his pupils in the art of love a precept which at present is given to children, had the former been taught when young how to make use of forks.

Had they been used by the Romans, they must necessarily have occurred among the numerous remains of antiquity which have been collected in modern times. But Baruffaldi and Biörnstähl[1017], who both made researches respecting them, assure us that they were never able to find any. Count Caylus[1018] and Grignon[1019] only assert the contrary. The former

has given a figure and description of a silver two-pronged fork, which was found among rubbish in the Appian Way. It is of exceedingly beautiful workmanship, and at one end terminates in a stag's foot. Notwithstanding the high reputation of this French author, I cannot possibly admit that everything of which he has given figures is so old as he seems to imagine. Grignon found in the ruins of a Roman town in Champagne some articles which he considers as table-forks; but he merely mentions them, without giving a description sufficient to convince one of the truth of what he asserts, which, in regard to a thing so unexpected, was certainly requisite. One fork was of copper or brass; two others were of iron; and he says, speaking of the latter, that they seem to have served as table-forks, but were coarsely made. I however doubt whether he conjectured right in regard to the use of them.

As far as I know, the use of forks was first known in Italy towards the end of the fifteenth century; but at that time they were not very common. Galeotus Martius, an Italian, resident at the court of Matthias Corvinus, king of Hungary, who reigned from 1458 to 1490, relates, in a book which he wrote in regard to the life and actions of this prince, that in Hungary, at that time, forks were not used at table, as they were in many parts of Italy[1020], but that at meals each person laid hold of the meat with his fingers, and on that account they were much stained with saffron, which was then put into sauces and soup. He praises the king for eating without a fork, yet conversing at the same time and never dirtying his clothes.

That in France, at the end of the sixteenth century, forks even at court were entirely new, is proved by a book, already quoted in the present volume of this work, entitled l'Isle des Hermaphrodites. It will therefore excite no wonder that in the same century forks were not used in Sweden.

But it must appear very strange that Thomas Coryate, the traveller, should see forks for the first time in Italy, and in the same year be the first person who used them in England, on which account he was called, by way of joke, Furcifer[1021].

In many parts of Spain, at present, drinking-glasses, spoons and forks are rarities[1022]; and even yet, in taverns, in many countries, particularly in some towns of France, knives are not placed on the table, because it is

expected that each person should have one of his own; a custom which the French seem to have retained from the old Gauls. But as no person would any longer eat without forks, landlords were obliged to furnish these, together with plates and spoons.

Among the Scotch highlanders, as Dr. Johnson asserts, knives have been introduced at table only since the time of the revolution. Before that period every man had a knife of his own as a companion to his dirk or dagger. The men cut the meat into small morsels for the women, who then put them into their mouths with their fingers. The use of forks at table was at first considered as a superfluous luxury, and therefore they were forbidden to convents, as was the case in regard to the congregation of St. Maur.

The English, Dutch and French have adopted the Italian names *forca* and *forchetta*, given to our table-forks; though these appellations, in my opinion, were used at an earlier period to denote large instruments, such as pitch-forks, flesh-forks, furnace-forks; because in the low German, *forke* is a very old name given to such implements. The German word *gabel*, which occurs first in dictionaries for these large instruments, is of great antiquity, and has been still retained in the Swedish and Dutch. It appears to have been used for many things which were split or divided into two; at any rate, it is certain that it is not derived from the Latin word *gabalus*.

FOOTNOTES

1007 Athen. lib. iv. p. 169.

1008 Hieron. Baruffaldi Sched. de armis convivalibus. In Salengri Nov. Thes. Antiq. Rom. iii. p. 742.

1009 Mart. Epigr. xiv.

120. *Ligula Argentea.*

Quamvis me ligulam dicant equitesque patresque,
Dicor ab indoctis lingula grammaticis.

121. *Cochlearia.*

Sum cochleis habilis, sed nec minus utilis ovis;
Num quid scis potius cur cochleare vocer?

1010 Plin. Hist. Natur. xxi. 14. Columella, ix. 15, 13. That the *ligula* was smaller than the *cochlear* is proved by Martial, viii. 23.

1011 See this word in Pitisci, Lexicon Antiq. Rom.

1012 Clemens Alexandr. Pædagog. lib. ii. p. 161. Posidonius relates, in Athenæus, iv. 13, p. 151, that the Gauls used to take roast meat in their hand and tear it to pieces with their teeth, or to cut it with a small knife which each carried in his girdle. This was told as a thing uncommon to the Greeks. Baumgarten, who quotes this passage in Algem. Welgeschichte, xvi. p. 657, adds, that Posidonius said also that the Gauls had bread so flat and hard that it could be easily broken. But this circumstance I cannot find in Athenæus.

1013 Sat. v. 65.

1014 This word, according to the Swedish dictionaries, signifies thin cakes, hard and crisp.

1015 Homeri Odyss. xiv. 453.

1016 De Arte Amandi, iii. 755.

1017 Reisen, i. p. 268.

1018 Rec. d'Antiq. iii. p. 312. tab. lxxxiv.

1019 Bulletin des Fouilles, i. p. 17; ii. p. 131.

1020 Galeoti Martii de Dictis et Factis Regis Matthiæ Liber. This work has also been printed in Schwandtneri Script. Rerum Hungar. tom. i. p. 548.

1021

Coryate, in the year 1608, travelled for five months, through France, Italy, Switzerland, and a part of Germany. An account of this tour was published by him, in 1611, under the singular title of Crudities, a new edition of which appeared in 1776. He travelled afterwards to the East Indies, and in 1615 wrote in that country some letters which may be seen in Purchas his Pilgrims, vol. ii.; also in the second edition of the Crudities published in 1776. In page 90 of the Crudities the author says, "Here j will mention a thing that might have been spoken of before in discourse of the first Italian towne. J observed a custome in all those Italian cities and townes through the which j passed, that is not used in any other country that j saw in my travels, neither do j thinke that any other nation of Christendome doth use it, but only Italy. The Italian, and also most strangers that are commorant in Italy, do alwaies at their meales use a little forke when they cut their meat. For while with their knife which they hold in one hand they cut the meate out of the dish, they fasten their forke, which they hold in their other hand, upon the same dish; so that whatsoever he be that sitting in the company of any others at meale, should unadvisedly touch the dish of meate with his fingers from which all at the table doe cut, he will give occasion of offence unto the company, as having transgressed the lawes of good manners, insomuch that for his error he shall be at least brow beaten if not reprehended in wordes. This form of feeding j understand is generally used in all places of Italy; their forkes being for the most part made of yron or steele, and some of silver, but those are used only by gentlemen. The reason of this their curiosity is, because the Italian cannot by any meanes indure to have his dish touched with fingers, seeing all men's fingers are not alike cleane. Hereupon j myselfe thought good to imitate the Italian fashion by this forked cutting of meate, not only while j was in Italy, but also in Germany, and oftentimes in England since j came home, being once quipped for that frequent using of my forke by a certain learned gentleman, a familiar friend of mine, one Mr. Laurence Whitaker, who in his merry humour doubted not to call me at table *furcifer*, only for using a forke at feeding, but for no other cause."

[The use of forks was at first much ridiculed in England, as an effeminate piece of finery; in one of Beaumont and Fletcher's plays, "your fork-carving traveller" is spoken of with much contempt; and Ben Jonson has joined in the laugh against them in his Devil's an Ass, Act. v. Scene 4. Meercraft says to Gilthead and Sledge:—

"Have I deserved this from you two? for all
My pains at court, to get you each a patent.

"*Gilthead.* For what?

"*Meercraft.* Upon my project of the *forks*.

"*Sledge. Forks!* What be they?

"*Meercraft.* The laudable use of forks,
Brought into custom here as they are in Italy,
To the sparing of napkins."]

1022 Fischer's Reise nach Madrid, p. 238.

LOTTERY. TONTINE.

At present there are two kinds of lottery in Europe. One is called the Italian or Genoese lotto, or merely the lotto; the other is the common lottery well known in England. Of the former, which has been long proved to be attended with great deception, and must soon be universally acknowledged to be hurtful, I do not mean here to treat, but only of the latter, which at any rate may be honourable or harmless, if we do not take into account the delusion it occasions to credulous and ignorant people, by exciting hopes which have little probability in their favour. I however do not promise a complete history of this invention: it experienced so many changes before it acquired its present form, that to give a full account of them would be tiresome to me as well as to the reader.

I shall not either, as some have done, reckon among the first traces of lotteries every division of property made by lot, otherwise it might be said, that Joshua partitioned the promised land into lottery-prizes, before it was conquered. In my opinion the peculiarity of lotteries consists in this, that numbers are distributed gratuitously, or, as in our public lotteries, for a certain price, and it is then left to chance to determine what numbers are to obtain the prizes, the value of which is previously settled. The various conditions and changes invented by ingenuity to entice people to purchase shares, and to conceal and increase the gain of the undertakers, are not here taken into consideration, because they do not appear to be essential.

In the whole history of antiquity, I find nothing which has a greater resemblance to our lotteries than the *congiaria* of the Romans; and I am inclined to think that the latter furnished the first hint for the establishment of the former. Rich persons at Rome, as is well known, and particularly the emperors, when they wished to gain or to strengthen the attachment of the people, distributed among them presents, consisting of eatables and other expensive articles, which were named *congiaria*. In general, tokens or tickets called *tesseræ*[1023] were given out, and the possessors of these, on

presenting them at the store or magazine of the donor, received those things which they announced. In many cases these tickets were distributed *viritim*, that is, to every person who applied for them; and in that case these donations had a resemblance to our distributions of bread, but not to our lotteries, in which chance must determine the number of those who are to participate in the things distributed.

But in the course of time it became customary to call the people together, and to throw among them, from a stage, the articles intended for distribution, in the same manner as money is scattered among the populace at the coronation of the emperor, and on other solemnities. Such things, in this case, were called *missilia*, and belonged to those who had the good fortune to catch them. But as oil, wine, corn and other articles of the like kind, could not be distributed by throwing them in this manner, and as some articles were so much injured by the too great eagerness of the people, that they could be of little or no use, tokens or tickets were thrown out in their stead. At first these were square pieces of wood or metal, but sometimes also balls of wood inscribed with the name of the article which the possessor was to receive from the magazine[1024]. Like bank-notes they were payable to the bearer; and those who had obtained *tesseræ* were allowed to transfer or to sell them to others. This is proved by a passage in Juvenal[1025], where allusion however is made only to the *tesseræ frumentariæ*, which were not thrown out, but distributed.

Imitations of these Roman *congiaria*, but indeed on a very reduced scale, have been employed in modern times by princes and princesses, in order to amuse themselves with distributing small presents to their courtiers. For this purpose various trinkets or toys are marked with numbers; these numbers are written upon separate tickets, which are rolled up and put into a small basket or basin. Each of the company then draws one out, and receives as a present the article marked with the same number. These small *congiaria* were formerly called in German *glückstöpfe*, or *glückshäfen*; and in the course of time the present lotteries took their rise from them.

In Italy, where commerce, as is well known, was first formed into a regular system, and where the principal mercantile establishments and useful regulations were invented, the merchants or shopkeepers, even in the

middle ages, were accustomed, in order that they might sell their wares in a speedier manner and with more advantage, to convert their shops into a *glücksbude*, where each person for a small sum of money was allowed to draw a number from the *glückstöpfe* (jar of fortune), which entitled him to the article written upon it. At first governments gave themselves very little trouble about this mode of selling merchandise. But as the shopkeepers gained excessive profits, and cheated the credulous people by setting on their wares an extravagant price, which was concealed by the blanks, these *glückshäfen* were forbidden, or permitted only under strict inspection, and in the course of time on paying a certain sum to the poor, or to the sovereign. In Germany they are still retained at many of the annual fairs; but in most countries they are subject to many limitations.

From these *glückshäfen* were produced our lotteries, when articles of merchandise were no longer employed as prizes, but certain sums of money, the value of which was determined by the amount of the money received, after the expenses and gain required by the undertakers were deducted, and when the tickets were publicly drawn by charity-boys blindfolded. As these lotteries could not be conducted without defrauding the adventurers, it was at first believed, through old-fashioned conscientiousness, that it was unlawful to take advantage of the folly and credulity of the people, but for pious or charitable purposes.

Lotteries were then established by private persons, and in the course of time even by governments; and the clear gain was applied to the purpose of portioning poor young women, of redeeming slaves, of forming funds for the indigent, and to other objects of beneficence. It was also hoped that these public games of hazard would banish other kinds still more dangerous; and no one suspected that the exposing of tickets for sale, and the division of them, so that one could purchase an eighth or even a smaller share, would maintain and diffuse the taste of the public for gambling. This, however, increased; and the profit of lotteries became so great, that princes and ministers were induced to employ them as an operation of finance, and to hold the bank which always enriched the undertakers. People were then forbidden to purchase tickets in foreign lotteries, that the money won from the adventurers might pass into the sovereign’s treasury, or at any rate be retained in the country; and in order that tickets might be disposed of sooner and with more certainty, many rulers were so shameless as to pay the

salaries of their servants partly in tickets, and to compel guild companies and societies to expend in lotteries what money they had saved[1026].

Of the oldest lotteries among the Italians I have not been able to find any account. Varchi, who wrote about the year 1537, relates that during a great scarcity of money at Florence in 1530, a lottery was established for the benefit of the state, and that the price of a ticket was a ducat. He however does not employ the term lottery, but uses the words *un lotto*, and calls a ticket *polizza*, a term which, as is well known, is generally used in regard to insurance. Le Bret says, that at Venice, in 1572, the inspection of lotteries was entrusted to the *proveditori del commune*; but as he does not mention the historian from whom this account is borrowed, the word which he translates lottery cannot be known. We nevertheless learn from his account, that this game was established at Venice in the middle of the sixteenth century, and placed under the inspection of the government.

It is certain that the chance game which gave rise to lotteries was brought from Italy to France under the name of *blanque*, a word formed from the Italian *bianca*. The greater part of the tickets drawn were always white paper, *carta bianca*, consequently blanks; and because that word occurred oftenest in drawing, it gave rise to the general appellation. Hence also is derived the phrase *trouver blanque*, to obtain nothing, to get a blank, or to lose. At the time Pasquier wrote[1027], that is, in the last half of the sixteenth century, the name *numero* was also usual, because the numbers of the tickets, which were then called *devises*, were announced in the time of drawing. This name, instead of *nombre*, confirms the Italian origin. As each person in the time of drawing was attentive to his number, the phrase *entendre le numero* was applied to those who knew or did not forget their numbers. Hence the expression, as Pasquier remarks, *Il entend le numero*, which is still said of those who know their own interest, or understand how to pursue it. Frisch and others, therefore, in their dictionaries have derived it improperly from the numbers with which merchants marked their goods.

In France also the first *blanques* (lotteries) had no other prizes than articles of merchandise; and on that account they were set on foot only by merchants. But in the year 1539 Francis I. endeavoured to turn them to his own advantage by imitating the public establishment of them usual at Venice, Florence, and Genoa. He permitted these games of chance under the

inspection of certain members of the government, with a view, as was pretended, of banishing deceptive and pernicious games of chance, on condition that for every ticket, *devise* or *mise*[1028], a *teston de dix sols six deniers* should be given to the king. But however small the sum required may have been, this *blanque* was not filled up in the course of two years, and the king was obliged to recommend it by an order issued in the month of February 1541; yet it is not known whether it was ever completed[1029].

In the years 1572 and 1588, Louis de Gonzague, duke de Nivernois and Rethelois, established a *blanque* at Paris, for the purpose of giving marriage portions to poor virtuous young women belonging to his estates. No lottery was ever drawn with so much ceremony and parade. Before the drawing, which began every year on Palm Sunday, mass was said; the servants employed were obliged to swear that they would act in a faithful and impartial manner; and even Sextus V. gave to those who should promote this good work remission of their sins. The prize tickets were inscribed as follows: *Dieu vous a élue*, or *Dieu vous console*. The former ensured to the young woman who drew it 500 francs, which were paid to her on her wedding-day; the latter was the inscription of blanks, but suggested the hope of being more fortunate the year following[1030].

This example induced ladies of quality from time to time to establish similar *blanques* (lotteries) for benevolent purposes. Some destined the profit to the building or repairing of certain churches and convents. Three ladies, whose names history has not thought proper to communicate, set on foot a lottery containing a certain number of tickets at forty sous each, and employed the gain in redeeming, by means of the Mathurines or Patres, as they were called, persons who had fallen into slavery among the Turks. On one occasion a *blanque* or lottery of a very singular nature was instituted by some ladies, in order to raise a fund for their spiritual guide or confessor, who had been chosen bishop, but had no property, that they might purchase for him a carriage and horses, with every thing necessary to support his ecclesiastical dignity. Each of these grateful ladies was obliged to procure or present to him the article announced by the ticket she had drawn, “pour le remercier, par cette petite largesse, pour le bon ordre qu’il avoit apporté à leurs consciences.”

But these games of chance occur much oftener in the French history, as the means employed to make valuable presents to ladies and other persons of distinction. The largest, in all probability, is that by which Cardinal Mazarine endeavoured to increase his splendour, and render himself more popular among the courtiers. The tickets were distributed as presents; each was a prize, and the prizes were rarities of various kinds, and of different values. This, says the historian, was perhaps the first time that fortune did good to all and hurt to no one[1031].

That these games of chance became in the middle of the seventeenth century lotteries, in the proper sense of the word, is unanimously asserted by all the French historians who have touched on this subject, though in some circumstances they differ from each other. In the year 1644, Laurence Tonti came from Naples to Paris, and during a scarcity of money which then prevailed, proposed that kind of life-rents or annuities which at present are named after him *Tontines*, though they were used in Italy long before his time. But after tedious disputes in regard to his proposal, which was at length rejected, he gave in its stead a new plan for a large *blanque*, or lottery, which in 1656 obtained the royal approbation. It was to consist of 50,000 tickets, each at two *Louis d'ors*, so that the whole receipt would amount to 1,100,000 livres; but it is to be recollected that a *Louis d'or* at that time was only eleven livres. Of this sum 540,000 livres were to be deducted for building a stone bridge and an aqueduct. The expenses of the *blanque* were estimated at 60,000 livres, and the remaining 500,000 were to be divided into prizes, the highest of which was 30,000 livres. But this *blanque royale*, for so it was called, was never filled up, and consequently never drawn. On this account it was found necessary to construct a wooden bridge in the room of that which had been burnt. As complaints were often made by mercantile people in regard to the disposal of merchandise in this manner, which had been hitherto permitted, and as this practice had evidently injured the *blanque royale*, the former in the month of January 1658 was entirely forbidden.

In the year 1660, when the conclusion of peace and the marriage of Louis XIV. were celebrated, the first lottery on the plan of Tonti was set on foot at Paris. It was drawn publicly under the inspection of the police. A ticket cost only a *Louis d'or*, and the highest prize was 100,000 livres. This was won by the king himself; but he would not receive it, and left it to the

next lottery in which he had no ticket[1032]. This was soon followed by several others. On that account, in the year 1661, all private lotteries were expressly forbidden under severe penalties, and this prohibition was repeated in 1670, 1681, 1687, and 1700[1033]. Since that time there have been no other lotteries but the *loteries royales*, the profits of which were, in general, applied to public buildings, as was the case in regard to the magnificent church of St. Sulpice, and on that account they met with great support.

Sauval, and some others, ascribe the introduction of lotteries to a person from Lyons, named De Chuyes, who by profession was a gold-beater, but had a great knowledge of trade. He afterwards undertook long sea voyages, and published a book entitled, La Guide des Chemins de Paris, redigée par ordre alphabetique. His name however does not occur in any of the king's patents, but that only of Tonti.

This De Chuyes, according to Sauval, first proposed the name *lottery*, then usual in Italy, which however the other persons concerned did not approve. In particular, the well-known De Vaugelas, who had been chosen director of the undertaking, and who thereby hoped to pay his debts, strongly opposed it, and recommended the title *blanque royale*, though, in consequence of the many deceptions practised in the old games of chance known under that name, it was not likely to become popular. This much is certain, that the name lottery was first used in France about the year 1658; for the order before-mentioned of 1656 has the name *blanque*, but in that of 1658, the word lottery occurs for the first time, and in that of 1661 we find *espèce de blanque et loterie*, and in that of 1670, *loteries et blanques*.

It is certain that the name was much earlier used in Italy and other countries, though Varchi employs only the word *Lotto*. I am acquainted with no older mention of the name Lottery than that in the passage quoted by Menage, from a letter of Christopher Longolius, or, as he is called by the French, Longueuil. It certainly seems to show that lotteries, in the first half of the sixteenth century, were new; but I doubt much whether it can be proved from it that the name is of French, and not Italian extraction, as Menage thinks, because Longolius generally gave himself out as a Frenchman, though he was born at Mechlin in 1490. As the name is much

newer in France, and as the letter was written from Padua, where Longolius died in 1522, it is far more probable that the name had its origin in Italy[1034].

In the last place, this letter was written a short time before Longolius's death; for he mentions the election of pope Adrian, which took place the same year.

The name lottery has been used also by Simon Majolus, who describes the oldest manner in which it was conducted[1035]; but I have not been able to find at what time this Italian ecclesiastic wrote, though in all probability about the end of the sixteenth century. However it is still doubtful whether he was the author of the portion of the work referred to; for it is known that the greater part of the Dies Caniculares, published under his name, was written by Petrus Draudius, who died in the year 1630.

The word *Lot*, in many ancient as well as modern languages, and particularly in the English, Swedish, Danish and Dutch, has the same signification as *sors*, and is evidently the *lotto* of the Italians, and the *los* or *loos* of the Germans; consequently there is no proof that the word lottery is of French extraction, as Menage has supposed[1036].

In England the first lottery was proposed in the years 1567 and 1568, and, as the historian says, held at the west door of St. Paul's Cathedral, and was drawn day and night[1037], from the 11th of January 1569, to the 6th of May the same year. It contained 400,000 tickets, at ten shillings each. The prizes consisted partly in money, and partly of silver plate and other articles. The net profit was to be employed in improving the English harbours. The Antiquarian Society of London have still in their possession the original scheme, as it was then printed[1038]; from which it appears that the name lottery was at that time used in England. [In the year 1612 a lottery was drawn for the benefit of the English colonies in Virginia; permission was granted by special favour of king James I.; the largest prize in which, being silver-plate to the value of 4000 crowns, fell to the share of a tailor. In 1620 lotteries were suspended, in consequence of a representation from the House of Commons that they were prejudicial to the morals of the nation; but one was afterwards permitted in 1630, by a special license from king Charles I., in aid of the expenses of a project for

conveying water to London; and Anderson[1039] says that this is the first time that lotteries are mentioned either in the *Fœdera* or *Statutes*.

In the reign of Charles II., one of the methods resorted to by that monarch to reward the officers who had remained faithful to his cause, was to give them grants of plate and other valuables, with permission to dispose of them by a lottery. This gave rise to various schemes, under the titles of royal-oak and twelve-penny lotteries, &c.; which were sanctioned by government, as we learn by the following advertisement, which appeared soon after the Restoration:—"This is to give notice, that any persons who are desirous to farm any of the counties within the kingdom of England or dominion of Wales, in order to the setting up of a plate lottery, or any other lottery whatsoever, may repair to the lottery-office in Mermaid-court, over against the mews, where they may contract with the trustees commissioned by his majesty's letters patent for the management of the said patent, on behalf of the truly loyal indigent officers."

In 1694, a loan of a million was raised by the sale of tickets at £10 each, the prizes in which were funded at the rate of 4 per cent. for sixteen years certain. In the reign of queen Anne lotteries were forbidden as hurtful, but soon after they were again permitted under a variety of conditions, and were commonly for terminable annuities, to which both blanks and prizes became entitled at different rates; thus in 1710, the lottery consisted of 150,000 tickets, valued at £10 each; every ticket being entitled to an annuity for thirty-two years, the blanks at 14*s.* per annum, and the prizes to various annuities, from £5 to £1000. Tickets appear to have been first divided into shares during the administration of Sir Robert Walpole.

In 1746, a loan of three millions was raised on 4 per cent. annuities, and a lottery of 50,000 tickets at £10 each; and in 1747, one million was raised by the sale of 100,000 tickets, the prizes in which were founded in perpetual annuities, at the rate of 4 per cent. per annum. During the same century government constantly availed itself of this means to raise money for various public works, of which the British Museum and Westminster-bridge are well-known examples.

Probably the last occasion on which this taste for gambling was thus made use of occurred in 1780, when every subscriber of £1000 towards a

loan of twelve millions, at 4 per cent., received a bonus of four lottery tickets, the intrinsic value of each of which was £10.

In 1778 an act was passed obliging every person who kept a lottery-office to take out an annual license, and to pay £50 for the same, a measure which reduced the number of lottery-offices from 400 to 51.

In 1823, however, the last act sanctioned by parliament for the sale of lottery tickets, contained provisions for putting down all state and private lotteries, and for rendering illegal the sale, in this kingdom, of all tickets or shares of tickets in any foreign lottery.]

A lottery was drawn at Amsterdam in 1549, the profit of which was employed in building a church steeple[1040]; and another was drawn at Delft in 1595. I was informed by Professor Fiorillo that there is still preserved at Amsterdam, in the hospital for old men, *oude mannen huys*, a beautiful painting by David Vinckenbooms, eight feet in height and fourteen in breadth, which represents the drawing of a lottery in the night-time. The artist is said to have been born in the year 1578.

This game of chance must have been known also at an early period in Germany; for, in the year 1521, a lottery was established by the council at Osnaburg, and is mentioned in a work published in 1582; but the prizes consisted only in articles of merchandise. The citizens of Hamburg having proposed a lottery, according to the Dutch manner, for the purpose of building a house of correction, the magistrates gave their approbation in the month of November 1611, and in 1615 it was drawn. At Nuremberg the first lottery seems to have been drawn in the year 1715. At any rate, Von Murr, in his Description of the remarkable things in that city, mentions an engraving with the following title: “Representation of the *Lotto publico*, which was drawn in the large hall of the council-house, at Nuremberg, anno 1715.” It is certain that we are not here to understand the so-called Italian *lotto*, but a common lottery, as the former was not introduced into Germany till a much later period. At Berlin the first lottery was drawn in the month of July 1740. It consisted only of one class of prizes, as was probably the case with all lotteries at first. It contained 20,000 tickets, each of which cost five dollars; so that the whole income amounted to 100,000 dollars. There were 4028 prizes, the largest of which was a house worth 24,000 dollars.

The ill-famed Italian or Genoese lottery was, as its name shows, an invention of the Genoese[1041], and arose from the mode in which the members of the senate were elected; for when that republic existed in a state of freedom, the names of the eligible candidates were thrown into a vessel called *seminario*, or, in modern times, into a wheel of fortune; and during the drawing of them it was customary for people to lay bets in regard to those who might be successful. That is to say, one chose the names of two or three *nobili*, for these only could be elected, and ventured upon them, according to pleasure, a piece of money; while, on the other hand, the opposite party, or the undertaker of the bank, who had the means of forming a pretty accurate conjecture in regard to the names that would be drawn, doubled the stakes several times. Afterwards the state itself undertook the bank for these bets, which was attended with so much advantage; and the drawing of the names was performed with great ceremony. The *venerabile* was exposed, and high mass was celebrated, at which all the candidates were obliged to be present.

A member of the senate, named Benedetto Gentile, is said to have first introduced this lottery, in the year 1620; and it is added, that the name of Gentile having never been drawn, the people took it into their heads that he and his names had been carried away by the devil, in the same manner as Schwartz, the inventor of gunpowder, as a punishment for this unfortunate invention. But at length, the wheel being taken to pieces in order to be mended, the name, which by some accident had never been drawn, was found concealed in it. Hence it may be easily seen how this game of chance was formed, by introducing numbers instead of the names of the nobility.

However, if I am not mistaken, it continued to be peculiar to the Genoese till nearly the middle of the eighteenth century. But as all travellers spoke of this *lotto di Genoa*, and many wished to try their fortune in it, the Genoese, for their own benefit, established in many large towns commissioners, whose business was to dispose of tickets, and to pay the prizes to those who had been fortunate.

As an immoderate spirit of gambling was thus excited at Rome, Pope Benedict XIII., who sat on the papal throne from 1724 to 1730, forbade the Genoese lottery, under the pain of banishment to those who gambled in it, and to those who received the money. As this threat however did not

remove the evil, the succeeding pope, Clement XII., who died in 1740, followed the example of our German princes, and caused a lottery to be established even at Rome. Since that time, permission for the same purpose has been renewed from year to year.

It was not till a much later period that the Genoese lottery was introduced into Germany. According to the account of J. A. Kalzabigi, who had made himself known in Italy by many projects, and was appointed a Prussian privy-counsellor of commerce and finance, the first was drawn at Berlin on the 31st of August 1763. In 1769, one was established in the principality of Anspach and Bayreuth, where it was continued till the year 1788. In 1774, a person named Wenceslaus Maurer came to Neufchatel, with permission from the king, and established a *Lotto* there much against the will of the prudent inhabitants; but some one having won a capital prize, for which the undertakers ought to have paid 30,000 francs, after procrastinating as long as they could, under various pretences, they at length became bankrupts, and made their escape from the country.

These pernicious lotteries continued till the end of the eighteenth century, when they were almost everywhere abolished and forbidden. They are now permitted only in a very few states, which are not able to give up the paltry income derived from them. To the honour of the Hanoverian government, no *Lotto* was ever introduced into it, though many foreigners have offered large sums for permission to cheat the people in this manner. Those who wish to see the prohibitions issued against the *Lotto*, after making a great part of the people lazy, indigent and thievish, may find them by the help of the index in Schlötzer's Staats-Anzeigen.

Si son exécrable mémoire
Parvient à la posterité,
C'est que le crime, aussi bien que la gloire,
Conduit à l'immortalité.

[The only lottery at present existing in England under the sanction of the government is the art-union of London. The first institution of this kind in Great Britain originated at Edinburgh in 1836, from the models existing in Prussia, formed under the patronage of the king and his minister Von Humboldt, about the year 1825. The money annually subscribed is expended in pictures, sculptures, &c. It is divided by the committee into

several portions or prizes, from £10 to £400, and on a certain day the prizes are distributed among the subscribers in the ordinary way. The prize-holders are then allowed to select works of art to the value of their respective prizes from any of the five annual exhibitions of works of art in the metropolis for the current year. A portion of the total sum subscribed is set aside and applied to the purpose of engraving and printing some work of art, a copy of which is given to each subscriber. Hence, by the combination of a very large number of persons to subscribe for this one work of art, and the avoidance of risk, incidental expenses, and publisher's profits, the print, though at least equal to what would be charged a guinea (the amount of subscription) in the ordinary course of trade, is supplied to the subscribers at so small a cost as to leave by far the greater part of the subscribed sum as a fund applicable to the purchase of prizes. Several similar associations have been since formed on a smaller scale in other parts of Great Britain.]

FOOTNOTES

[1023] And in Greek σύμβολα.

[1024] Many have written at considerable length on the *congiaria*, yet the difference between the *missilia* and *tesseræ* has not been sufficiently explained. The first, or at least the best account, is in Turnebi Adversaria, xxix. 9, p. 637. In a passage in the Life of Nero by Suetonius, xi. 11, p. 21, the articles which were thrown among the people are called *missilia*; but in regard to corn, the term *tesseræ* is expressly named.

The passages where a description is given of the manner in which the *tesseræ* were thrown out, are to be found in Dio Cassius. The wooden balls, like those of the Lotto, appear to have been hollow, and to have contained the ticket or written order. Those desirous of knowing how these *tesseræ* were formed, and of what they were made, may consult Hugo de Prima Scribendi Origine, Traj. 1738, 8vo, cap. 15, p. 229.

[1025] Juven. Sat. vii. 174.

[1026] This abuse of lotteries was mentioned by the states of Wirtemberg, in the year 1764, among the public grievances; and in 1770 the duke promised that it should be abolished. I must here mention, to the honour of our prince and government (the author alludes to Hanover), that since lotteries were found necessary in this country, not a farthing of the profit has gone to the treasury of the prince, but the whole has been employed for pious or charitable purposes.

[1027] Recherches de la France. Paris, 1665, fol. viii. 49, p. 729.

[1028] This word is still used in Germany by the writers on Tontines; such, for example, as Michelsen.

[1029] Both the orders may be found in Traité de la Police, par De la Mare, Paris 1722, fol. i. pp. 502, 504.

[1030] The whole establishment is particularly described in Sauval, Histoire et Recherches des Antiquités de Paris, 1724, fol.

[1031] Sauval, pp. 71, 73, 76.

[1032] Dictionnaire de Commerce, par Savary. Art. *Lotterie*.

[1033] All the orders here quoted may be found in De la Mare. Those desirous of being fully acquainted with the nature of the first Parisian lotteries, and the method of drawing them, may consult Histoire de la Ville de Paris, par Felibien. Paris, 1725, fol. ii. p. 1462.

[1034] Christ. Longolii Epistolarum libri iv. Basiliæ, 1570, 8vo, iii. 33, p. 239. The letter is addressed to Octavius Grimoaldo, who lived, I think, at Venice, and had written, it seems, to Longolius, that he was unwilling to venture his money in the lottery. That Longolius had in his hands money belonging to Grimoaldo is proved by the letters iii. 3, iii. 7, 20. “That new kind of gambling is truly ours, and is called by us *Loteria*, as it were, a table-vessel (*vasculia*);

doubtless from an arrangement of silver vessels appended to the gaming-table, which are distributed amongst those whose names are in the lottery, in such a manner that one vessel is assigned to each. But as you signify your disapproval of that kind of gaming, and do not think fit to expose my money to so much hazard, I acknowledge your prudence and kindness to me." This derivation of the word *Loteria* is undoubtedly false, as Menage has already remarked, in his dictionary, art. *Lot*. He there says, "Je n'ay point lu ailleurs que *lot* signifiast *de la vaiselle*. Et je croy Longueuil s'est mal expliqué, et qu'il a voulu dire qu'on appelloit *Loterie* la vaiselle d'argent d'un buffet, parceque de son tems on mettoit ordinairement à la loterie la vaiselle d'argent d'un buffet."

1035 Dier. Canicul. 1691, fol. tom. ii. colloq. 2.

1036 See Du Cange, art. *Lot*. Muratori, Antiquit. Ital. Medii Ævi, ii. p. 1240. Among the oldest German words in Lipsii Epistolæ ad Belgas, Cent. 3, 44, p. 49, stands *Los*, sors. The *t* is often changed into *s*. Thus *nut* in the English and Low German, *noot* in the Dutch, and *nöt* in the Swedish, are the same as the German *nuss*.

1037 The convenient machine and apparatus, by which the drawing is much forwarded at present, were not then known. A description of them may be found in Savary's Diction. de Commerce.

1038 Gent. Mag. xlviii. an. 1778, p. 470, from which I shall also transcribe the whole title of the scheme:—"A proposal for a very rich lottery general, without blanks, contayning a great number of good prizes, as well as of redy money as of plate, and certain sorts of merchandises, having been valued and prized by the commandment of the queen's most excellent majesties order, to the intent that such commodities as may chance to arise thereof, after the charges borne, may be converted towards the reperations of the havens and strength of the realme, and towards such other public good workes. The number of lotts shall be foure hundred thousand, and no more; and every lott shall be the sum of tenne shillings sterling, and no more. To be filled by the feast of St. Bartholomew.

The show of prises are to be seen in Cheapside, at the sign of the Queene's Armes, the house of Mr. Dericke, goldsmith, servant to the queene, 1567, 8vo. Printed by Hen. Bynneman." See also Maitland's History of London, 1756, fol. i. p. 257.—Northouck's History of London. Lond. 1773, 4to, p. 257.

1039 Hist. of Commerce.

1040 Commelin's Amsterdam, i. p. 440. In the year 1561 the profit on a lottery was employed for enlarging the Orphan House. See Pontani Rerum Amst. Hist. 1611, fol. lib. ii. c. 2.

1041 [Lotto does not consist, like the lottery, of a fixed number of tickets and a certain number of specified prizes, but is, in fact, a mere game of chance, at which the stakes are indefinite, and is thus played. A given quantity of numbers are placed together, of which a few are only to be drawn: the adventurers then select any one or more, on which they bet any sum they think proper; and, should they prove successful, they draw so much more than their stake, in a settled proportion, according as their risk was increased by the quantity of numbers which they named together. Thus the usual quantity is ninety numbers, from one upwards, and five only of these are drawn: if the adventurer chooses but *one* number out of the 90, and that it be one of those drawn, his stake is returned fifteen fold; if *two*, he receives, if they be drawn, 270 times the stake; if *three*, 5500 times; if *four*, 75,000 times; and should he name the *entire five, in the exact order in which they happen to be drawn*, he is entitled to 1,000,000 times more than the stake he ventured. These chances are all calculated largely in favour of the banker or holder of the lotto, and there is no instance upon public record of any person having named the five numbers in regular succession; but three have been frequently fixed upon, and even four have been sometimes, though rarely, attained: by the latter chance, the lotto established in 1774 at Neufchatel was ruined.]

BOLOGNA STONE.

The Bologna stone, in consequence of its property of shining in the dark, which was observed by accident, has given rise to many laborious researches and experiments, and to writings almost without number, which have not so much enlarged our knowledge of light, as proved that all the hypotheses hitherto offered by philosophers for explaining it, if not entirely false, are at least insufficient and uncertain. The history of this stone, therefore, though not unknown, deserves to be here repeated, especially as many parts of it require to be rectified.

As a complete description of it would be superfluous to mineralogists, it may be sufficient to remark, that this kind of stone is found in plates or single pieces, which in general are more or less of a conical form, have a dirty white or semi-transparent water-colour, and a foliaceous structure, which is observed on its being broken, though the stone, considered in another direction, appears to be fibrous. The surface of single pieces is uneven. But what distinguishes this species from the gypseous spars, to which it bears the greatest resemblance, is its extraordinary weight; and this it has in common with all the varieties of heavy spar, to which, according to its component parts, it belongs.

This stone is found on different eminences around Bologna, and particularly on the hill of Paderno, which is situated at the distance of about a German mile from the city, loose, and scattered about between gypseous stones, in a marly earth, some of which is still seen adhering to pieces in my possession. It is found most readily after heavy rains, particularly in the streams which run down the sides of the hill; and it is there collected by persons who sell it at Bologna. In the year 1730, when Keysler was there, a pound of it could be purchased for a *paolo*[1042].

I shall take this opportunity of remarking, that the Bologna stone, according to its external characteristics, heaviness and hardness excepted,

has a great similarity to those gypseous spars or selenites which were first described by Lehman[1043], and at the time perhaps by him alone; according to whose account, it is mentioned also by Vogel[1044] and by Wallerius[1045], under the name of *Selenites globosus*: on the other hand, it has not been mentioned by modern mineralogists under any particular appellation. In the county of Mansfeld it is found in detached masses or single pieces, more or less conical; and, to judge from the earth purposely left on the specimens in my possession, which were picked up in the neighbourhood of Sangershausen, in a yellowish-red sandy clay. The pieces, many of which are round balls, two or three inches in diameter, and others longish rolls, have, externally as well as internally, a grayish colour, appear foliated on the fracture, or seem to consist of cuneiform radii, which meet in the centre of the ball. Many are hollow in the inside; and in this case the ends of the cunei or needles, which have between them a granulated gypsum mixed with a little clay, project into the cavity. Lehman says that the leaves, when placed in a heated stove, emit a hesperus, that is, shine; and this circumstance made Wallerius doubtful whether this selenite did not belong to the fluor-spars; but it is undoubtedly a sulphate of baryta. When the crude stone is put into acids, a very faint effervescence is sometimes observed, arising from foreign matters; but when burnt pieces are employed, this effect is much stronger. It does not crack or break in the fire; but if exposed only a short time to a red heat, it becomes totally opake, whiter, and void of all lustre; it is also more friable, and crumbles to dust in water, exactly in the same manner as bastard *lapis specularis*. The luminous appearance in a warm stove I did not observe in the few pieces which I subjected to experiment. I was desirous to make this remark, because the mineralogists before-mentioned place globular selenite along with the Bologna stone, to which however it does not belong.

To render it capable of shining in the dark, a piece particularly heavy, foliaceous and pure, must be selected[1046]. After being made red-hot, it is pounded and reduced to a fine powder, which, by means of a solution of gum-tragacanth, is converted into a kind of paste, and formed into small cakes. When these are dried, they are brought to a state of ignition between coals, and then suffered to cool; after which they are preserved from the air and moisture in a close vessel. If one of these cakes be exposed a few

minutes to the light, and then carried into a dark place, it will shine like a burning coal. It appears therefore to attract the light, or to be as it were a light-magnet. This power of emitting light becomes lost in the course of time; but it may be restored at first by heating, and afterwards by exposure again to ignition. I shall pass over the rules necessary to be observed in the numerous experiments made with this stone, as well as the consequences deduced from them. The former may be found in works on chemistry, and the latter in those on natural philosophy.

All the Italian writers who first describe this remarkable phænomenon give the following account of the discovery. At the beginning of the seventeenth century there was at Bologna a shoemaker, who, having quitted his trade, applied himself to chemical labours, and particularly to the art of gold-making. I do not know whether those who have made the very just remark, that many shoemakers go beyond their last into the province of other arts or sciences, have mentioned among the already numerous instances this shoemaker of Bologna, whose name was Vincentius Casciorolus; but he certainly deserves a niche in the temple of fame, because it may with truth be said of him, that he kindled up a light to the learned; whereas the shoemaker of Görlitz, Jacob Behmen, darkened or extinguished the existing light to the learned as well as the unlearned, so that the minds of many are still left in obscurity.

In the year 1602 Casciorolus came to Scipio Begatello of Bologna, who at that time was particularly well known by his attachment to the art of gold-making, and showed him this stone, under the mystical name of *lapis solaris*, which, on account of its weight and the sulphur it contained, as well as of its attracting the golden light of the sun, seemed to be fit for converting the more ignoble metals into gold, the *sol* of the alchemists. He showed it also to J. A. Maginus, the professor of mathematics; and the latter, who in all probability was no adept, sent both the natural and prepared stones to princes and learned men, and perhaps contributed more than any other person to make known this singular discovery[1047].

It however appears as if the Italian chemists concealed the preparation of this stone, or were not all acquainted with it. It was always said to be a secret known only to a few individuals in Bologna. Misson, who was there in the year 1690, asserts that Bartholomew Zanichelli was the only person

at that time in possession of it. In 1666 it was announced in the Philosophical Transactions[1048], that a clergyman, who exclusively possessed the art, had died, without communicating it to any one. Niceron[1049], Lemery[1050], and many others say, that Homberg, during his residence at Bologna, had again discovered it, after many experiments; and that Lemery learned it from him and made it publicly known.

This however cannot be altogether true; for in the year 1622, P. Potier, or Poterius, a French chemist, who lived at Bologna, taught the preparation of it in his work already quoted, as did Kircher[1051] in 1641, and the jesuit Casati[1052] in 1686; though the process then employed was indeed not the best or most convenient; the proper method being first found out, after many accurate experiments, by the German chemist Marggraf, who showed also how similar light-magnets or luminous stones can be prepared from most of the heavy spars and fluor-spars[1053].

But even at present, those who prepare this stone for sale at Bologna talk in such a manner as if the secret were known to them alone. This was the case, in 1771, with the director of the institute in that city[1054]. Keysler purchased a piece, as large as a dried fig pressed flat, for about two or three *paoli*.

I shall embrace this opportunity of bringing to recollection, from De Thou's history of his own times, a relation which indeed contains many things incredible, and in all probability exaggerated, yet seems to be too well confirmed to be altogether rejected as false. If this be admitted, it may then be conjectured that, about the year 1550, either the Bologna stone, or what at present is called *phosphorus* and *pyrophorus*, was known to a few individuals. In the above year, when Henry II. king of France made his solemn entrance into the town of Boulogne, on its restoration by the English, a stone from India, which was not hard, which had a luminous appearance like fire, and which could not be touched without danger, was presented to him by a stranger. For the truth of this account De Thou refers to the testimony of J. Pipin, in a letter to Ant. Mizaud, who asserts that he himself saw the stone. Morhof, who seems inclined to consider this stone as that of the philosophers[1055], remarks that this passage is found in the first

Paris edition in octavo, and in the Frankfort re-impressions, both in folio and octavo; but not in the other editions. He quotes also the words from the letter to Mizaud, which must be printed somewhere, but in what work I do not know. It appears that the historian inserted it almost without any change.

[We may take this opportunity of describing one or two other pyrophori: thus Canton's pyrophorus is prepared by heating a mixture of three parts of sifted calcined oyster-shells with one part of flowers of sulphur to an intense heat for one hour; Homberg's, by mixing equal weights of alum and brown sugar, and stirring the mixture over the fire in an iron ladle until quite dry; it is then put into an earthenware or coated glass bottle and heated red-hot as long as a flame appears at the mouth; it is then removed, carefully stopped and suffered to cool. The black powder which it contains becomes glowing hot when exposed for a few minutes to the air.]

FOOTNOTES

1042 [Several localities are now known for this peculiar variety of heavy spar; among others we may mention Amberg in the Upper Palatinate, and near Osterode in the Harz mountains.]

1043 Geschichte von Flötz-Gebürgen. Berl. 1756, 8vo.

1044 Mineral System. Leip. 1762, 8vo.

1045 Syst. Mineral. 1772, 8vo, i. p. 162.

1046 [In preparing solar phosphorus from the Bolognian stone, it should be carefully separated from any contamination of iron or other heavy metals, formed into a paste as above-described, and exposed to the heat of a wind-furnace for an hour or two.]

1047 Fortunii Liceti Litheosphorus, sive de lapide Bononiensi. Utini 1640, 4to, p. 13. He calls the shoemaker *Casciorolus*, which seems to be wrong, as Lemery and others write his name *Cascariolo*. Licetus refers to the letters of Ovidio Montalbani. Epist. var. ad Eruditos viros de Rebus in Bononiensi tractu indigenus, ut est lapis Illuminabilis et lapis specularis, calamonastos, &c., Bonon. 1634, 4to. Among the oldest accounts are those in Petri Poterii Pharmacopœia spagyrica, ii. 27, in Opera, Fran. 1698, 4to. In this work the alchemist is called *Scipio Bagatellus*, a name which does not occur in Fantuzzi, Notizie degli scrittori Bolognesi.

1048 An. 1666, n. 21, p. 375.

1049 Mémoires des Hommes Illustres.

1050 Cours de Chymie. Dresd. 1734, 8vo.

1051 Magnes, p. 481.

1052 De Igne. Franc. 1688, 4to, p. 350.

1053 Marggrafs Chymische Schriften, ii. p. 119. This author says the cakes must be only as thick as the back of a knife; but that which I obtained in the year 1782 from Bologna, was an inch English measure in diameter, and two lines in thickness. It still weighs, after the brass box in which I long preserved it between cotton in a luminous state, has become black, and itself has lost its virtue, three drachms. In colour it has a perfect resemblance to the star which Marggraf prepared from German stones, and presented to Professor Hollman, and which is now in my possession. It is contained in a capsule of tin plate, over which a piece of glass is cemented.

1054 Ferber’s Briefe aus Wälschland, p. 75.

1055 Polyhist. i. 1, 13, 26, p. 127.

FOUNDLING HOSPITALS.

Child-murder is so unnatural a crime, that mankind can be brought to the commission of it only by the greatest desperation, for which unfortunately there is too much cause. To parents who are just able by incessant labour to procure those things indispensably necessary to support life, the birth of every child increases the fear of starving or of being reduced to beggary. Those who have secured to them a scanty subsistence, but who live amidst the torments of slavery, wish to the new-born child, which at any rate is doomed to death, a speedy dissolution, before it can know that it has had the misfortune to be brought into the world, in order that they may not bequeath to it their poverty. A young female who has acquired by education the most delicate sense of honour and shame, finds herself, on the birth of an illegitimate child, exposed at once to the utmost disgrace and contempt. Her misfortune, though viewed with an eye of pity by the compassionate, excites the hatred of the greater part of her relations and friends, by whom she was before loved and respected, and who endeavoured to render her happy; and often amidst the most poignant feelings, and an agitation bordering on madness, she sees no other means of saving her honour than the total concealment of her error by destroying the child: a resolution which, notwithstanding the vigilance of the laws, is too often attended with success. A young woman who at this moment finds herself suddenly despised and neglected by her admirer, who gained her affections by the most powerful of all means, love and confidence, and obtained from her what she can never recover, is often induced, in a fit of despair, to vent her fury on the consequences of her seduction—the child of her seducer.

These misfortunes of mankind are among the disadvantages attending civilised society, which always render marriage more difficult as well as burthensome, and thereby make it impossible to gratify one of the most powerful impulses of nature. In the savage state, parents require no more for themselves and their children than what they can easily obtain. The

inhabitants of Terra del Fuego, who live at the greatest distance from all culture, find shell-fish and esculent plants sufficient to appease their hunger; never are their thoughts disturbed by care for the maintenance of a child. The black slaves in St. Domingo say, that “it is only the white man who begs;” and indeed in this they are right[1056]. Beggars exist only where they are established by religion and governments which command them to be fed. But the transition from living by one’s own industry to beggary is, in consequence of the shame attending it, most painful and insupportable to those who with the greatest exertion and waste of strength, amidst the privation of every comfort, are exposed with their children to the horrors of famine. On the other hand, to those who, in our states, are obliged to eat the bread of mendicity, children are a blessing; because as long as they are incapable of running alone, they increase their alms by exciting greater compassion, and afterwards by begging in the streets[1057].

It is not therefore poverty already reduced to the state of beggary, but the dread of being at length overwhelmed notwithstanding every exertion to swim against the stream, that occasions child-murder. The same is the effect of slavery, which excludes the possibility of even hoping for a change to a better condition. The serfs of a hard-hearted land-proprietor, who however acted according to the established laws, entered into a resolution to get no children, that they might not be under the necessity of putting any of them to death[1058]. The sense of honour becomes stronger the more the manners approach towards a certain degree of refinement; and it is proved that it is this cause which, in most instances, gives rise to child-murder. In vain have legislators endeavoured to prevent this crime by capital punishment, more cruel than the crime itself. But indeed it is difficult, or rather impossible, to proportion punishment to delinquency or the just degree of guilt.

It needs excite no wonder that many states where the Christian religion was not introduced, and even the Jewish, made no law against child-murder, though the atrocity of it was never denied[1059]. To render this crime less frequent, men fell upon the way of exposing children, in the hope that they might be found by benevolent persons, who would educate and maintain them. Parents imagined that in this manner less violence was offered to humanity, and they could more easily be induced to resign their children to

chance than to become their murderers. They consoled themselves with the possibility, proved by various examples, that the exposed children might be saved, and be more fortunate than their parents[1060]. To promote this, they deposited them in places where a great many people might be expected soon to pass, and where the child would consequently be found before it should perish by cold and hunger or be devoured by ravenous animals.

With this view they made choice of the market-places, temples, places where two or more highways met, wells, the banks of rivers or the sea-shore, from which water was brought or which were the usual places of bathing; and even, when the children were placed in the water, means were contrived that they should at any rate float some time without being injured. For this purpose they were placed in small chests, trays, or close baskets, or wrapped up in waterproof bandages[1061]. At Athens children were commonly exposed in that place called *cynosarges*, which was one of the *gymnasia*. At Rome the most usual place was that pillar called *columna lactaria*, which stood in the market where kitchen vegetables were sold[1062].

When the exposure of children in civilised states began to be condemned as unlawful, it was however suffered to pass unpunished, even under the first Christian emperors. Legislators only endeavoured by regulations of every kind to render it less common, and to provide for the maintenance of children; until at last, through horror at the cruelty of it, but without thinking of the causes or attempting to remove them, they conceived the unfortunate idea, in order to guard against this crime, of declaring it to be murder, and punishing it as such. It became then much safer for parents to bury children, or to throw them into the sea, than to run the chance of exposing themselves to the utmost shame and punishment, when they were searched out and discovered. In Greece, but not at Thebes in Bœotia[1063], the exposure of children was permitted and common, and therefore many of the Greek historians mention the contrary as a foreign but meritorious custom. Strabo[1064], on this account, praises the Egyptians, and Ælian[1065] extols the laws of the Thebans against the killing and exposing of children. This cruel practice was equally common at Rome. Romulus however, who was himself a foundling, endeavoured to restrain it, and his

order was confirmed in the twelve tables; but as population, luxury, scarcity, and dissipation increased, it became customary for those who had more children than they wished, to expose some of them. Many deposited with them rings and other costly ornaments; and those who were poorer, trinkets of little value, partly to entice people to receive the children, and partly that, by describing these appendages, when the children were grown up, or their own circumstances had become better, they might be able to recover them.

Even at present, in many places, the children carried to foundling hospitals are accompanied by tokens, which are carefully preserved, as is the case in the Spedale degl' Innocenti at Florence, where a piece of lead imprinted with a number is hung round the neck of each babe, in such a manner that it cannot be easily removed, and occasions no inconvenience in the wearing. By these means one can obtain information there, even at a late period, in regard to each child[1066].

It is mentioned by Tacitus[1067], as a circumstance deviating from the Roman manners, that the old Germans considered child-murder as a crime; and where he speaks of the peculiarities of the Jews, he does not fail to relate the same thing of them[1068]. Dionysius of Halicarnassus bestows the like praise on the Aborigines[1069].

When the morals of mankind began to be improved under the influence of Christianity, its followers endeavoured by every means in their power to banish from among them this cruelty, on account of which they so bitterly reproached the Romans[1070]. The first Christian emperors, however, did not venture to forbid it as a crime; though Constantine called exposure a kind of murder, and wisely exerted himself to remove the causes of it. By an order issued in the year 331, he endeavoured to deter parents from it, as he there deprived them of all hope of being able to claim or recover exposed children, even if they should make good the expenses incurred by those who had maintained them[1071]. This cruel practice was nevertheless continued for a long time after. Lactantius[1072], who lived under the reign of Constantine, describes it as a still prevailing remnant of barbarity; and Julius Firmicus, who wrote about the year 336, considered it worth his while to give particular instructions for casting the nativity of

foundlings[1073]. The exposure of children was not completely prohibited till the time of Valentinian, Valens and Gratian, in the last half of the fourth century[1074].

One cannot, without reluctance, believe that this barbarous practice was so long permitted, or remained unpunished, in civilised states; but it must be mentioned, to the honour of antiquity, that in many countries the care of government was directed at an early period to exposed children. Not only were means pursued in Greece and Rome to encourage the reception and educating of foundlings, by assigning them as property to those who took them under their protection; but it was also made a law, that foundlings who were not received by private persons should be educated at the public expense. At Thebes, where, as already observed, child-murder and the exposure of children were forbidden, parents in needy circumstances were desired to carry their new-born children to the government, and the latter committed them into the hands of those who engaged to take the best care of them for the least money. In the like manner, at present, foundlings are placed with nurses to be maintained at the cheapest rate; but with this difference, that at Thebes the children became slaves for life to those by whom they were educated, whereas in our times, when they grow up they are free people and learn to gain a livelihood for themselves.

The humane decrees of the emperor Constantine the Great, both for Italy and Africa, the first in the year 315, and the second in 322, deserve here to be mentioned. The governments in those countries were enjoined to prevent the murder, sale, giving in pawn, or the exposure of children, by taking care that parents who were too poor to educate their offspring, should receive from the public treasury or magazines, or from the emperor's privy purse, as we say at present, food, clothing and other necessaries; and as new-born children required immediate attention, that this should be done without any delay[1075].

The conjecture of Gothofredus, that the emperor was induced to adopt these measures by the urgent representation of Lactantius, appears to me highly probable. This writer, from the year 317, had been tutor to prince Crispus, and had before dedicated or transmitted to the emperor his book, wherein he painted, in glowing colours, the detestable practice of parents

then prevalent, which gave rise to the greatest disorders; and on that account he offered them the specious advice not to beget more children than they were able to maintain. I am inclined to think that this advice did not much please the emperor, who was obliged to keep on foot a numerous army; and as it could not be very agreeable to many married persons, he comprehended this recommendation of prudence or moderation among those calamities from which he was desirous to preserve parents by the above decrees.

After these imperial orders, children remained with their parents, and were educated by them; but it appears that the cities of Athens and Rome had, at an early period, public orphan-houses, in which children were educated at the public expense. What has been already said of the gymnasium called *cynosarges* may serve as a proof; and Festus and Victor make it still more certain that there was an institution of this kind at the *columna lactaria*. At any rate there can be no doubt that, in the sixth century, there were houses at Rome for the reception of deserted children.

The emperor Justinian, who by a particular law, in the year 529, declared foundlings to be free, and forbade those by whom they were received and educated to treat them and detain them as slaves[1076], often introduces these establishments, under the appellation of *brephotrophium*, in his laws respecting donations to churches and other beneficent institutions[1077]. This word, composed of the Greek term *brephos* a child, and *trepho* to educate, seems to show that houses of this kind were established at an earlier period in the cities of Greece, and were only imitated at Rome; though of this I have as yet found no proof. Du Cange and Stephen have both introduced the word in their Greek dictionaries, but refer only to the Justinian code. Gesner, in Stephen's lexicon, makes a distinction between *brephotrophium* and *curotrophium*; the latter, it is said, means a house in which grown-up and not new-born children are educated, and the same thing is repeated in the same words in Calvini Lexicon Juridicum. Both assert that this word, formed from κοῦρος or κόρος, *puer*, is used by Justinian, but does not occur in the book of laws, nor is used by Brisson. It is not to be found in the dictionary of Basle nor in Stephen's Greek Lexicon, but both these have the word κουροτρόφος, which indeed occurs in Homer and in Hesiod. As Calvin and Gesner refer to Hottoman, I

am inclined to think that the word was coined by him, especially as Gesner in the Thesaurus of Faber says, “Curotrophium *potest dici* domus alendis parvulis destinata.”

It is rather astonishing that no mention of the oldest institutions of this kind, or of their establishment, is to be found in the works of the ancients. There is reason however to conjecture, that as long as the sale of children and the slavery of foundlings were permitted, the number of those maintained at the public expense could not be very great. But respecting the *brephotrophia*, even under the later Christian emperors, nothing is said to be found that can give us any idea of the manner in which they were regulated; nothing in regard to the place from which the nurses were procured, or how food and clothing were provided for the children, and as little in regard to the number of children reared in these benevolent institutions who lived to become old.

It might be satisfactory to know, whether the oldest institutions of this kind were more fortunate in answering the object of their establishment than our expensive orphan-houses are at present.

The great difficulties which attend institutions of this kind are, no doubt, the chief cause why mention of them so seldom occurs during the later centuries, in which the foundation of hospitals, and donations to these and other pious establishments, were so numerous; they are however found so often, that it is impossible to consider them as an invention of modern times. I shall here point out those instances which have hitherto occurred to me; but must first observe, that many more will be found in perusing the lives of saints, and the history of convents, religious orders, churches and towns. Wherever they are mentioned, they are always under the inspection of the clergy.

The oldest establishment for orphans in Germany, which I can mention at present, is that at Triers, in the eighth, or seventh, or even sixth century; the account of it is to be found in the life of St. Goar, who lived at Triers under Childebert, consequently in the last half of the sixth century. His historians or panegyrists relate that, being accused before archbishop Rusticus of many misdemeanours, as a proof of his innocence he hung up his hood upon one of the sun’s rays, which entered his cell, as if upon a nail, and that his enemies were still so incredulous as to consider him guilty. The

archbishop then, continue they, to whom a new-born child, which had been deposited in the marble conch before the church-door, had been brought, asked him, as a proof of his sanctity, whether he could tell the father of it; upon which Goar, after a most fervent prayer, commanded the child, in the name of the Father, Son and Holy Ghost, to declare who were its parents. The child, with a clear voice, immediately named its mother, and also its father, the archbishop himself, who in consequence was deprived of his dignity[1078].

The small portion of truth contained in this ridiculous story is, that, at the time when the author wrote, there was an establishment for foundlings at the church of Triers; that the children were deposited in a marble conch placed before the church; that they were received by poor people maintained in order to watch the church, and who were called *matricarii*, because they were matriculated in it, and by them carried immediately to the bishop, and that the child under his sanction was given to some person in the community who agreed to take care of it. These foster-parents were named *nutricarii*. It may be thence easily perceived, that there were then no orphan-houses properly so called, in which children are educated; but that the children, as is the case in our institutions for the poor, were given to others to be nursed, and in all probability the clergy paid to the *nutricarii* a certain sum from the alms destined for that purpose.

One of the lives which relates to the silly tale already mentioned was written by an author who, according to the opinion of Mabillon, lived at a period not much later than St. Goar. The other is by Wandelbart, who lived in the ninth century, and who refers for his authorities to old manuscripts and other documents, *vetusta et perantiqua exemplaria*. It may therefore with safety be asserted, that this establishment for foundlings existed at Triers in the eighth century. The annalists of Triers, indeed, do not mention any bishop named Rusticus who lived about that period; but no doubt needs be excited on that account, as this difficulty may be solved in more ways than one[1079].

In the seventh century there were similar establishments at Anjou, or Angers, in France. St. Magnebodus, who was bishop of that place, where he died, and was buried in the church called at present Saint Mainbeuf, is

praised in a very old life of him, never yet printed, for having caused several houses for the rearing of children to be erected[1080].

In the following century, that is about the year 787, an arch-priest named Datheus, established at Milan, at his own expense, a foundling hospital, in order to put a stop to the crime of child-murder, which had been introduced, and of which he gives a very affecting account in the letter of foundation. With this view he purchased a house near the church, and issued an order that the foundlings (*jactati*) should be suckled in it by hired nurses, and educated for seven years. They were to be taught some handicraft; to be supplied in the establishment with food, clothing and shoes, and at the age of seven to be discharged as free-born[1081]. It deserves to be remarked, that the mothers of children carried to such establishments strewed salt between the swaddling-clothes, when they wished to announce that the child had not been baptized. This perhaps had a reference to the circumstance of new-born children being washed in salt water; but I conjecture that the salt thus interspersed was meant to denote that the child had not been washed, and much less baptized.

In the capitulary of Charlemagne we meet with all the *loci venerabiles* of the Justinian code: *xenodochium*, *ptochotrophium*, *nosocomium*, *orphanotrophium*[1082], *gerontocomium*, and also *brephotrophium*[1083]. But at that time, at least among the Franks, the foundlings belonged to those by whom they had been received and educated, unless they were demanded back by their parents or relations within ten days[1084]. It is not improbable that the same practice prevailed at this time in other countries; and perhaps the founder of the foundling hospital at Milan, on this account, declared so expressly that the children, when they grew up, were to be discharged from the institution, as persons born free.

In the year 1168, St. Galdinus, cardinal and archbishop of Milan, exercised great severity against heretics; but took particular care of the poor, who believed what he taught; namely, that the hospital there considered itself obliged, not only to receive the sick, but also such children as might be exposed in the city, and to provide them with food and clothing[1085].

In 1070 Olivier de la Trau founded at Montpellier an order, the members of which called themselves *hospitalarii*, sive *spiritus*. They entered into an engagement to take care of the poor as soon as possible, and to provide for the maintenance and education of foundlings and orphans. In the course of a little time they spread themselves into different countries; and wherever they went, the effects of their benevolent vow are still to be found. Some say that the institution for foundlings, or the Hospital of the Holy Ghost, at Montpellier, was established in the year 1180. In 1201 they settled at Rome, and, according to the testimony of historians, formed there an establishment of the same kind, after they had been confirmed by Pope Innocent III., in the year 1198, and obtained for that purpose an elegant mansion, fitted up in the best manner. In the papal bulls mention is made of many convents founded by this order; and I am inclined to think that those who might take the trouble to examine thoroughly the confused history of these hospitallers, or of this order of the Holy Ghost, and of the still existing hospitals distinguished by that title, would find much information in regard to this subject. I call the history confused, because there have been many kinds of hospitallers and similar orders, and these have often been confounded with each other[1086].

Our neighbourhood had similar establishments at an early period. At any rate there was one of this kind at Einbeck, before the year 1274, that is to say, an hospital of the Holy Ghost. It began to be built by duke Albert, who brought Einbeck to the house of Brunswick, when it submitted to him in 1272, in order to get rid of the importunity of count von Dassel. Alms were collected for its establishment and maintenance; and to promote these, the council issued recommendations, or letters-patent, in which it was expressly stated, that not only the indigent, and among these foreigners, were received into their hospital, but also orphans and foundlings, who were maintained and educated till they grew up. Such recommendations were from time to time repeated, for one still exists of the year 1300, which is a literal transcript of that issued in 1274. I do not believe that the hospital at Einbeck was established by the order before-mentioned; at any rate, hospitals of the Holy Ghost occur chiefly in the twelfth and two following centuries; and were founded, not by hospitallers, but established perhaps upon their model.

In this manner a rich citizen of Nuremberg, Conrad Heinz, surnamed *der Grosse*, founded the hospital of the Holy Ghost, in 1331. It began to be built in 1333, and was completed in 1341. Neither in the letter of foundation, however, nor in the confirmation, are foundlings particularly named; but it may be readily seen that this institution received poor pregnant women, and educated the children which were either born in it or admitted into it. In the like manner pregnant females, both married and unmarried, and also foundlings, are received into the hospital of St. John, at Turin. The founder of the house at Nuremberg made it a rule, that the day of the birth or reception of each child should be written down, in order that the expense incurred by it might be known, in case it should ever be able and inclined to repay it[1087].

The magnificent foundling hospital at Florence, called at present *Spedale degl' Innocenti*, was founded in 1316, by one Pollini. There can be little doubt that this is the same establishment for which the well-known Camaldule monk, Ambrosius, often mentioned under his family name Traversari, solicited support from the pope, in the beginning of the fifteenth century. He boasts that the foundlings received by this institution, which he calls *brephotrophium*, were first given to nurses to be suckled, and then admitted into the house and instructed. Girls fit for marriage were furnished with a portion. Citizens also were accustomed to send their children to be educated in the school of this hospital[1088].

L'Hopital du S. Esprit, at Paris, is said to have been founded in 1362, and various persons out of compassion for the exposed children contributed the money necessary to its support. A brotherhood, called la Confrairie du S. Esprit, established to conduct the affairs of the institution, was confirmed the same year by pope Urban V.

Paris, however, from time to time obtained more institutions of this kind. In the year 1638 a widow devoted her house to this purpose, and on that account it was called la Maison de la Couche, a name still given to the foundling hospital at the church of Notre Dame. But it was soon found necessary to abandon this well-meant institution, in consequence of the shameful abuses which had crept into it. The nurses often sold the children to beggars, who distorted or mutilated their limbs, in order that they might

excite more compassion, and thereby obtain greater alms. Many were purchased also for magical purposes. The price for each was twenty sous.

St. Vincent de Paule, of the congregation St. Lazare, founded, in 1640, a new institution, which in 1670 was transferred to the street Notre Dame. It obtained new improvements by the chancellor Etienne d'Aligre and his lady Elizabeth Luillier. At present this house is known under the name l'Hopital des Enfans Trouvés, or de Notre Dame de la Misericorde.

That an institution for foundlings at Venice, named before the destruction of the republic Della Pietá, was established in 1380, by a Franciscan named Petruccio, I have somewhere read, but in what author I do not at present remember.

In England a proposal for a similar institution was made so early as 1687; but the present foundling hospital was not established till the year 1739[1089]. I shall not however enlarge further on the modern institutions of this kind: my object was to show that they are by no means a new invention, and that they have been continued from the oldest periods to the present time through all ages, and even in those which we are accustomed to call barbarous.

In our times most of the foundling hospitals have been suffered to fall to decay; chiefly because, to answer the benevolent purpose for which they are intended, they would require to be on a larger scale and better supported than it is possible for them to be at present; also because they do not entirely prevent child-murder, as they are not capable of completely removing the causes of it. After the establishment of the foundling institution at Cassel, not a year passed without some children being found murdered, either in that place or its neighbourhood. To this may be added also, that it is impossible with the utmost exertion to provide sound nurses for the continually increasing number of children brought in, and to ensure to them sufficient attention.

From the year 1763 to the end of 1781 the number of children brought into the foundling hospital at Cassel amounted to 740, of whom no more than eighty-eight remained alive at the end of the latter year. More than one half of them died under the age of eight, and scarcely ten attained to their fourteenth year. In Paris, in the year 1790, more than 23,000, and in 1800

about 62,000 children were brought in[1090]. In 1790, of the children which had been brought in between 1774 and that period, 15,000 only were alive; and it is estimated that 11/13 of all the children brought in perish annually through hunger or neglect. Of 100 foundlings in the foundling hospital at Vienna, 54½ died in the year 1789. In 1797, the nurses in the foundling hospital at Metz had for fourteen months received no wages, and calculation showed that 7/8ths of the whole children perished. In an institution of this kind, in a certain German principality, only one of the foundlings in twenty years attained to manhood, and yet the establishment had cost the country annually 20,000 dollars at least. The education of no German prince ever cost so much.

The case with foundling hospitals is the same as with the artificial breeding of fowls; it is easy to obtain chickens, but for want of maternal feeding and care it is almost impossible to rear them. Of what use then is it to collect chickens?

FOOTNOTES

1056 The negroes in St. Domingo cannot bear to be thought poor, or to be called beggars. They say none but white men beg; and when any one asks alms at the door, they observe to their master, “There is a poor white man, or a poor Frenchman, begging.” Labat had a negro who gave away a small part of his property, merely that he might have the proud satisfaction of being able to say, “There, white man; there is an alms for you.” But, in all probability, there will be beggars even in St. Domingo, if the negroes are so fortunate as to establish the freedom which they have obtained at the expense of so much blood, and to form a negro state.

1057 During a great scarcity at Hamburgh, when bread was distributed to the poor, one woman told another, to whose request no attention had been paid, that she brought her child with her, and pinching it so as to make it cry, excited compassion and by these means

received bread. The latter begged the other to lend her the child for the like purpose, and having made it cry obtained bread also; but when she returned and wished to restore the child with thanks, the mother was not to be found, and therefore she was obliged to keep the child.

1058 In the course of nine years not a single individual announced an intention of marrying. The young people supplied their wants in another manner. Hence arose a scarcity of men, who cannot be purchased in Europe, as in the West Indies. The proprietor, therefore, was obliged to sell his estate. The purchaser improved the condition of his serfs, and marriages became common among them. See Büsch vom Geld-umlauf. vi. 3. § 35, p. 393. “La dureté du gouvernement peut aller jusqu’à detruire les sentimens naturels, par les sentimens naturels mêmes. Les femmes de l’Amerique ne se faisoient-elles pas avorter, pour que leurs enfans n’eussent pas des maîtres aussi cruels?”—Montesquieu, Esprit des Loix. Amst. 1758, 12mo, ii. p. 402.

1059 See an Enquiry by Michaelis, why Moses did not introduce into his laws anything in regard to child-murder.

1060 The cause of children being exposed in this manner has been assigned and ably examined by Lactantius, vi. 20, 21; from whose remarks one will readily comprehend how parents could be so hard-hearted.

1061 Many preparations for this purpose may be seen quoted in Hofmanni Lexicon Universale: art. Exponendi mos.

1062 Pomp. Festus de Verb. Signif. p. 203.

1063 Aristot. Polit. vii. 16.

1064 Lib. xvii.

1065 Variæ Histor. ii. 7.

1066 Such appendages or tokens were called crepundia. Instances of their use may be found in Heliodor. Æthiop. iv. 7., also in many comedies.

1067 De Mor. Germ. cap. 19.

1068 Histor. v. 5.

1069 Lib. i. cap. 16.

1070 Minucii Felicis Octav. xxx. xxxi.

1071 Cod. Theodos. lib. v. tit. 7, De Expositis, l. 1, p. 487, edit. Ritteri, where the whole has been proved and illustrated by Gothofredus.

1072 Lactant. vi. 20, 21.

1073 Astronom. lib. vii. c. 1. I shall refer those desirous of becoming acquainted with all the proofs belonging to this subject to Ger. Noot, Opera Omnia, Col. 1732, fol. p. 493. The observations on Minucius Felix, pp. 307 and 326, in the beautiful edition Lugd. Bat. 1709, 8vo, deserve in particular to be read.

1074 Cod. Justin. lib. iv. tit. 52.

1075 Codex. Theodos. lib. xi. tit. 27.

1076 Cod. lib. viii. tit. De Infant. Expos. l. 3.

1077 Cod. lib. i. tit. 2, De Sacrosanctis Eccles. 19, p. 19: “Si quis vero donationes usque ad 500 solidos in quibuscunque rebus fecerit, vel in sanctam ecclesiam, vel in xenodochium, vel in nosocomium, vel orphanotrophium, vel in ptochotrophium, vel in gerontocomium, vel in brephotrophium, vel in ipsos pauperes, vel in quamcunque civitatem; istæ donationes”.... The same names are repeated in the law 23 immediately following; also in Novell. Collat. 8, tit. 12, cap. 1, p. 219, and Coll. 9, tit. 3, cap. 1, p. 245. Here not only foundling hospitals, but poor-houses in particular, are mentioned.

The former are named also in Cod. lib. 1, tit. 3, De Episc. et Clericis, l. 32, p. 32, and in the same l. 42, 5 and 9; likewise l. 46, 1.

1078 The life of St. Goar is to be found in Acta Sanctorum, Jul. 2, pp. 327–346; also in Mabillon's Acta Sanctorum Ordinis S. Benedicti, Venetiis, 1733, fol. p. 266; but at page 273 of Mabillon there is another life by Wandelbart, in which the story is fuller and more circumstantial.

1079 Meusel's Geschichtforscher, iv. p. 232.

1080 Du Cange, under the word *brephotrophium*, has quoted the passage.

1081 Muratori has printed the letter of foundation in Antiq. Ital. Medii Ævi, t. iii. p. 587.

1082 "In quo parentibus orbati pueri pascuntur." These orphan-houses then were expressly distinguished from the foundling hospitals.

1083 Baluzii Capitularia Reg. Franc. i. p. 747; Capit. lib. ii. 29.

1084 In the Capitulare, composed about the year 744, in Baluz. p. 151.

1085 See Muratori Antiq. Ital. Medii Ævi, iii. p. 591.

1086 See Greg. Rivii Monastica Historia Occidentis. Lips. 1737, 8vo cap. 34. The name of the author was Lauterbach.

1087 The documents may be found in Von Murr Beschreibung der Merkw. in Nürnberg, 1801, 8vo.

1088 Martenne, Vet. Script. amplis. Collectio. Paris, 1724, fol. iii. p. 15.

1089 [The foundling hospital of London was founded in the year 1739, by charter of king George II., on the petition of captain Thomas Coram, and the memorial of sundry persons of quality and

distinction. It maintains and educates 500 children, from extreme infancy to a period of life when they are capable of being placed out in the world. Illegitimate children are the objects of this hospital. The child must be under twelve months old when offered for admission, and the committee require to be satisfied of the previous good character and present necessity of the mother, and that the father has deserted both mother and infant; and that the reception of the infant will, in all probability, be the means of replacing the mother in the course of virtue and the way of an honest livelihood.]

1090

[The number of illegitimate births in France is truly fearful. In 1831 there were 71,411, about 1-13th of the total number of births; in Paris the proportion is still larger, being about one in every three births!—Penny Cyclopædia.]

ORPHAN HOUSES.

As so ancient proofs are found of public attention paid to foundlings, it may be readily supposed that in well-regulated states care was employed at an early period to provide also for the maintenance and education of orphans. There is reason to believe that this was the case at Thebes, which took under its protection the children of all poor parents. Solon made a law, that children whose fathers had fallen in the defence of their country should be educated at the expense and under the inspection of government[1091]. The same thing was customary among the Iasei, who inhabited an island on the western coast of Caria[1092].

At Rome children maintained at the public expense were called *pueri alimentarii*, and *puellæ alimentariæ*[1093].

The emperor Trajan was the first who formed large establishments for this purpose; and the children maintained in them were called, from his family name, *pueri Ulpiani*. Pliny relates in his panegyric, that he had caused five thousand free-born children to be sought out and educated. It is more than probable that he suffered them to remain with their parents, and that those who were unable to educate them themselves, received a monthly or annual allowance in corn or money. Orphans perhaps were given out to board at a certain fixed sum. It deserves to be remarked, that the emperor in this manner might afford assistance, not only to such as were depressed by poverty, but also to persons of distinction who were not able, according as we say at present, to support their families in a manner suitable to their rank. To have an offspring therefore was not a misfortune, but rather a blessing. Children were begotten in order that the parents might take advantage of this beneficence, as some people build houses that they may obtain the offered premium; and the large capitals required were not taken from the public treasury, but from the emperor’s own privy purse. That these establishments might exist after his death, the money in different parts

destined for their support was laid out on land, which produced a perpetual income. This is shown by a letter of foundation for the town of Veleia[1094], which is still extant.

In the year 1747, some peasants while ploughing in the neighbourhood of Placentia found, together with several other antiquities, a copper-plate five and a half feet in height and ten and a half in breadth, which weighed 600 pounds. They broke it in great haste, because they expected to find under it a treasure, and sold the pieces as old copper. One of these having fallen into the hands of the learned count Giovanni Roncovieri, he remarked that it contained a part of a public document belonging to the reign of Trajan. With much trouble and at considerable expense he at length collected all the pieces, the possessors of which, on account of the eagerness shown to obtain them, expected for them a high price, and thus was the means of saving one of the most beautiful monuments of antiquity, a complete document in regard to the imperial establishment for the community of Valeia[1095]. The inscription forms six hundred and seventy lines, and is divided into seven columns, over which stands the following title: "Obligatio. praediorum. ob. H—S. deciens. quadraginta. quatuor. milia. vt. ex. indulgentia. optimi maximique. principis. imp. caes. Nervae. Trajani. Aug. Germanici. Dacici. pueri. puellaeque. alimenta. accipiant. legitimi. n. CCXLV. in. singulos H—S. XVI. n. f. H—S XLVII. XL n. legitimae. n. XXXIV. sing. H—S. XII. n. f. H—S. IV. DCCCXCVI. spurius I. H—S. CXLIV. spuria. I. H—S. CXX. summa. H—S. LIICC. quae. sit vsura 55 5 55 sortis. supra. scriptae."

Trajan therefore laid out a capital of 1,044,000 sesterces at five per cent. interest on forty-six farms around Valeia, which town or community was destined for this establishment. These farms formed the mortgage, and on that account are particularly named, together with the sum for which they were security. The annual interest amounted to 52,200 sesterces. Of this sum 245 boys born in wedlock received monthly sixteen sesterces each, which in a year makes 47,040; and 34 girls of the same description twelve sesterces monthly, making in a year 4896 sesterces. Besides these, one illegitimate male child received yearly 144 sesterces, and one illegitimate female child 120 sesterces. These different sums amounted exactly to the interest of the capital laid out.

It is hardly worth while to reduce these sums to our present currency. For even if we should calculate how many pounds or shillings the silver contained in 1,044,000 sesterces would make, this result would not give us the real value, because we have no standard by which the relative value can be determined; that is to say, it is not known what proportion silver and copper bore in those periods to the prices of the necessaries of life. The price of grain proposed by Unger as a standard, can be employed only for later times, when corn began to be a more general article of trade.

However, Trajan's capital, according to our money at present, makes about 54,375 dollars, and the sum of the interest 2718 dollars; consequently a legitimate male child obtained yearly ten dollars, and a legitimate female child between seven and eight dollars. Such is the calculation made from the principles laid down in Romé de l'Isle's Metrology by Professor Hegewisch, who has endeavoured also to compare some pieces in the time of Trajan with those at present.

It appears, therefore, that among 300 children the emperor admitted only two illegitimate; and Professor Hegewisch is inclined to believe that this was the actual proportion at that time; which indeed would induce one to form a very favourable opinion of the state of public morals, under the reign of Trajan, in the district above named.

That it was then customary to pay interest, salaries, and pensions, not annually but monthly, is known from other sources of information. The case was the same in regard to the distribution of corn (*frumentatio*), as is proved by a passage in Dionysius of Halicarnassus[1096], and when money was bequeathed in perpetuity for benevolent purposes by any person's will[1097].

Muratori is of opinion that these pensions were paid to boys till they arrived at the age of eighteen, and to girls till they attained to that of fourteen; and for a proof he refers to an order of Adrian, confirmed by the emperor Alexander Severus[1098]. At the above age the males could become soldiers and gain their pay; and girls of fourteen were fit either to be given in marriage, or to be employed in such a way as to obtain a livelihood by their industry. That the emperor, in forming this establishment, had an eye to recruits for the army, appears probable from a passage in Pliny[1099]; and

the example of Trajan induced rich private individuals during his life-time, and afterwards many of his successors, to form similar establishments for the like purpose. The same plate was destined also to eternise the bequest of one Cornelius, according to which 3600 sesterces, or about 187 dollars, being the interest of 72,000 sesterces, or 3750 dollars, were to be employed in maintaining eighteen legitimate male children, and one legitimate female child, at the rate before-mentioned. Pliny even, the panegyrist of Trajan, founded from his own property pensions for the free-born children of poor parents; a circumstance which he does not forget to mention in his letters, and the same thing is confirmed by an inscription still extant[1100]. Antoninus Pius made a similar establishment for poor girls, which after his consort were called *puellæ Faustinianæ*[1101]. The emperor Antoninus Philosophus did the same thing; and from the name of the empress the girls were called *Faustinianæ*, but by way of distinction *novæ puellæ Faustinianæ*[1102]. Alexander Severus formed an institution for the education of boys and girls, whom he caused to be named from his mother *mammæani* and *mammæanæ*[1103].

In regard to the manner in which these establishments were managed we are entirely ignorant. It is known only, that in each of the provinces into which Italy was divided, there was a public functionary of some rank, with the title *procurator ad alimenta*, to whom, in all probability, the inspection of them was entrusted. This is known to have been an honourable office. It was held by the emperor Pertinax when a young man, in the towns and villages on the Via Ancilia, and in his old age at Rome itself[1104]. It was held also by Didius Julianus before he became emperor, after he had been prætor and consul, that is, enjoyed the highest offices next to the imperial dignity, and after he had been governor of Germany[1105]. On ancient monuments erected to the memory of persons of distinction, by their children, relations or friends, it is mentioned, that, besides filling other places of honour, they had been *procuratores ad alimenta* in certain districts there named.

These are the oldest instances, with which I am at present acquainted, of institutions for the benefit of poor children and orphans. Orphan-houses, properly so called, in which the children were educated together, I find

mentioned for the first time, under the name of *orphanotrophium*, in the laws of the emperor Justinian. At later periods they occur frequently in the decrees of the different councils, such as that of Chalcedon in the fifth century. At the court of Byzantium the office of inspector of orphans, *orphanotrophi*, was so honourable and important, that it was filled by a brother of the emperor Michael IV. (Paphlago), in the beginning of the eleventh century[1106]. But under the latter emperors this place was entirely suppressed.

At present, orphan-houses have been abolished, since it has been shown, by many years' experience, that the children cannot be educated in them healthy and at a sufficiently cheap rate. The children are placed out to be boarded and educated by individuals, under the inspection of those who manage everything relating to the poor.

FOOTNOTES

[1091] Diogen. Laert. i. § 55, and the observation of Menage. This law is praised by Plato in Menexenus, and by Demosthenes, adversus Macartatum.

[1092] Heraclides de Politiis, added to the addition of Aristot. Politic. Heinsii, Lugd. Bat. 1621, 8vo, p. 1004.

[1093] Mention is made of them several times in the Roman code of laws, L. 8, § 9, et § 24, D. de Transact. L. pen. § 1, D. ad leg. Falcid. See also Ælii Spart. Vita Adriani, c. 7.—Æl. Capitolin. Vita Antonini. P. cap. 8.—Vita Pertin. c. 9, p. 555.—Æl. Lamprid. Vita Alexandri Severi, c. 44, p. 995.

[1094] This city was situated at no great distance from Piacenza (Placentia). It is mentioned by Horace, Pliny and Phlego Trallianus de Longævis, i. p. 114. See Cluverii Ital. p. 1259.

[1095] This remarkable inscription was first printed at Florence in 1749, by itself, with the title Exemplar Tabulæ Trajanæ pro Pueris et Puellis Alimentariis Reip. Veleiatium. Secondly, in Museum Veronense, Veronæ, 1749, fol., to which some explanations are added. Thirdly, in Histoire de la Jurisprudence Romaine, par A. Terrasson. Paris, 1750, fol. in the Appendix, pp. 27–43.

[1096] Lib. iv. p. 228.

[1097] See the proofs quoted by Brisson, under the word *Menstruum*.

[1098] Digest, 34, tit. 1. 14.

[1099] "Crescerent de tuo qui crescerent tibi, alimentisque tuis ad stipendia tua pervenirent."

[1100] Plin. Epist. i. 8, 10, and vii. 18. Gruteri Inscript. p. MXXVIII. n. 5.

[1101] Capitolin. cap. 8.

[1102] Ib. cap. 26.

[1103] Lamprid. cap. 57.

[1104] Ælian. Spartian. cap. 1. p. 574.

[1105] Capitolin. cap. 2, p. 532; and cap. 4, p. 537.

[1106] Zonaras in the Life of that Emperor. Hist. August.

INFIRMARIES. HOSPITALS FOR INVALIDS. FIELD LAZARETTOS.

By the preceding article I am induced to give some information in regard to the history of infirmaries. To offer anything complete on this subject, it would be necessary to enter also into the history of inns established for the use of pilgrims and strangers, which in general were combined with them, and likewise into that of the different orders instituted for the like purpose, and of taverns which arose at a later period.

It is certain that ancient Rome, though a magnificent city, had no houses into which sick persons were admitted in order to be taken care of and cured. Diseased people, however, were carried to the temple of Æsculapius, but for a very different purpose. They waited there for a cure, as some Christian believers still do in churches which contain wonder-working images; but no preparations were made there for their accommodation. Those numerous benevolent institutions for the accommodation of travellers, the indigent, and the sick, which do so much honour to modern times, were first introduced by Christianity.

Bodin[1107], who could not deny this service, endeavoured to lessen it, by asserting that, on the introduction of Christianity, freedom was given to many slaves, who possessed nothing else; and who, having learned no trade or handicraft by which they could gain a living, became so burdensome to the state, that the clergy were obliged to devise some means to remove them from the public view, and to provide with the necessary support these unfortunate beings, abandoned by all mankind, whose increasing number was asserted by unbelievers to be an effect of the Christian religion.

In this representation however there is some truth. It indeed cannot be denied that our religion, as it requires humanity and compassion, though the intolerance it occasions converts the severest cruelties into good works, procures to beggars more indulgence and respect than they in general

deserve, and thereby causes a continual increase of their number. But it is to be observed that Bodin, notwithstanding his acuteness and great learning, often suffers himself to be led away by the effects of his innate Jewish hatred to the Christians; and he readily embraces every opportunity of exalting his paternal religion, the Jewish, and depreciating the Christian, by which he obtained riches and honour.

The enemies of Christianity, however, during the first years of our æra, could not but observe the numerous means for alleviating human misfortunes which were introduced by the new religion. It was galling to the emperor Julian to acknowledge this superiority; and in order to banish it, he caused his priests to provide for the poor, and to establish for them inns (*Xenodochia*), into which they could be received; and he assigned to them the funds necessary for that purpose. Into these were admitted not only persons of his own religion but of every other, in imitation of the Christians, who, besides supporting their own poor, maintained those of the pagans also. How much he interested himself to weaken this means, by which the impious Galilæans procured respect, love, and attachment, may be seen by an oration wherein he inculcated the Christian morality as his own[1108]. This imitation of the new religion, which contributed more perhaps to recommend it than to bring it into discredit, is ridiculed by Gregory Nazianzenus in his third oration.

The care of providing the necessary assistance to those sick persons who can expect no help and attention from individuals, belongs to the police; and because this forms a part of government, rulers and sovereigns ought at all times to have made the establishments requisite for that purpose. But in the oldest periods, as appears, they had too much to do in administering justice, and securing the state against hostile attacks, to be able to attend to the necessary police establishments.

On the other hand, the clergy, whose first duty was to maintain good order, discipline, and virtue, however much they might often in private offend against them themselves, endeavoured to supply this want; and, on that account, among the decrees of various councils, we find a great many regulations which have not yet been sufficiently employed to illustrate the history of police. The establishment of the first houses for the reception of the sick is among the services rendered by the clergy; and to mention all the

places of this kind, either founded by them or at their instigation, would form a very long list. The first, or at least one of the first houses for the reception of indigent sick was that built at Rome by Fabiola, a Roman lady, the friend of St. Jerome, consequently in the fifth century[1109].

When pilgrimages to holy places, as they were called, and often from very distant countries, came to be considered as a part of religion, the number of these houses was much increased. Taverns, in which pilgrims could procure proper care and attention for payment, were not then to be found; and most people travelled without money, in the full confidence of meeting with gratuitous assistance. When the clergy wished to maintain and increase the number of pilgrims, which their own advantage induced them to do, it was necessary that they should afford them every facility of travelling, and consequently provide for the wants of indigent pilgrims; and it was impossible that among these there should not be some sick, especially as the inconvenience, fatigue, and dangers of the journey were much increased by many things injurious to the health.

But as the principal and most dangerous pilgrimages were made to Palestine, which is situated beyond the boundaries of Europe, where no countrymen, and not even Christians, one of whose religious duties it is to be compassionate, could be expected, institutions for the reception of sound as well as of sick pilgrims were erected by the clergy at a very early period on the road thither, and also at the holy places. Thus Jerome built an hospital at Bethlem; and his friend Paula caused several to be erected on the road to that village, in order that the devout idlers, as she says, might fare better than the mother of God, who, on her necessary journey thither, could find no inn[1110]. In the like manner, the Scots and Irish erected hospitals in France for the use of their countrymen, who, on their pilgrimage to Rome, might be desirous of passing through that kingdom[1111].

But hospitals were most necessary in wild and desert parts, where human habitations were not to be expected; and particularly in woody mountainous districts, and on the banks of broad rivers, where travellers were stopped for the want of bridges, and collected together in great numbers. It is probable that many of these hospitals may have given rise to the villages which are still found in such situations.

Pope Adrian I. recommended to the notice of Charlemagne[1112] the hospitals built in the Alps; and in the year 855, the emperor Louis II. caused those situated on mountains to be visited and repaired[1113]. The ruins of many of these edifices still exist.

Towards the end of the eleventh century, brotherhoods, which undertook to provide for the wants of sick pilgrims, were formed in the Holy Land; and these became richer and more numerous as the crusades increased. It was not uncommon for opulent persons, when dying, to bequeathe their property to establishments in which they had found consolation and relief; and very often those who had experienced a cure gave their money and effects, or a considerable part of them, to some brotherhood, either in consequence of a vow, or in order to show their gratitude. On this account the hospitals in Palestine could be constructed on a larger scale, and provided with better accommodations, than any before seen in Europe. They were therefore considered as models; and princes and rich persons, on returning safe from their pilgrimages, caused similar ones to be established in their own countries. Many princes even brought with them to Europe members of these brotherhoods, which in the course of time were converted into orders of knighthood, that they might employ them in the erection of hospitals. Instances of this circumstance have been given by Möhsen, in his History of the Sciences in the Mark of Brandenburg, and these might be easily increased. In the same author may be seen an account of the establishment of houses for the reception of persons afflicted with cutaneous disorders, and of their conversion into pest-houses. I shall here only remark, that these inns and hospitals contributed, in no small degree, to facilitate the travelling of mercantile people, who in the infancy of trade, when the roads were insecure and no means of conveyance established, were obliged to accompany their merchandise themselves.

The assertion of Muratori, however, that the oldest hospitals were not properly established for sick travellers, but rather for the sound, is undoubtedly true; and it appears that hospitals, according to the meaning of the word at present, that is, such as were destined for the sick alone, were not introduced before the eleventh century. The above author quotes[1114] from the life of St. Lanfranc, who was archbishop of Canterbury in the year 1070, that he caused an hospital to be built there, and fitted up in such a

manner, that one part of it was destined for sick men, and the other for sick women. It is probable, or rather almost certain, that this prelate formed the institution here mentioned after the model of those which he had seen in his native country, Italy. After this period similar establishments for the sick are mentioned in various other parts.

The first hospitals, at least in general, were built close to cathedrals or monasteries; and the bishops themselves had the inspection of them; but afterwards, either for the greater convenience or the want of leisure, when their occupations increased, they committed this charge to the deacons. In the course of time, when houses for the sick were erected by laymen, and entirely separate from monasteries, the bishops asserted their right, often confirmed to them by imperial as well as pontifical laws, of visiting these institutions. We find, however, that in later times they were deprived of this privilege by princes and sovereigns, either because they wished to omit no opportunity of lessening the power of the clergy, or because the latter had given reason to suspect that the incomes destined for the use of the hospitals were not always applied to the intended purpose. Instances are found also, where, by the letters of foundation, the whole management is consigned to the sovereign or the heirs of the founder. These institutions, however, have the appearance of ecclesiastical establishments, and still retain in many cases similar privileges. As such they are free from all taxes, are spared as much as possible in war, and enjoy the same rank as churches.

Of the internal œconomy of the oldest houses for the reception of the sick, no information, however, is to be found. It is not even known whether physicians and surgeons belonged to them, nor in what manner they were supplied with medicines. Apothecary shops were not then established; and those found in hospitals at present, are but of modern existence.

In the hospitals at Jerusalem the knights and brothers attended the sick themselves, bound up their wounds, and, in imitation of the Grecian heroes, Hercules, Achilles and others, acted as their physicians. Thus we find in Amadis, and other books of knight-errantry written in the middle ages, how much the knights exerted themselves to obtain the best balsamic mixtures, and that, in general, they dressed each other’s wounds. The well-known *baume de commendeur* is one of the oldest compositions of this kind, belonging to the times of knighthood.

Profound or extensive knowledge of medicine could not be expected among these knights, were we even unacquainted with the account given of their skill by Guy de Chauliac. This author, who wrote his book on the healing of wounds in the year 1363, mentions the different medical sects, and among these names the German knights as the fourth sect, who, he says, cured wounds by exorcism, beverages, oil, wool, and cabbage-leaves, and trusted to the belief that God had conferred a supernatural power upon words, plants, and stones[1115].

The oldest mention of physicians and surgeons, established in houses for the sick belonging to the order of Templars, is under the government of John de Lastic, who, in 1437, undertook the office of grand-master, and defined very exactly the duty of physician and surgeon[1116]. It however appears to me, as it does to Möhsen, that the hospitals had regular and learned physicians at a period much earlier.

But, as long as this was not the case, they could afford no instruction to young physicians in the theory or practice of their art, like our hospitals at present. We, however, find a very singular account in regard to Persia, where it is said that some Nestorian priests had an hospital adjacent to their monastery, together with an institute or school for young physicians, who under certain prescribed rules were allowed to visit the sick. This establishment was in a town called Gandisapora, or, as Professor Sprengel writes it, Dschandisabor, the medical school of which is not unfrequently mentioned after the seventh century. The pupils who were desirous of attending the hospital for their improvement, were first obliged to submit to a trial, and to read the psalms of David and the New Testament. Many of those who had here studied medicine attained to high ecclesiastical dignity, which is the more surprising as the rest of the Nestorian schools in the East pay attention only to theology, and prohibit the young clergy entirely from studying medicine[1117].

Mad-houses, or houses for the reception and cure of insane persons, seem also to have been first established in the East. Zimmerman, in his work on Solitude, says that as early as the year 491 there was a house of this kind at Jerusalem, the chief object of which was to take care of such monks as became insane in the monasteries, or such hermits as were visited

by the same affliction in the deserts; but, as usual, he has given no proofs. In the twelfth century, when the Jew, Benjamin of Tudela, was in Bagdad, he found many hospitals having nearly sixty shops or dispensaries belonging to them, which distributed, at the public expense, the necessary medicines. A large building called *Dal almeraphtan*, that is, the House of Grace, was destined for the reception of those who lost their reason in summer. They were kept there in chains till they were cured; and every month this house was visited by magistrates, who examined the state of the patients and suffered those who had recovered their reason to return to their relations or friends.

To those police establishments which form the subject of this article belong also hospitals for invalids. Though it may be true, that among many ancient nations the soldiers, as sailors in some privateers at present, served voluntarily and without pay, in the hope of acquiring by plunder a sufficient compensation for the expenses, labour, and dangers to which they were exposed in war, it was at any rate considered as a general duty to make such provision for the indigent, and also for those become incapable of military service, when they had no means of support, that they might not be a burthen on the public. If any one should be so devoid of feeling as to suppose that our soldiers, after enjoying years of peace without much waste of their bodily powers or laborious occupation, free from care, amidst every necessary of life, and the enjoyment of rank above those members of the state from which they were taken, ought to consider it no hardship to perform military service when war renders it necessary; it still remains a duty incumbent on the government to provide for soldiers incapable of further service, who are destitute of support; and besides, political prudence requires it, in order that others may not be deterred from defending their native country or sovereign, but rather by the confident hope of a future provision may have their courage and fidelity strengthened; which, notwithstanding the strictest subordination, and though fire-arms require less personal bravery than bows and arrows, is still indispensably necessary. This truth seems to have been fully acknowledged in the oldest periods.

Solon deducted something from the pay of soldiers, and employed it for the education of children whose fathers had fallen in battle, in order that others might be encouraged to bravery[1118]. Pisistratus, following this example, made an order that those who had lost any of their limbs in war

should be maintained at the public expense. The pensions granted do not seem at all times to have been equally great, and they appear to have been even modified according to circumstances[1119].

Of the attention paid by the Romans to the care of their invalids, *milites causarii*, or soldiers become unfit for service, either by wounds or old-age, many instances may be found, some of which occur in the Justinian and several in the Theodosian code[1120]. They were not only exempted from taxes, but frequently obtained lands and cattle as well as money, and were assigned over, to be taken care of by rich families and communities[1121]. The assertion, however, that the Romans had particular houses for invalids, in which soldiers worn out by the fatigues of war were taken care of, and that the *taberna meritoria* was a house of this kind, is one of the many errors of Peter von Andlo, canon of Colmer, who is entitled to the merit of having written in the fifteenth century, and with a great deal of freedom, the first work on the German public law[1122].

How such an idea could be conceived by this author I do not know, for the following is the only account of the *taberna meritoria* to be found among the ancients. In the first place we are told by Valerius Maximus[1123], that a traveller was murdered in one of them in which he lodged. Judging from this circumstance, the *taberna meritoria* appears to have been a public tavern or inn, a meaning which writers on jurisprudence seem always to have adopted[1124]. In the next place Eusebius, who died in the year 340, relates in his Chronicon[1125], that under the second or third year of the reign of Augustus, an oil issued from the earth in a *taberna meritoria*, on the other side of the Tiber, and continued flowing without interruption the whole day; but I cannot see what relation this phenomenon can have to Jesus Christ. In the third place, the same thing is related by Orosius[1126], who lived about the year 416; but he makes the time of this event much later, that is to say, in the year 730 or 731 after the building of the city, which would be about twenty years before the birth of Christ. Nevertheless, Martinus Polonus said, in the thirteenth century, that this oil appeared at the birth of Christ[1127]. Damasus (Pope Formosus? in the ninth century) added

that, on this account, Pope Callistus I., so early as the third century, caused a Christian church to be built in that place; and some modern writers believe, contrary to the assertion of Platina[1128], that it is the present church of St. Mary Transtiberina, *Maria in Trastevere*; and in this church a stone is still shown with the inscription *fons olei*. To render the building of a church in the third century probable, some moderns have conjectured that this *taberna* was the cook's shop purchased by the Christians under the reign of Alexander Severus, who assigned it to them with the observation that "it was better that God should be served in any manner in that place, than that tavern-keepers, cooks, or perhaps the ministers of voluptuousness, *popinarii*, should there carry on their occupations[1129]." Our writers on historical criticism positively deny that Callistus I. built a church at Rome[1130]. It is to be observed also, that Donatus, who died in 1640, confidently asserts that the *taberna meritoria* was the house where the people of Ravenna lodged when they came to Rome to see the public spectacles; but he does not tell us whence he derived this information[1131]. What I have here collected in regard to the *taberna meritoria* may serve to correct a false and often repeated relation; but all I can prove from it is, that this *taberna* was not an hospital for invalids.

Hardouin also was of opinion that there were hospitals for invalids at Rome, one of which was built by Metellus, the son-in-law of Pompey; but for proof he refers only to a coin with the image of Metellus, on the reverse of which is the naked figure of a man walking, who holds in his right-hand the palladium, and bears on his left shoulder a naked man, with the inscription on the face, "Q. Metellus Pius." From this Hardouin infers that Metellus built an Hôtel des Invalides for sick or wounded soldiers, which he dedicated to Pallas, and that on this account he obtained the surname of *Pius*[1132]. It is indeed remarkable, that two coins having the same reverse, and the inscription *pietas*, occur in Patin. I shall leave to the judgement of the critics this opinion of Hardouin; but I must confess that the explanation of ambiguous figures on coins, has a resemblance to the far-fetched derivations of etymologists. Both may be learned, ingenious, and probable; but they cannot be employed alone as evidence, except to add more force to a truth already proved. These coins, perhaps, allude to some other attention

paid to wounded soldiers, of which Metellus, Herennius, and Cæsar may have given examples; and the people are always weak enough to set too high a value on every mark of compassion or benevolence exhibited by their sovereigns or commanders, because it is seldom that they observe as they ought the general duties incumbent upon them.

I do not consider it a reproach to the Romans, notwithstanding their propensity to war and robbery, that they had no hospitals for invalids; because the remark already made in regard to orphan-houses is applicable also to them. Magnificent buildings, fitted up at great expense, afford a proof of the wealth and perhaps the liberality of the founder; but there can be no doubt that, with the capital employed, a greater number of invalids might be maintained, and in a manner much more beneficial to the public; that is to say, by making such arrangements that the invalids could be distributed throughout the country, and placed out at board and lodging for a certain sum. In this case many families would be glad to receive them, both on account of the money, and because these invalids could be of great assistance to them in their domestic œconomy, either by labouring themselves or overlooking others. People may praise large and expensive hospitals as much as they please; but the sight of so many men who have lost their health or limbs in war is but a melancholy spectacle, and gives too great occasion to reflect how much mankind suffer from the avarice, pride, and revenge of sovereigns, without which wars would be less frequent.

The first establishment for the reception of invalids which, as far as I know at present, occurs in history, was that formed at Constantinople by the emperor Alexius Comnenus, at the end of the eleventh century. A complete description of it may be found in the history of that prince, written by his learned daughter Anna Comnena, who says that the emperor caused a great number of buildings standing around a church to be fitted up as an hospital, which undoubtedly was never exceeded in size; though other historians relate that Alexius only revived and enlarged in an uncommon degree an old institution. It was indeed called the Orphan-house; but sick and indigent persons of both sexes and of every age, and, as the female historian expressly says, soldiers dismissed from service, were admitted into it, and provided with bed, board, and clothing[1133]. Though the emperor secured to this institution several sources of revenue, it however appears not to have long existed; at any rate, in the time of George Codinus, that is, in the

fifteenth century, the high office of director or manager had long been disused.

Of the hospitals for invalids existing at present, the oldest and largest is the Hôtel des Invalides at Paris. The kings of France enjoyed from the earliest times what was called *droit d'oblat*, which consisted in the power of sending to abbeys and monasteries, in order to be maintained, officers and soldiers unfit for further service, and particularly such as had been wounded. Traces of this practice are said to occur under the reign of Charles the Great; at least Seissel, in the Life of Louis XII., relates that there was an old tradition in an abbey in Languedoc, that the abbot had been punished by that prince, because he would not receive the soldiers assigned to him. It may be readily conceived how unpleasant these guests must have been to the clergy, and how little the ideas, mode of living, and manners of these two classes would accord with each other. The complaints on this subject had become so great under Henry IV., that he at length resolved to cause all invalids to be lodged and maintained together in a palace called "La Maison Royale de la Charité Chretienne." But as the revenues destined for the support of this establishment were not sufficient, it was abolished under the same sovereign, and the invalids were again distributed among the abbeys and convents. In the course of time these houses purchased exemption from this burthen, by giving an annual pension to their guests; but they soon spent their money, and then fell into a state of the greatest poverty. On this account Louis XIII. renewed the experiment of founding an hospital for invalids, which through the want of money was never completed. At length Louis XIV., in the year 1670, began to build the Hôtel des Invalides, the extravagant magnificence of which is rather a proof and monument of the profusion and pride of that sovereign, than of his care for meritorious soldiers.

In the year 1682, the hospital for soldiers at Chelsea was founded in England by Charles II.[1134], carried on by James II., and completed by William III. But far larger and more magnificent is the hospital for seamen at Greenwich, which was first suggested by Queen Mary, the consort of King William. The building, determined on in the year 1694, was begun in 1695, and from time to time enlarged and beautified[1135]. As France was the first country in Europe that maintained a standing army of national troops, it

had therefore first occasion to make provision for its native soldiers when disabled by service. As long as military men consisted chiefly of foreigners, who served during a certain period for pay and plunder, sovereigns believed that when a war was ended, they were no further indebted to these aliens; they consequently suffered them to retire wherever they thought proper, and gave themselves no further trouble respecting them.

In the last place, I shall here consider the question, Since what time have regular surgeons been appointed to armies? and lay before the reader the little I have been able to collect towards answering it. In the Trojan war they were indeed not known. At that period many of the principal heroes had acquired some knowledge of surgery, and, like the knights in the time of the crusades, undertook the office of assisting and curing the wounded[1136]. Such persons in armies were particularly honoured, and considered to be of great value, as appears from what Idomeneus, speaking of Machaon, says:

> Ιητρὸς γὰρ ἀνὴρ πολλῶν ἀντάξιος ἄλλον.
> Medicus vir multis æquiparandus aliis[1137].

Yet the instance of Machaon shows how little care was then taken of the wounded; for Virgil makes him even, whose assistance must every moment have been necessary, mount into the wooden horse, and he was the first who came out of it[1138]. There is reason to think that the armies in Homer, and until the introduction of Christianity, and the invention of gunpowder, had in every battle but few wounded, and always a much greater proportion of killed than in modern times. Hostile bands stood nearer to each other; all came to close action; prisoners were not exchanged, but made slaves, and among the Romans sold to the infamous schools for gladiators. Wounded prisoners were a burthen to the victorious party; such as could not escape defended themselves to the last, and were put to death by the conquerors.

In Achilles Tatius[1139], who seems to have lived in the third century of the Christian æra, I find that an army-physician, *exercitus medicus*, was called in to a sick person; and one might almost believe that a regular physician appointed to attend an army is here meant, especially as Salmasius, on this passage, says that each cohort had in general a physician,

and therefore the appellations *medicus cohortis*, *medicus legionis*, were found in ancient inscriptions. I will not venture to contradict so great an authority on a subject of this kind; but I am sorry that I have not been able to find any other evidence of such army-physicians.

The first traces of field-hospitals, or, as they are commonly called at present, flying-hospitals, occur perhaps in the East. At any rate, the emperor Mauricius, in the sixth century, had along with his armies *deputati*, whose duty he describes, as did also the emperor Leo VI. in the ninth century, who has copied many things verbatim from the work of that prince. These *deputati* were distributed in the armies among the cavalry, and were obliged to carry off those wounded in battle. On this account they had on the left side of the saddle two stirrups, in order that they might more easily take up the wounded behind them; and for every person thus saved, they obtained a certain reward. They were obliged also to carry with them a bottle containing water, for the purpose of reviving those who might have fainted through the loss of blood. Leo, besides the officers necessary for each band or company of a regiment, mentions expressly not only the *deputati*, but also physicians and attendants on the sick[1140].

Though an order was made by the Convention of Ratisbon[1141] in 742, that every commander of an army should have along with him two bishops, with priests and chaplains, and that every colonel should be attended by a confessor, no mention is to be found either of field-hospitals or army-surgeons belonging to the first Christian armies in the writings of the middle ages. We read, however, in the works of Paracelsus, Thurneyser, Lottich and others, that they were present at battles and sieges; but it can be proved that they were not appointed as army-surgeons, but served merely as soldiers.

The field-surgeons, who occur as accompanying armies in the beginning of the fifteenth century, were destined rather for the use of the commanders and principal officers, than for the service of the field-hospital. Their number was too small for a whole army; and as they were authorised by their commission to receive prisoners and booty, and, like the knights, were obliged to bring with them archers, it is highly probable that to fight was a part of their duty also.

When Henry V. of England carried on war with France in 1415, he took into his service Nicholas Colnet, as field-surgeon, for a year[1142]. He was bound to carry with him three archers on horseback, and to accompany the king wherever he went. In return he was to receive yearly forty marks or pounds, to be paid at the rate of ten marks every quarter. He was allowed also twelve pennies per day as subsistence money, and each of his archers had twenty marks a year, and six pennies daily for subsistence. The chief army-surgeon, Morstede, was engaged with fifteen men, three of whom were to be archers, and the remaining twelve surgeons. He received also ten pounds quarterly as pay, and twelve pennies daily for subsistence. His archers and surgeons were placed on an equal footing; each was to receive quarterly five pounds, and six pennies daily as subsistence. Both Colnet and Morstede could receive prisoners and plunder; but when the latter amounted to more than twenty pounds in value, a third part of it was to be given to the king. Both these head-men had a quarter's pay in advance; and, that they might always have security for the next quarter, the king engaged to put into their hands, by way of pledge, as many jewels or other articles as might be equivalent to one quarter's pay and subsistence.

Harte, in his Life of Gustavus Adolphus, seems to believe that this prince first appointed four surgeons to each regiment, which he reduced from the number of two or three thousand, first to 1200, and afterwards to 1008; and he is of opinion that it may with certainty be believed that the imperial troops at that time had no surgeons, because Tilly himself, after the battle at Leipsic, was obliged to cause his wounds to be dressed by a surgeon established at Halle. He adds in a note, that he was told that the Austrians, till about the year 1718, had no regimental surgeons regularly appointed. However this may be, it is certain that the field-hospital establishments of the imperial army, till the beginning of the eighteenth century, were on a very bad footing. Even in the year 1718, they had no field-surgeons; but at this period the company surgeons were dismissed, and a regimental surgeon, with six assistants, was appointed to each regiment; and beside the field medicine-chest, surgical instruments were provided at the emperor's expense[1143].

The establishment of field-hospitals in Germany is certainly much older; for Fronsperger, who wrote in the middle of the sixteenth century,

does not speak of field-surgeons, army-surgeons and their servants, as if they had been then newly introduced; but in such a manner as shows that the need of them had been generally acknowledged long before that period[1144]. According to his statement, it was necessary that there should be along with the commander-in-chief, or, according to the modern phrase, the general staff, a field-surgeon-in-chief, a doctor who had the inspection of the field-surgeons, the barbers and their servants, whose duty was to drag the wounded from the heaps of slain and to convey them to the former. He was obliged to keep by him instruments and medicines, and at each mustering to examine the instruments and apparatus of the field-surgeons; he decided also, in disputed cases, how much soldiers whose wounds had been cured ought to pay to the field-surgeon. During marches he was bound to remain with the commander-in-chief. Fronsperger says also, that there ought to be with the artillery a field-surgeon of *arckelley*, and with each company a particular field-surgeon, not however a paltry beard-scraper (*bart-scherer*), but a regularly instructed, experienced and well-practised man. This person was bound always to accompany, with able servants, the ensign, and he received double pay.

[To give a description of all the hospitals, infirmaries and dispensaries in this country would fill volumes. It may be sufficient here to observe, that there are ten large hospitals in the metropolis, each of which receives a considerable number of patients into the house, and a still larger number of out-door patients are prescribed for and supplied with medicines, but attend at the establishments. In the largest of these, which is that of St. Bartholomew, the annual number of patients, both in-door and out, is about 12,000; about three-fifths of these are out-door patients. The number of beds in the hospital amounts to upwards of 550.

There are twenty-eight dispensaries; such patients as are able, attend at these establishments; those who are incapable, are visited and relieved at their own homes.

Moreover, there are in the metropolis ten midwifery establishments, three ophthalmic institutions, three public lunatic asylums, a venereal hospital, a small-pox and a fever hospital, as also one for patients suffering from consumption.

There are also ninety-seven county hospitals, infirmaries and dispensaries[1145].

Admission to the hospitals is gained by the presentation of a petition signed by a governor, on a certain day in each week; of course, out of the number of patients who apply, the worst cases have the preference. Accidents and very severe cases are admitted at any time, and without any petition or recommendation. The out-patients require no recommendation. The same general rule gains attendance at the other medical establishments.]

FOOTNOTES

[1107] J. Bodini De Republica libri vi., lib. 1. cap. 5.

[1108] The imperial order has been preserved by Sozomenus in his Ecclesiastic History, v. 16, where more information on this subject, worthy of attention, has been collected. See Juliani Opera, edit. Spanhemii, Lips. 1696, fol. p. 430.

[1109] Hieron. ep. 39.

[1110] Hieron. Epitaph. Paulæ.

[1111] Baronii Annal. ad an. 845, xxxvi. ed. Mansii. Lucæ 1743, tom. xiv. p. 325.

[1112] Muratori Antiq. Ital. Med. Ævi, iii. p. 581.

[1113] Ib. et Antiquitat. Ital. Med. Ævi, iii. p. 581.

[1114] Antiquitat. *l. c.* p. 593.

[1115] See La Grande Chirurgie de M. Guy de Chauliac, Medecin tres-fameux de l'Université de Montpelier, restituée par M. Laurens

Joubert. A Rouen 1641, 8vo.

1116 There are various editions of the statutes of this order. 1. Nova Stat. ord. S. Joannis Hierosolymitani. Madriti 1577, small folio. 2. Privilegia ordinis S. Jo. Hierosol. small folio, Romæ 1588. 3. Statuta Hospitalis, without place or date, small folio. Each copy, however, has many things which in the others are wanting. 4. Histoire de Malthe, avec les Statuts et les Ordonnances de l'Ordre. Paris, 1643, fol. 5. Codice del sacro militare ordine Gerosolimitano. In Malta 1782, fol. The words relating to this subject may be found in Titulo quarto, xi et xii.

1117 The proofs of this singular account may be seen in Assemani Bibliotheca Orientalis, tom. iii. P. 2. pag. CMXL.

1118 Diogen. Laert. lib. i. seg. 55. This regulation has been praised by many. Plato in Menexemo, Æschines contra Ctesiphon.

1119 Suidas, v. αδυνατοι, Lysiæ Orat. 23, contra Pancleonem.

1120 Cod. Theodos. lib. vii. tit. 20, 8. Brissonius v. Causarius.

1121 Livius, ii. 47, p. 458.—Dio Cassius, lib. lv. 23, p. 793.—Sueton. Vita Jul. Cæsar. cap. 38. To this subject belong many passages in the Auctor. Rei Agrar. pp. 15, 16, 17, 205, ed. Amstelod. 1674, 4to.

1122 De Imperio Romano, lib. ii. cap. 12. Argent. 1612, 4to.

1123 Lib. i. cap. 7, ext. 10.

1124 Brisson de Verbor. Signif. v. Meritorius.

1125 p. 146.

1126 Histor. lib. vi. cap. 20.

1127 This I learn from Pontac's Observations on the Chronicon of Eusebius, p. 507, Chronica trium illustrium auctorum. Burdigalæ

1604, fol.

1128 Platina de vitis Pontificum, p. 48, 1664, 12mo.

1129 Lamprid. vita Alex. Severi, cap. 49.

1130 Walch's Histor. der Päbste. Göttingen, 1758, 8vo, p. 57.

1131 Roma Vet. et Nova. lib. iii. cap. 21.

1132 See Hardouin's Observations on Plin. lib. viii. seg. 74, p. 477; and the figure of the coin, plate vii.

1133 Annæ Comnenæ Alexiados lib. xv. p. 484. The authoress says expressly, that the name ὀρφανοτροφεῖον is taken only *a parte potiori*, as it is known that at later periods not only children who had lost their parents, but others also who were entirely or in part educated at the public expense, and likewise the children of the choir, were called ὀρφανοί. See Du Cange, Gloss. Græcit. The emperor was accustomed to send orphans to the monasteries to be educated and instructed; but with this express intimation, that they were not to be treated and instructed as serfs, but as the children of freemen.—Anna Comn. p. 381.

1134 [There is a tradition that this institution owes its rise to the patriotic exertions of Nell Gwynn, the celebrated mistress of Charles II. A paragraph in a newspaper of the day seems to give some little strength to the supposition that her family once dwelt in the vicinity; and a public-house still exists at no great distance from the hospital, having her portrait for its sign, with an inscription ascribing to her the merit of the foundation. The anonymous author also of the life of Eleanor Gwynn states, that it was at her instigation that this noble charity was established. "Another act of generosity," he says, "which raised the character of this lady above every other courtezan of these or any other times, was her solicitude to effect the institution of Chelsea Hospital. One day, when she was rolling about town in her coach, a poor man came to the coach-door soliciting charity, who told her a story, whether true

or false is immaterial, of his having been wounded in the civil wars in defence of the royal cause. This circumstance greatly affected the benevolent heart of Eleanor; she considered that (besides the hardships of their being exposed to beggary by wounds received in defence of their country) it seemed to be the most monstrous ingratitude in the government to suffer those to perish who had stood up in their defence.

"Warm with these reflections and the overflow of pity, she hurried to the king, and represented the misery in which she had found an old servant; entreated that he might suffer some scheme to be proposed to him towards supporting those unfortunate sons of valour, whose old age, wounds, or infirmities, rendered them unfit for service; so that they might not close their days with repining against fortune, and be oppressed with the misery of want."

Another anecdote of that period states, with somewhat more probability, "That when the garrison was withdrawn from Tangiers, there was among them a considerable number of aged and decrepid persons. It was therefore proposed to build an hospital for them; and the king being applied to for a piece of ground for the site, he offered the spot on which king James's College stood; but recollecting himself, 'Odso,' says he, ''tis true I have already given that land to Nell, here.' She, who was one of the most generous and benevolent of human beings, immediately said, 'Have you so, Charles? then I will return it to you again for this purpose;' and the hospital was accordingly erected. The king however built a house for Eleanor in Pall Mall."

It is however very probable, according to Mr. Evelyn's Memoirs, that the design originated with Sir Stephen Fox, who for some years had been paymaster of the forces, and certainly had better opportunities of becoming acquainted with the wants and distresses of the aged and worn-out veterans, great numbers of whom had been thrown on the charity of the country at this period. The building was erected under the superintendence of Sir C. Wren, and cost £150,000. It usually contains about 500 invalids;

there are also a number of out-door pensioners, amounting to about 85,000.]

1135 An Historical Account of the Royal Hospital for Seamen at Greenwich. London, 1789, 4to. [The foundation-stone of this magnificent building was laid on June 3, 1696, and the whole of the superstructure, under the honorary superintendence of Sir Christopher Wren, was finished within two years; the hospital was opened for the reception of pensioners in 1705. In the year of the foundation an act was passed, 7 and 8 William III., cap. 21, by which sixpence a month of the wages of all seamen belonging to the royal navy is appropriated to the benefits of the institution. Since that time large sums have been bequeathed for the use of the hospital, and the buildings have been successively enlarged and improved.

The indoor pensioners, of whom there are 2700 (which number is kept up by filling the vacancies twice a month), are maintained, clothed, and lodged, having also a weekly allowance for pocket-money.

By the act, 10 Anne, cap. 27, it is enacted that the seamen of the merchant service shall contribute equally with those of the royal navy; and that such of the former as may be wounded in the defence of property belonging to Her Majesty's subjects, or otherwise disabled while capturing vessels from an enemy, shall also be admitted to the benefits of the institution. The money received from visitors and other sources is appropriated to the support of a school, wherein upwards of 4000 boys have been (1838) educated, from the foundation of the establishment to the present time. There are also about 32,000 out-pensioners.]

1136 Even Alexander the Great undertook this office, as Plutarch expressly says in his life.

1137 Iliad. xi. 514.

1138 Æneid. ii. 263.

[1139] Achil. Tat. Lugd. Batav. 1640, 12mo, pp. 243, 617.

[1140] Mauricii Ars Militaris, pp. 29, 62. Upsaliæ 1664, 8vo.—Leonis Tactica, ed. Meursii, Lugd. Batt. 1612, 4to, lib. iv. 6; xii. 51, 53, p. 150; 119, p. 128. To this subject belongs, in particular, a passage in the Tactica of the emperor Leo, p. 430, n. 62, 63, where it is recommended that medicines both for the healing of wounds and the curing of diseases should be kept in readiness in armies.

[1141] Often called *Concilium Carolomanni*. See Semleri Hist. Eccles. Selecta Capita. Halæ, 1769, 8vo, ii. p. 144.

[1142] Rymer's Fœdera, t. iv. 2, pp. 116, 117.

[1143] See Hoyers Gesch. der Kriegskunst, 1799, 8vo, ii. p. 176.

[1144] Kriegsbuch, durch Leonhart Fronsperger. Frankfort, 1565.

[1145] The Margate sea-bathing infirmary deserves especial mention, as being the only institution of the kind in England, perhaps in Europe. Its object is to provide sea-bathing for necessitous patients suffering under scrofulous and such other diseases as are likely to yield only to sea-air and bathing. It was set on foot in 1793, and established in 1796, by a few benevolent individuals in London, under the fostering auspices of Dr. Lettsom, John Nichols, Esq. (the eminent printer), and his son-in-law, the Rev. John Pridden. Its present site, Westbrook, near Margate, was selected after much inquiry, as the most salubrious spot on the coast within a convenient distance of the metropolis. From a small beginning this excellent charity has arisen to considerable importance in the scale of those valuable institutions which are designed to lessen the amount of human suffering, and it now numbers 230 in-door and about as many out-door patients. This praiseworthy institution however is closed during six months in the year (from November to April), and the in-door patients are required to pay, either by themselves or their friends, from 5*s.* to 6*s.* per week for adults, and 4*s.* to 4*s.* 6*d.* per week for children; which, as scrofulous diseases

more particularly afflict the very poorer classes, are subjects of regret.

COCK-FIGHTING.

Until a recent period the English were almost the only people among whom cock-fighting was a favourite amusement; and on that account it is considered as peculiar to them, though it was esteemed among various nations many centuries ago. It is not improbable that it was first introduced into England by the Romans. That it, however, has been constantly retained there, though the practice of inciting animals to fight has been long scouted by moral and enlightened nations, is as singular an anomaly, as that the Spaniards should still continue their bull-fights, and that princes who wish to avoid the appearance of cruelty should nevertheless pursue, with immoderate passion, the detestable and so often condemned hunting with dogs. I shall leave to others the task of moralising on these contradictions in the character of whole nations as well as individuals, and shall here only give the history of cock-fighting as far as I am acquainted with it.

This pastime is certainly very old; but I agree in opinion with Mr. Pegge[1146], that Palmerius[1147] has made it much older than can fully be proved. The latter supposes that Adrastus, the son of Midas, king of Phrygia, killed his brother in consequence of a quarrel which took place between them in regard to a battle of quails. Adrastus on account of this murder fled to Crœsus; and as that prince lived about 550 years before the Christian æra, quail-fighting, according to the opinion of Palmerius, must have been customary at that time; and in this case one might admit that cock-fighting was of the same antiquity, because the battles of the domestic cock are still more violent, and can afford more amusement. Herodotus[1148], who relates the story of Adrastus, does not mention the cause of the quarrel; but it is given by the historian Ptolemy, the son of Hephestion, called also Alexandrinus, who lived about the time of Trajan and Adrian[1149]. He however only says that the two brothers quarrelled about a quail. Did any other proofs exist that quail-fighting was common at so early a period, it

would indeed be then probable that the brothers quarrelled during that pastime. But as no such proofs are to be found, many other causes of quarrelling in regard to a quail, either in catching or pursuing it, may be conceived.

It is however certain that quails, as well as the domestic cock, are exceedingly irritable and quarrelsome birds; and that, like the latter, they can be employed for fighting; but it appears that quail-fighting was first practised by the Romans, in whose writings it is frequently mentioned[1150]; whereas among the Greeks it seldom or never occurs, while cock-fighting is spoken of on many occasions. The latter however sported with quails; but their pastime with these birds seems not to have been fighting, properly so called, where the great object of contest is whose quail shall be the victor; but the information on this subject is so imperfect that it cannot be fully understood[1151]. Sometimes the parties laid bets who could kill the other's quails, or the greatest number of them, with one blow. One placed a quail within a circle, and another endeavoured by irritating the animal to make it go beyond it. If he proved successful in this attempt, he was declared the winner. Several were often placed within a circle at the same time, and the person lost whose bird first quitted it. Kühn and others are of opinion, that each of the parties endeavoured to induce the quail of the other to leave the circle, by irritating or enticing it; but the words appear without doubt to allude to a contest of several quails with each other[1152], were it possible that the later Greeks had learned to play at this game from the contests of the Romans.

Solon, however, in Lucian[1153], speaks of cock-fights and quail-fights exhibited publicly at Athens. But Lucian lived in the second century, had travelled into Italy, was well acquainted with the Roman customs, and made Solon mention quail-fighting, which he never saw in Greece, merely because he himself had seen it in Italy. This blunder may appear too gross, perhaps, for so acute a writer as Lucian; but since he has fallen into two anachronisms in the same dialogue, as he not only makes Solon a contemporary of Lycurgus, who lived two centuries earlier, but also introduces him as speaking of public cock-fights at Athens, which were first established half a century later, that is to say, after the battle of Marathon,

he may readily have been guilty of a third oversight, by transferring quail-fighting to Athens. But at any rate similar games were usual in the island of Cyprus in the sixteenth century.

It appears, however, that the Romans bred and employed partridges for fighting in the same manner as quails. Lampridius relates, that the emperor Alexander Severus was fond of seeing battles of this kind[1154]; and Ælian, who lived in Italy under Heliogabalus, in the second century[1155], says that those who kept partridges for fighting, when they pitted them against each other, placed the females close to the males, in order to render them more courageous. Without doubt he here speaks of what was then usual at Rome.

Cock-fighting was appointed at Athens to be a public or solemn pastime, in consequence of a circumstance which occurred to Themistocles. At least Ælian relates[1156] that this commander, when he led out the Greeks against the Persians, happening to see two cocks fighting, took that opportunity to rouse the courage of his soldiers, by telling them that as these animals contended with so much obstinacy, though they fought neither for their country, their families, nor their liberty, but merely for the honour of victory, it was much more incumbent on them to exert themselves with bravery, as they had all these causes of incitement. Having defeated the enemy, as a memorial of his victory and a future encouragement to bravery, it was ordered that fighting-cocks should be exhibited every year, in a public theatre, in the presence of the whole people.

Mr. Pegge and others are of opinion that the Greeks afterwards took so much pleasure in the fighting of these birds, that they were generally employed throughout all Greece for this pastime and for betting. I am ready to admit that this is probable; but the institution of Themistocles appears to me to be no proof that cock-fighting was not practised at an earlier period. Even if it had been common, the Athenians might have thought proper to establish a religious or at least solemn cock-fighting to be exhibited every year. Themistocles however is not the only person who employed the courage of game-cocks as an incitement to bravery. Socrates inspired Iphicrates with courage, by showing him with what ferocity the cock of Midas, or Meidias, and that of Callias attacked each other[1157]. What Themistocles said to his soldiers was addressed by Musonius as a

philosopher to mankind, to encourage them to support labour, danger, and pain, when duty or honour require it[1158].

Many modern writers ascribe the establishment of public cock-fighting at Athens, not to Themistocles, but to his contemporary Miltiades. I have hitherto suspected that this arises merely from a confusion of names, as is certainly the case in Moses du Soul[1159], where a reference is made to Ælian, by whom however Miltiades is not mentioned. At present, I am of opinion that Philo Judæus, who wrote in the first century, gave occasion to this assertion. He relates, that when Miltiades was about to lead the Grecian troops against the Persians, he exhibited a cock-fight, in a place which had been employed for public shows, in order to inspire courage into his soldiers by this spectacle, and that the end proposed was accomplished; but nothing is said by that author in regard to the establishment of annual cock-fights[1160]. According to this account, cock-fighting seems to have been at that time not uncommon; but as it remains doubtful whether Philo speaks of the campaign before the battle of Marathon, in which Miltiades and Themistocles were both present, very little can be gathered from his relation, and it appears to me not sufficient to contradict the more circumstantial account of Ælian.

Another small mistake, which Pegge thought it worth while to notice, deserves also perhaps to be rectified. Dalechamp[1161] and Potter[1162] assert that Themistocles, while leading out his army, having heard a cock crow, declared this to be an omen of victory, and after beating the enemy he instituted cock-fighting in remembrance of that event. I shall here remark, that Dalechamp is not the first person who made this assertion. Peucer[1163], and at a period still earlier, Alexander ab Alexandro[1164] mentioned the same thing, but no one ever pointed out the passage in any ancient author upon which this assertion was founded; and I have been as unsuccessful in my endeavours to find it, as those who attempted to discover the sources from which Alexander derived his information. This author perhaps collected from manuscripts, in the fifteenth century, many things never printed, and which therefore have been lost. He may also have written many things from memory without remembering them all with accuracy.

It is indeed true, that the crowing of a cock was sometimes considered as a presage of victory. Thus Cicero quotes an instance[1165] where a Bœotian soothsayer promised victory to the Thebans from the crowing of a cock; and according to Pliny[1166], the same circumstance once served to the Bœotians as an omen of victory over the Lacedæmonians. How then could Themistocles make choice of a cock-fight to commemorate a victory announced by the crowing of a cock? Besides, Anacharsis in Lucian confirms the object of the institution assigned by Ælian. In the history of antiquity many things are often repeated, without any one taking the trouble to examine whether they can be proved by the testimony of the ancients. Those who wish to attain to truth and certainty in matters of this kind, will not consider such short examinations to be of so little importance as they may to others appear.

Dempster has assigned another reason for the cock-fights established by Themistocles, which, though adopted by many, is not even supported by probability. He conceives that these cock-fights were like a kind of permanent trophies or monuments of the conquered Persians, because the game-cock was indigenous in Persia, and conveyed thence to other countries[1167].

Athenæus[1168], indeed, quotes from a work of Menodotus some lines by which the latter part of this assertion is confirmed; and Aristophanes[1169] in two places calls the domestic cock a Persian bird. It is proved by more modern accounts, that this species of fowl is at present found wild in the East Indies and many neighbouring countries. Sonnerat[1170] found them in Hindostan; and they were seen by Cook and by Dampier on Pulo Condor and many islands of the South Sea. According to the testimony of Gemelli Careri, they were indigenous in the Philippine islands, and according to Morolla in the kingdom of Congo. That they are still found wild in Georgia is asserted by Reineggs[1171]. The account therefore of the Greeks, that they obtained domestic fowls from Persia, may be admitted; but as in cock-fights one Persian overcame another, how could these convey the idea of a victory of the Greeks over the Persians? Is the object, then, as stated by Lucian and Ælian not sufficient and intelligible?

That cock-fighting, in the course of time, became a favourite pastime among the people, is proved by the frequent mention which is made of it in various authors. Pliny says[1172] that it was exhibited annually at Pergamus, in the same manner as combats of gladiators. In this city, according to Petronius[1173], a boy was promised a fighting-cock; and therefore it appears that boys kept cocks there for this pastime. Æschines reproaches Timarchus with spending the whole day in gaming and cock-fighting. Plato[1174] complains, that not only boys but grown-up persons, instead of labouring, bred birds for fighting, and employed their whole time in such idle amusements.

Cock-fights were represented also by the Greeks on coins and on cut stones. That the Dardani had them on their coins we are told by Pollux[1175]; and this seems to prove that these people were as fond of that sport as their neighbours of Pergamus. Mr. Pegge caused engravings to be made of two gems in the collection of Sir William Hamilton, on one of which is seen a cock in the humble attitude of defeat, with its head hanging down, and another in the attitude of victory, with an ear of corn in its bill as the object of contest. On the other stone two cocks are fighting, while a mouse carries away the ear of corn for the possession of which they had quarrelled; a happy emblem of our law-suits, in which the greater part of the property in dispute falls to the lawyers and attorneys. Two cocks in the attitude of fighting are represented also on a lamp found in Herculaneum[1176].

That the Greeks employed various means to increase the irritability and courage of fighting-cocks is beyond all doubt. Besides the circumstance already mentioned in regard to the females, they gave them also food which produced nearly the same effect as opium does in India, and as brandy did some years ago on the European armies. Dioscorides[1177] and Pliny[1178] ascribe this effect to a plant which they call *adiantum*. The former says it was given to game-cocks and quails, and the latter that it was given to game-cocks and partridges, to incite them to fight. Garlick, *allium*, was employed also, as we are told by Xenophon, not only for game-cocks but also for horses and soldiers. That the Greeks, however, like the English at present, armed their cocks with steel spurs, in order to render their battles

more bloody, is denied by Pegge; though the contrary seems to be proved by a passage in Aristophanes, now become a proverb, and the remarks of the scholiast[1179]. As the English procure the strongest and best fighting-cocks from other countries, and often from Germany, through Hamburg, the Greeks, in the like manner, obtained foreign game-cocks for the same purpose[1180].

Why the Romans showed more fondness for quail-fighting than for cock-fighting I do not know; but it is certain that they had not the latter, or at any rate only seldom and at a late period, which appears to be very singular, as they began then more and more to imitate the Greeks. Varro mentions the breeds which were chiefly sought for in Greece; but he adds, that though they might be good for fighting, they were not fit for breeding[1181]. Had the breeding of game-cocks been an employment, he would have spoken in a different manner. Columella also ridicules the breeding of these cocks, as a Grecian custom, and prefers the native race to all others. Eustathius, in the place already quoted, says expressly that the Romans preferred quails to game-cocks; yet in later times we find mention among them of cock-fighting, as has been before remarked.

There were cocks in England in the time of Julius Cæsar[1182]; but it is said that they were kept there merely for pleasure, and not used as food. The latter part of this account is not improbable. The inhabitants of the Pelew Islands, we are told, eat only the eggs of their hens, and not the flesh. But the question, how old cock-fighting is in England, cannot be determined. Pegge says, the oldest information which he found on this subject was in the Description of the City of London by William Fitz-Stephens, who lived in the reign of Henry II., and died in 1191[1183]. This writer relates that every year on Shrove Tuesday the boys at school brought their game-cocks to the master, and the whole forenoon was devoted to cock-fighting, for the amusement of the pupils. The theatre or cock-pit, therefore, was in the school-house, and the pupils seem to have had the direction of it. To this information I can add, that cock-fighting in France was forbidden by a council in 1260, on account of some mischief to which it had given rise[1184].

This pastime has been sometimes forbidden even in England, as was the case under Edward III. and Henry VIII.; also in the year 1569, and even later; but it was nevertheless retained to a late period. Even Henry VIII. himself instituted fights of this kind; and a writer worthy of credit relates, that James I. took great delight in them[1185]. In modern times this cruel amusement has been carried beyond all bounds; so that the cock-fights in China[1186], Persia[1187], Malacca[1188], and America[1189], are nothing in comparison of those called the *battle-royal* and the *Welsh main*. In the former a certain number of cocks are let loose to fight, and when they have destroyed each other, the survivor is accounted the victor, and obtains the prize. In the latter kind of battle, sixteen pair of cocks, for example, being pitted against each other, the sixteen conquerors are made to fight again; the eight of these which are victors, must fight a third time; and the four remaining a fourth time, till at length the two last conquerors terminate, by a fifth contest, this murderous game, after thirty-one cocks have successively butchered each other amidst the noisy exultation of the spectators, who however make a pretence to the character of magnanimity.

[Cock-fighting is one of the chief amusements throughout the East Indies and China, and it is a fashionable pastime for ladies in Peru. The spot on which the cock-pit Royal, which was built in the reign of Charles II., existed, is now used for the meetings of the members of Her Majesty's Privy Council. The custom of cock-throwing, that is, of throwing sticks at a cock exposed at a stake and which was practised in this country at Shrovetide, is supposed to have originated during the war with France in the reign of Edward III., and to have been considered a mark of hatred and contempt for the French people, of whom that bird was the national emblem; but the conjecture rests upon no solid authority and must be regarded as mere legend.

Cock-fighting is now forbidden and punishable by law in Great Britain, and every attempt is made to prevent this and other similar barbarous sports and to convict the offenders, by the Society for the Prevention of Cruelty to Animals.]

FOOTNOTES

1146 Archæologia, vol. iii. p. 132. A Memoir on Cock-fighting, by Samuel Pegge, M.A., Rector of Wittington. As this learned antiquary made use of what was collected by others on this subject, I have taken the same liberty with his paper; but have rectified some mistakes and made new additions.

1147 Palmerii Exercit. in Auct. Græcos. Ultraj. 1694, 4to, p. 3.

1148 Lib. i. cap. 35 et 45.

1149 See Vossius de Historicis Græcis, lib. ii. cap. 10. Extracts from this book of Ptolemy may be found in Photii Bibliotheca, 1612, fol. p. 472.

1150 The passages which indisputably relate to quail-fighting, as far as I know, are as follows: Plutarch. Apophthegm. p. 207, ed. Francofurt, 1620, fol. Cæsar Augustus caused a person to be punished for having purchased and used as food a quail which had always been victorious; and in Vita Antonini, p. 930, it is said that Antoninus often had the satisfaction of seeing his game-cocks and quails victorious. M. Antoninus de Se-ipso, i. § 6, declares that he never took pleasure in keeping quails for fighting. Herodian, iii. 10, 4, says that the son of Septimus Severus always got into quarrels at quail- and cock-fighting.

1151 This account is given by Jul. Pollux, lib. ix. cap. 7, § 102 et 108.—Suidas, v. ὀρτυγοκόπος, ed. Kusteri, ii. p. 717.—Meursius de Ludis Græcorum, in Gronovii Thes. Græc. Antiq. vii. p. 979.

1152 Pollux, p. 1095.

1153 De Gymnasiis, cap. 37.

1154 Cap. 41, p. 985.

1155 Histor. Anim. iv. 1.

1156 Var. Histor. ii. 28. Kühn quotes from Eustathius's commentary on the Iliad, p. 740, a passage which contains a new proof that the Romans had quail-fighting rather than cock-fighting. The words of Ælian are admitted by Petit among the Attic laws. See his Leges Atticæ, p. 156.

1157 Diogen. Laert. ii. 30. p. 98.

1158 Stobæi Eclog. ed. Gesneri. Tiguri 1543, fol. p. 298. Cœlius Rhodiginus Lection. Antiq. xvi. 13, and after him Delechamp, Kühn, Pegge, and others say, that the philosopher Chrysippus extols the game-cock also on account of its courage; but none of these writers has told us where this fragment of the lost works of that polygraph is to be found. I met with it in Plutarchi lib. de Stoicorum repugnantiis, p. 1049.

1159 Solanus ad Luciani lib. c.

1160 The passage occurs in the treatise, Liber quisquis virtuti studet, in op. ed. Mangey, ii. p. 466.

1161 In his observations on Pliny, lib. x. 21, sect. 34.

1162 Antiq. of Greece.

1163 De Divinationum Generibus, 1591, 8vo, 232, b.

1164 Geniales Dies, v. 13.

1165 De Divinatione, i. cap. 34.

1166 Plin. x. 21, sect. 34.

1167 In his Annotations on Rosini Antiquit. Rom. iii. cap. 10. See Hyde de Religione Persarum, p. 163.

1168 Lib. xiv. cap. 20.

1169 Aves, 484, 707. Beck, in his edition of this comedy, Lips. 1782, 8vo, p. 50, thinks that the ancients themselves did not know whence this appellation arose. He refers therefore to the scholiasts, and to Suidas, v. Περσικός ὄρνις, p. 102, whose words have been copied by Phavorinus into his dictionary, p. 598; and he supposes, with Suidas, that the similarity of the cock's comb to the Persian covering for the head gave occasion to the name. But the passage quoted from Athenæus assigns a much more probable reason.

1170 Voy. aux Indes Or. ii. p. 117, where there is also a figure of the wild fowls.

1171 Reineggs Beschreibung des Kaukasus, 1797, 8vo, p. 69.

1172 Lib. x. c. 7.

1173 Cap. 86.

1174 De Legibus, l. vii.

1175 Onomast. ix. 84.

1176 Antich. di Ercolano, tom. viii. Lucerne, p. 63. More engravings of coins with similar impressions may be found in Haym. Thes. Brit. i. pp. 213, 234, in Agostini Gem. P. i. p. 199, and in Gorleus, P. i. 51, and 114, also P. ii. 246. Frölich Notit. Numism. p. 81. A single cock may often have been the emblem of vigilance.

1177 Lib. iv. cap. 36.

1178 Lib. xxii. cap. 21, sect. 30: "perdices et gallinaceos pugnaciores fieri putant, in cibum eorum additis." This affords a further proof that partridges also were made to fight.

1179 Aves, 760: αἶρε πλῆκτρον εἰ μάχει: tolle calcar si pugnas. See what has been said in regard to this proverb by Suidas, and by Erasmus

in his Adagia.

1180 The most celebrated breeds are mentioned by Columella, viii. 2.—Plin. x. 21.—Geopon. xvi. 3, 30.

1181 Varro, iii. 9.

1182 De Bello Gallico, lib. v. 12.

1183 "Præterea quotannis die, quæ dicitur carnivale (ut a puerorum ludis incipiamus, omnes enim pueri fuimus) scholarum singuli pueri suos apportant magistro suo gallos gallinaceos pugnatores, et totum illud antemeridanum datur ludo puerorum vacantium spectare in scholis suorum pugnas gallorum." I have transcribed these words from the first edition of this old topography, which is entitled A Survey of London, written in the year 1598, by John Stow ... with an appendix containing Libellum de situ et nobilitate Londini, written by William Fitzstephen. Lond. 1599, 4to, p. 480. Stow translates the word *Carnivale* by *Shrove Tuesday*.

1184 Du Cange, Glossarium. This council, as I conjecture, was held in the town of Copriniacum in diocesi Burdegalensi, which, as some think, was Cognac.

1185 See Maitland's London, and Stow's Survey, by Strype, i. p. 302. edit. 1754.

1186 Bell's Travels, p. 303.

1187 Tavernier.

1188 Dampier. Also the Gentleman's Mag. 1770, p. 564.

1189 Wafer, p. 118.

SALTPETRE. GUNPOWDER. AQUAFORTIS.

In examining the question, whether Theophrastus, Pliny, and in general the ancient Greeks and Romans, were acquainted with our saltpetre, or at what period it became known, I shall perhaps meet with as little success as those who have preceded me in the same research[1190]. I shall therefore be satisfied if competent judges allow that I have contributed anything new that can tend to illustrate the subject.

Our saltpetre, which is commonly called *nitrum*, and sometimes, though more rarely, *sal nitræ*, is a neutral salt composed of a peculiar acid, named the acid of saltpetre or nitric acid, and that alkali called potash. The characters by which it is most readily distinguished from other salts are its cooling taste, its fusibility when exposed to a small degree of heat, and in particular its so-called deflagration; that is, the property it has when placed in the fire, or on an ignited body, or when melted in a crucible, with a combustible substance, of suddenly bursting into a very bright flame, by which it loses its acid, and nothing remains but a carbonate of potash. The principal use of it is in making gunpowder, and for the preparation of that acid known under the name of aquafortis[1191], which is employed in various ways.

Native saltpetre is so rare, that Cronstedt was not acquainted with it. At present, however, it is known to occur in the East Indies, in the lower part of Italy, also in Portugal[1192], Spain, America, and some other countries[1193]. But almost all the saltpetre obtained in Europe is produced partly by nature and partly by art. The putrefaction of organic bodies gives rise, under certain circumstances, to nitric acid, which in general combines with calcareous earth wherever it finds it, and forms the so-called earthy saltpetre. This is decomposed by potash, and the latter uniting with the acid forms common saltpetre. Sometimes also it is found that the nitric acid, instead of being united with calcareous earth, is combined with soda, which

produces the so-called cubic saltpeter[1194]. Both these saline substances, but the earthy more frequently than the cubic, are often found on effloresced walls; and both are then comprehended under the common names of *Mauersalz* or *Mauerbeschlag*, *sal murale*.

This efflorescence on walls was observed, in all probability, at a very early period, especially as it is produced in many parts in great abundance, and as it makes itself perceptible by the decay of walls, which it seems to corrode. It is the plague or leprosy of houses mentioned in the Mosaic code of laws. As the ancients were so much inclined to expect medicinal virtue in all natural bodies, there is reason to think that they soon collected and made trial of this saline incrustation. That this indeed was actually the case, and that they gave the name of *nitrum* to this saline mass, may be proved from their writings. Their *nitrum*, however, must have been exceedingly various in its properties. For this incrustation is not always calcareous saltpetre; it is often soda[1195], mixed with more or less calcareous earth; and sometimes it consists of salts of sulphuric acid. In modern times, on closer examination, other salts of nitric acid have been found in the incrustation of walls, such as flaming saltpetre or nitrate of ammonia, bitter saltpetre or nitrate of magnesia; but of these no mention can be expected in the works of the ancients.

Substances so different ought not indeed to have been all named *nitrum*; but before natural history began to be formed into a regular system, mankind in general fell into an error directly contrary to that committed at present. Objects essentially different were comprehended under one name, if they any how corresponded with each other even in things accidental. Whereas at present every variety, however small, obtains a distinct appellation; because many wish to have the pleasure, if not of forming new species, at any rate of giving new names. The elephant and rhinoceros were formerly called oxen; the sable and ermine were named mice, and the ostrich was distinguished by the appellation of sparrow. In the like manner, calcareous saltpetre and alkali might be called *nitrum*. The ancients, however, gave to their *nitrum* some epithets, but they seem to have been used only to denote uncommon varieties.

Now, as the ancients were not acquainted with any accurate method of separating and distinguishing salts, it needs excite no wonder that they

should ascribe to their *nitrum* properties which could not possibly be united in a salt, and much less exist in our saltpetre. But as they were neither acquainted with aquafortis nor manufactured gunpowder, and as no particular use of calcareous saltpetre was known, the *nitrum* most valuable to them must have been that which consisted chiefly of soda, and which consequently could be employed in washing, in painting, and in glass-making.

It is well known that in warm countries this alkali effloresces here and there from the earth, particularly in a dry soil, and even in such quantity as to be employed in commerce. Hence it may be readily comprehended why this effloresced salt, which is very often mixed with common salt, obtained the name of *nitrum*.

The important discovery, that a similar salt, having the like properties, and applicable to the same uses, named at present soda, may be obtained from the ashes of certain plants, was first made, in my opinion, by the ancient Egyptians or Arabians[1196]. This salt also, at least by the Greeks, was named *nitrum*, or considered as a species of it. By the incineration of the plants this salt was rendered slightly caustic; and it then became moist in the air, and deliquesced when not preserved in very close vessels. It was therefore like those salts which are obtained, in the same manner, from the ashes of all other plants; though the latter are essentially different from the former, and in the course of time obtained the peculiar appellation of potash or pearlash. One can hardly be surprised that the ancients were not able to distinguish soda from potash, especially as they were both obtained from vegetable ashes.

But were the ancients, under the ambiguous name of *nitrum*, acquainted with our saltpetre? There is certainly reason to think that it became known to them by lixiviating earths impregnated with salts. There are, as already said, not only in India but also in Africa, and particularly in Egypt, earths which, without the addition of ashes or potash, give real saltpetre, like that of the rubbish-hills on the road from new to old Cairo[1197], and like the earth in some parts of Spain. It is a knowledge only of this natural kind of saltpetre, which required no artificial composition, that can be allowed to the ancients, as it does not appear by their writings that they were sufficiently versed in chemistry to prepare the artificial kind used at present.

But even admitting that they had our saltpetre, where and by what means can we be convinced of it? Is it to be expected that any of the before-mentioned characters or properties of this salt should occur in their writings? They neither made aquafortis nor gunpowder; and they seem scarcely to have had any occasion or opportunity to discover its deflagration and the carbonization thereby effected, or, when observed, to examine and describe it. No other use of our saltpetre which could properly announce this phenomenon has yet been known. How then can it be ascertained that under the term *nitrum* they sometimes meant our saltpetre?

Those inclined to believe too little rather than too much, who cannot be satisfied with mere conjectures or probabilities, but always require full proof, will acknowledge with me, that the first certain accounts of our saltpetre cannot be expected much before the invention of aquafortis and gunpowder. It deserves also to be remarked, that the real saltpetre, as soon as it became known, was named also *nitrum*; but, by way of distinction, either *sal nitrum*, or *sal nitri*, or *sal petræ*. The first appellation, from which our ancestors made *salniter*, was occasioned by an unintelligible passage of Pliny, which I shall afterwards point out. The two other names signify, like *sal tartari*, *sal succini*, a salt which was not *nitrum* but obtained from *nitrum*. *Sal-nitri*, therefore, or *salniter*, was that salt which, according to the representation of the ancients, was separated by art from *nitrum*, yet was essentially different from the *nitrum* or soda commonly in use. Biringoccio says expressly, that the artificial *nitrum*, for the sake of distinction, was named, not *nitrum*, but *sal nitrum*.

The name *nitrum* is of great antiquity, and seems to have been conveyed from Egypt and Palestine to Greece, and thence to Italy and every part of Europe. For it is evidently the *neter* mentioned by the prophet Jeremiah, chap. ii. ver. 22; and which occurs also in the Proverbs of Solomon, chap. xxv. ver. 20. But whether the name *nitrum*, as Jerome says[1198], be derived from the Egyptian province *Nitria*, whence it was exported in great abundance, or the name of the province was derived from *nitrum*, is a question of little importance in regard to this research. *Nitron* is mentioned by Herodotus, where he describes the Egyptian method of embalming dead bodies[1199]; by some of the Greeks the word was written and pronounced *litron*. In the same manner people say *nympha* and *lympha*.

In order to avoid confusion, I shall here call the *nitrum* of the ancients nitrum, and the *nitrum* of the mineralogists saltpetre.

In the course of time men became acquainted with the purer, more useful, and cheaper mineral alkali which was furnished, under the name of soda, by the Moors and inhabitants of the southern countries, who had learned the method of preparing it. The vegetable alkali also was always more and more manufactured in woody districts, as an article in great request, and sold under the name of potash, *cineres clavellati*. All knowledge of the impure alkali from the incrustation of walls was then lost; and as there was no further need of guarding against confusion, it was not longer thought worth while to name saltpetre *sal nitri*: it was called *nitrum*; and the oldest signification of this word being forgotten, it was admitted without further examination, that the *nitrum* of the ancients was nothing else than our saltpetre.

In the sixteenth century some learned Europeans, while travelling through the East, heard the name *natrum* given to the mineral alkali which was then exported as an article of commerce, and introduced in their works this transformation of the ancient word *nitrum*. This appellation was employed by the systematic mineralogists, who, giving themselves little trouble about the original meaning of words, and taking care only to avoid confusion, called the mineral alkali also *natrum*, and applied the name of *nitrum* to saltpetre. As far as I know at present, it was first stated by Peter Bellon and Prosper Alpinus[1200], that the mineral alkali was in the East called *natrum*. The former returned in 1549, and the latter was still in Cairo in 1580.

This word was adopted in mineralogy by Linnæus, in the year 1736, as the name of a species, in which he comprehended for the first time the alkaline incrustation found on walls. In this he is followed by Wallerius, who includes also the mineral alkali from the East. Afterwards the word *natrum* was employed in the same sense by all mineralogists.

It deserves here to be remarked, that Boyle had even examined and determined the difference between the fixed and volatile alkalies; but that mineralogists and chemists, till the latest periods, believed that all fixed alkali arose, or at least was obtained, by the incineration of plants. The difference between the mineral and vegetable alkalies was first defined, in a

proper manner, by the exertion of the German chemists Pott, Model and Marggraf[1201]; especially after the last had proved, in the year 1758, that the basis of common salt was not, as had before been generally believed, an alkaline earth, but a fixed alkali, to which, because it was in many of its properties different from the fixed vegetable alkali, he gave the name of fixed mineral alkali. Soon after this substance was discovered in mineral springs; and Model and others have shown that it is not essentially different from that which in the East is called *natrum*.

It is singular, and yet may be accounted for, that since that time many have spoken of the *nitrum* and *natrum* of the ancients, though they are only different pronunciations of the same word; and *natrum* is never found in the works of the Greeks or the Romans, and not even in writings of the middle ages.

But if the greater part of what I have here said should be considered only as conjecture, it must nevertheless be acknowledged that it is deduced from the nature of the thing; and when impartially compared with what we read in the ancients, the latter I hope will be better understood than it hitherto has been; the impropriety of many readings will become apparent, and the truth of this conjecture be admitted.

Were I here to relate everything that we read of *nitrum*, in order to compare it with nature and to examine it thoroughly, I should be obliged to extend this article to a greater length than might be agreeable to the reader. I shall therefore give only the principal proofs of my assertion, premising, that doubts which might be excited by single passages not here mentioned, will, on a closer comparison, vanish without my assistance. But I maintain that those who wish to explain the old names of natural objects must relate everything said of them, and not that alone which is favourable to their opinion, and which may be often contradicted by what was purposely or accidentally concealed. The first part of such an examination is always a careful collection from the writings of the ancients of all the predicates of the natural object, the systematic name of which one is endeavouring to prove.

There is reason however to conjecture, that the ancients, in the history of their impure nitre, the manner of obtaining which the Romans at least had no opportunity themselves of seeing, for Pliny says expressly that it

was not procured in Italy, fell into many errors and mistakes, which at present cannot all be explained.

Hence it happened that the ancients did not understand the art of purifying the salt which they obtained from minerals; and therefore they were obliged to use it in the same impure state in which they found it. On this account they considered each natural mixture as a peculiar kind; gave to the greater part of them, or those most useful, particular names; and of these recommended for different purposes those which, according to their purity or mixture, or according to other circumstances, were the most convenient. It is not probable that all these varieties could be again found out or defined; and it seems to be of little importance, when it is known that the names denote nothing more than the varieties of a mineral.

In this examination it is to be regretted that the book of Theophrastus, in which he expressly treated of *nitrum*, has not been preserved. But it may be believed, even without the testimony of Pliny, that he was one of the most accurate and acute naturalists among the ancients, and that he gave the best account of this substance[1202]. It must, however, be admitted that Pliny thoroughly understood this author, and gave a correct extract from him, and that the transcriber fell into no mistake.

That the *nitrum* of the ancients was an alkali more or less impure, but not saltpetre, has been long admitted by those who had the least knowledge of mineralogy, as well as by the most sagacious physicians. The grounds for this opinion, as far as I have yet learned, are as follows: more indeed might be found, but these are sufficient to afford a complete proof. Galen, a cautious writer, says that *nitrum* was in general burnt, by which means its effects were strengthened[1203]. Had it been saltpetre, it is impossible that the ancients should not in burning it have observed its deflagration, and this property is too remarkable not to have been mentioned. But nothing is to be found that can with any probability be supposed to allude to it.

But should it be admitted without any grounds that it was not an alkali but saltpetre which they burnt, it must certainly have been carbonized; for a burning body may easily have fallen into the crucible, and in general *nitrum* seems to have been burnt in an open fire, like our lime, because Pliny, speaking of the Egyptian, considers the contrary as somewhat uncommon.

Physicians then, at any rate, must have observed, that a body very different both in its appearance and effects was produced from saltpetre by burning, but which could not be used for any other purpose than that salt. Of this however we do not find the least intimation.

But *nitrum* was undoubtedly soda, and on that account when burnt must have become more caustic as well as stronger in most of its effects, and in this respect similar to potash, since [owing to impurities] it in the same manner became moist and deliquesced in the air. What Pliny relates of the Egyptian *nitrum* becomes then intelligible. The latter, he says, was transported in pitched vessels, because it would otherwise have deliquesced; and he afterwards adds, that it was burnt before it was sent off. Had he known that the latter was the cause and the former the effect, he would have mentioned the latter first; but his whole extract, in regard to nitre, is written in general without order. The vessels, no doubt, were of clay; but whether he means in what he adds that they were not burnt but only baked in the sun, or that before they were filled they were completely dried in the sun, has been determined by no commentator. To me the latter is the more probable. Pliny also mentions another circumstance in regard to the burning of the Egyptian *nitrum*; namely, that it must be done in a close vessel, otherwise it would decrepitate or fly off. This is perfectly intelligible, when it is considered that it contained a great deal of common salt, which alone possessed the property of decrepitating; and it is well known in mineralogy that native soda, and even that which in modern times has been introduced into our collections from Tripoli, and of which I have in my possession a specimen, contains common salt[1204], and often in cubic crystals. Pliny had just reason to add, that *nitrum* otherwise does not properly decrepitate. The ancients were well acquainted with the resemblance of their *nitrum* to lime, and especially of that which was burnt. On this account, because the Egyptian was exported after it had been burnt, it could easily be mixed with quicklime, or, as Pliny says, be adulterated. But the proof which he gives he does not seem to have thoroughly understood. The Egyptian must at all times have been caustic (*pungens*) even without lime; but that which was mixed with lime could not so speedily or completely dissolve on the tongue as that which was pure, and left behind it more earth. What he says of a test by the smell, I cannot understand in any other manner than that burnt lime, when moistened with

water, diffused that disagreeable vapour observed in apartments the walls of which have been newly plastered; though when the quantity is small this is hardly perceptible.

If I understand Theophrastus[1205] properly, he seems to say, that if *nitrum* be burnt as soon as it is dug up, it communicates heat to water in the same manner as lime. It may here be seen how great a resemblance the ancients found between their *nitrum*, alkaline earth and lime.

The similarity of wood-ashes to the *nitrum* of the ancients, which they acknowledged, proves also that it was in reality an alkaline salt. We are told by Theophrastus[1206] that *nitrum* was said to be produced from oak-ashes; and Pliny[1207], who borrowed from this writer, remarks that it was certain the ashes of that wood were nitrous. He ascribes also to burnt wine-lees the nature and properties of *nitrum*[1208]. Nay he considers as a kind of *nitrum* those saline ashes which, in many countries destitute of salt, were used for seasoning food, and which were prepared by pouring sea-water or salt brine over burning piles of wood, gradually and in small quantities, so that the fire was not extinguished, by which means the water evaporated, leaving the salt behind, but mixed indeed with charcoal, ashes, earth, and alkaline salts; consequently it must have been moist, or at any rate nauseous, if not refined by a new solution. This method of preparing or boiling salt, which perhaps is the oldest, has been mentioned by various writers; but many of them, through ignorance or neglect, have not told us that sea-water or brine was employed, as they speak in such a manner as if any kind and even fresh water had been used for that purpose.

Varro relates that he saw this process employed on the Rhine[1209]. Pliny says[1210] that oak timber had before been burnt for that purpose. In another place he mentions a similar process among the Gauls and the Germans[1211], as Tacitus does among the Hermanduri and the Catti[1212]. The former also states, on the authority of Theophrastus, that the Umbri burnt salt in the like manner[1213]. It is however certain that Pliny and other ancient writers often

quote from Theophrastus what, at present, is not to be found in the works of that naturalist, but in those of his preceptor Aristotle[1214].

Pliny adds, that this paltry method of obtaining salt had been long given up; and this indeed was the natural consequence of increased civilization. It is however certain that it was long continued in many countries, and in some still exists.

About two centuries ago the inhabitants of the province of Zeeland, descendants perhaps of the Catti, used no other salt than what they obtained in the like manner, from mud thrown up by the sea, which they burned and moistened with sea-water, as we are told by Lemnius, who was himself a native of that country. Boxhorn says, in his annotations on the above-quoted passage of Tacitus, that he saw a painting at Zirkzee, in which the whole process was represented. It is probable that salt was boiled exactly in the same manner as at some of the Sleswic islands, described by Denkwerth[1215], from whose account it is seen that the *glebæ marinæ*, of which Lemnius speaks, consisted of mud mixed with roots growing in them; and that the salt when afterwards refined was called there Frisic, in all probability because the inhabitants had learned to make it from their ancestors the Frieslanders. I remember somewhere to have read that salt was made for a long time in this manner by the so-called Wurst-Frieslanders, in the country of Wurst, belonging to the duchy of Bremen. The inhabitants also of the Austrian part of Moldavia, or Buccowina as it is called, still use a salt, which they do not boil, but burn with their superfluous wood, in the like manner from the brine of a saline spring. A member of the former Academy of Brussels[1216] took the trouble to examine the process as described by the ancients, and obtained, as might certainly have been expected, a highly alkaline kind of common salt, similar to that which Pliny, not without reason, considered as a sort of *nitrum*, because undoubtedly it may oftener have been an alkaline carbonate than common salt.

Boerhaave[1217], in quoting the passages of the ancients, did not reflect that, during the incineration of the wood, salt water was poured over it. He considered the whole process as a burning of potash, and thought that the salt obtained was fit for use only because it was made according to the

manner of Tachenius. That indeed gives a carbonated salt, which is almost saponaceous, and so mixed with various parts of the burnt plants that it is much milder, consequently fitter for use than common soda or pearlash can be; but that salt was not so much of the Tachenian kind as a species of common salt superabundant in alkali.

If the *nitrum* was carbonated alkali, there is reason to suppose that the ancients must have occasionally mentioned in their writings that it effervesced with acids. With the mineral acids indeed they were not acquainted; but they had vinegar, and that *nitrum* produced with this an effervescence had been known in the oldest times. A very clear allusion to this circumstance is found in the book of Proverbs, chap. xxv. ver. 20; where Luther however translates the word by *chalk*. Jerome, whose explanation I have already quoted, was in some degree acquainted with this phænomenon; and therefore to him the comparison of Solomon was intelligible[1218]. But at present I can produce no proofs from Greek writers; though they might have occurred during the use of *nitrum* in medicine, in consequence of which it was often put into vinegar.

We shall be further convinced what *nitrum* really was, when the uses to which it was applied, as mentioned in the works of the ancients, are considered. The most common, as soap was not then known, appears to have been in washing, a purpose for which our saltpetre would not be fit; besides, it is at all times too scarce and too dear. I shall not here adduce any proofs of its being employed in this manner, as they often occur, and as several have been already given in the preceding volume[1219]. Many salves and cosmetics were prepared with *nitrum*; and in all probability articles of this kind, used chiefly among the women, are to be understood by the term *nitron parthenicon*, which occurs in Nicholas Myrepsius, in the beginning of the fourteenth century; *matronicon*, mentioned by the same, and by Alexander of Tralles, about the year 565; and the *nitrum matronale* of Marcellus Empiricus, in the fifth century. That the use of it for washing still continues in the East, is confirmed in various books of travels.

The oldest glass, of the preparation of which any account is to be found in history, was made by means of *nitrum* or mineral alkali. For though I doubt that it could have been produced on the sandy banks of the Belus, where some merchants, when cooking, supported their pots with lumps of

nitrum[1220], because sand is not so easily brought to a state of fusion; it at any rate remains certain, that this supposed fusion with our saltpetre is altogether impossible.

The use of *nitrum* for painting announces, without doubt, an alkaline carbonate, and not saltpetre[1221]; and the case is the same with the various uses in the cookery of the ancients, many of which we have still retained. It was added to bread in baking, according to Pliny[1222], in the stead of salt, but probably to promote its rising, for which purpose it is still employed by the Egyptians, as potash was by our bakers. For this use the mineral alkali was formerly brought from the Levant to France, till it was declared by the physicians to be injurious to the health[1223].

When meat which was too fresh was to be dressed, it was put into *nitrum*[1224], in order to make it tender; and, according to Forskäl and others, this is still practised in the East. Our cooks also know that smoked meat, fish and other dried provisions become more tender when placed in a ley of potash, or when a little potash is added while they are boiling.

Nitrum, however, was employed for curing articles of food which people wished to preserve. This appears to contradict what has been mentioned above; but in all probability a caustic sort was used for the former purpose; but for the latter a mild kind, mixed with a great deal of common salt. There were so many species, that some of them might have been applied to quite contrary purposes.

As I conjecture, the use of *nitrum* for causing chestnuts and other husky fruits to boil soft, was also known: to produce the same effect, potash is at present thrown among boiling lentils and peas. I am inclined to think that for this reason Apicius caused chestnuts to be boiled with nitre.

It is highly probable that this effect of alkaline carbonates induced agriculturists to believe that beans, peas, lentils and other leguminous fruits, if steeped, before they were sown, in water in which nitre had been dissolved, or if the dung spread over the earth had been mixed with nitre, the future product could be more easily boiled soft[1225]. However useful this addition may be in cookery, it would produce little effect on seed; and it

appears to me that the old agriculturists placed little confidence in the last-mentioned use, because they were not agreed in regard to the result. Virgil and others seem to expect from it an increase of the fruit[1226]; but others, security against beetles, which eat the fruit and leave the husks empty[1227]. When cabbages were transplanted they were strewed over with nitre, and by these means were said to come sooner to maturity[1228]. Radishes also were treated in the same manner, or besprinkled with nitrous water, in order to make them more tender[1229].

A common method employed by the ancient cooks to give a beautiful green colour to pickled or boiled vegetables, was to add *nitrum* to them while boiling; but this effect could be produced by *natrum*, and not by the *nitrum* of the moderns, or that neutral salt called saltpetre[1230].

Among the oldest accounts of *nitrum* is that where it is mentioned as being employed for embalming dead bodies. It would be tiresome to read over and examine everything written on that subject by the learned; but this much I think is clear, that either the flesh, and in general the softer parts of the body could be corroded in the course of seventy days by the Egyptian nitrum[1231], which, as above shown, was burnt, and in general mixed with unslaked lime, and consequently caustic[1232]; or that the moist parts could be desiccated by carbonate alkali, in the same manner as the manufacturers of parchment purify and dry their skins by the application of chalk. That saltpetre in no case could be useful for this purpose needs hardly be mentioned.

The ancient physicians, who were unacquainted with our numerous class of salts, employed their *nitrum* in many ways, and for a great variety of mixtures; but no writer, as far as I know, ever took the trouble to examine these recipes, though it has long since been declared that *nitrum* must have been potash or salt of tartar. Matthioli[1233] asserted, that those physicians would act very improperly who should prescribe our saltpetre where the ancients employed their *nitrum*; and indeed those in the least acquainted with the effects of salts must know, that all those extolled by the ancients announce carbonated alkalies. Thus burnt *nitrum* was employed for

cleaning black teeth, as at present many use tobacco ashes instead of tooth-powder. It is seen by the works of Aretæus and others, that burnt *nitrum* was used as a caustic, till people learned in modern times to prepare the more active *causticum potentiale*, or *sal causticum*.

What the ancients say of the taste of their *nitrum* seems, however, not entirely applicable to pure carbonated alkali; and much less, or not at all, to our saltpetre. Had they meant the latter, they would certainly not have failed to mention the sensation of coolness which it occasions when applied to the tongue. Galen and Aetius say, that *nitrum* is as bitter as gall; but Serapio ascribes to it a saline taste, with a small degree of bitterness; as does also Pliny, only that for bitterness he substitutes the word sharpness. The names of tastes, however, are as uncertain as the names of the colours which occur in the works of the ancients. Both certainly deserve to be more accurately examined, and to be defined by comparing the things to which these names are given. Prosper Alpinus, however, is of opinion that what the ancients called *amarum*, is not inapplicable to the taste of *natrum*.

The ancients mention various springs and streams which contained what they called *nitrum*[1234]; but nitrous water, according to the present acceptation of the word, that is, water which contains saltpetre, does not exist; and if credit is to be given to Marggraf and others, that they observed traces of saltpetre in some kinds of water, the instances must have been so rare that mention of them could not be expected among the ancients. Their nitrous water was undoubtedly alkaline, and this indeed is not scarce. Such water was recommended by the ancient physicians, both for bathing and drinking[1235]; and Pliny says, it was singular that the salt of such water would not shoot into crystals, like common salt, which is undoubtedly true[1236].

Alkaline water of this kind, such as that of Armenia, was used for washing, and also by fullers. In Egypt, at present, people wash in the same manner with *nitrum*.

It appears to me that many kinds of water, which were only impure and not potable on account of their nauseous taste, were considered by the ancients as nitrous. This seems to be proved by the means which they propose for rendering nitrous water fit to be drunk; that is, by throwing into

it clay, or some grains of barley[1237]. In the like manner, I saw the brewers at Amsterdam improve their dirty water, in some degree, by putting into it kneaded clay, and allowing it to sink to the bottom.

One foundation more for my assertion may be found, I think, in the name *borax*. The ancient *nitrum* by the Arabians was called *Bauracon* or *Baurach*. When that salt, which at present is everywhere called borax, became known to the Arabians, it was at first generally considered as a kind of nitre, and on that account called *Baurach*, because in most of its properties it approached near to the *nitrum* of the ancients, that is, the *natrum* of the present day. But afterwards, when the difference became known, our borax, at least in Europe, retained exclusively the general name of *Baurach*, from which at length was formed the present word *borax*. My conclusion therefore is, that the *nitrum* of the ancients must have been mineral alkali; otherwise it is impossible that our borax, which till modern times was reckoned to be mineral alkali, should have been considered as a *nitrum*.

For many centuries past, the people in Africa and Asia, and also in Spain and Sicily, have cultivated some kinds of plants, which they dry and then burn to ashes. By regulating the fire in a particular manner, they cause these ashes to assume a certain degree of concretion, or vitrification, by which means they are formed into solid cakes of a grey colour, interspersed with many white and black spots. This substance, which in consequence of the vitrification does not become moist in the air, is broken into fragments, and sent to every part of Europe under the name of *soda*, for the use of the glass-houses, soap-boilers, dyers, and for other purposes.

These plants were undoubtedly first cultivated and employed in Europe by the Arabians, who made known the use of them. Those first or chiefly employed were named by them *axnan*, *usnan*, *usnen*, or *uscnanon*; and also *Hasciscio alcali*, that is, *herba kali*, the plant or herb kali, because the name *kali*, or, with the article prefixed, *al kali*, was not given to the plant but to the half-vitrified ashes *kali*. Hence the chemists call salts obtained from the ashes of plants, alkaline salts. I do not know how old this appellation may be; but it is to be found in Vincent Bellovacensis and in the interpolated writings of Geber and Avicenna, and particularly in a passage quoted by the former from an old alchemist named Jahie, where it is called *sal alchali*[1238].

All these salts formerly were considered as nitrous salts, or a kind of *nitrum*. It was indeed soon observed that soda and wood-ashes, which from the earliest periods had been burnt in woody districts, and which are now called potash, were not all of the same nature; but when the difference between the mineral and vegetable alkalies began to be studied, it was then known that soda contains the former, that is, our *natrum*, and potash the latter, but both indeed often rendered impure by earthy and foreign saline particles; and that there are many plants from the ashes of which mineral and not vegetable alkali is obtained. A question now arises, How old in the Levant is the method of preparing this *natrum* from the ashes of plants?

Michaelis is of opinion that it is mentioned in Malachi, chap. iii. ver. 2; which passage I shall give according to Luther's translation: "Who shall stand when he appeareth? for he is like the fire of the goldsmith, and the soap of the scourer. He will sit and melt and purify the silver, and make pure like gold and silver." This learned man here seems to think that the sacred writer alludes to refining the noble metals, and that the word *borith* means soda, which indeed may serve as a flux in the purification of them. I at first considered this meaning as true; but, on closer examination, I am fully convinced that we have both erred.

Those who read without prejudice the above passage of Malachi, must remark, that a double comparison or double image is employed. The messenger there promised was to separate the good from the bad, the clean from the unclean. The first occupation is compared with the labour of the gold-refiner; the other, with that of the scourer of clothes. The first image is afterwards heightened, because the poet, in all probability, was desirous of applying the separation of the ignoble parts, such as slag, by means of fire, as being the stronger image which denotes punishment, in a closer manner to the Levites and priests. At the time of the poet, before the invention of soap, people employed for washing either nitre or the saponaceous juice of certain plants, which I have already endeavoured to determine. The *borith* of the washer there expressly named, was undoubtedly one of these soap plants, and not the half-vitrified ashes either of soda or potash.

This passage of Malachi was so understood in the oldest times. Professor Tychsen, a true pupil and intimate friend of Michaelis, to whose opinion I subjected my doubts, assured me that Michaelis was never able to

convince him of the justness of his exposition; especially as Jerome[1239], without the least hesitation, understood *borith* to be a plant growing in Palestine, and used there for washing; and as the Greek translators, who were much nearer to the period of the poet, and could not be unacquainted with a thing so much used, have translated *borith* by the word πoα, a plant.

In Jeremiah, chap. ii. ver. 22[1240], both the substances formerly used for washing, *nitrum* and the soap-plant, are so clearly named, that Michaelis was obliged to admit that we cannot understand there soda or potash, but a ley or soap, the last of which however was not at that time known. But, to speak the truth, potash and soda would not be altogether unfit for washing; at any rate, not less fit than the *nether* or *nitrum* there named. What may serve, however, to refute entirely the opinion of Michaelis is, that no proof has yet been found that soda is of so great antiquity. For my part, I am acquainted with no older mention of it than that which occurs in the works of the more modern Arabian physicians, Avicenna, Serapio, and others[1241].

All these grounds afford sufficient proof that the *nitrum* of the ancients was our *natrum*, and not our saltpetre. But still, in the account given by the ancients of that salt, there remain many things inexplicable. Thus, for example, no one can accurately define the epithets, *chalastricum*, *halmirhaga*, *agrium*, *spuma nitri*, *aphronitrum*, and others, because they do not indicate different kinds, as already said, but accidental properties of the same salt. Without enlarging further on this subject, I shall only remark that Pliny admits a natural and an artificial kind of *nitrum*, and this division is adopted by Serapio; but the latter term has not the meaning which we affix to it at present. The ancients were acquainted with no other than native *nitrum*, which they called artificial only when it required a little more trouble and art to obtain it.

Most of the physicians recommend red *nitrum*, which is mentioned also by many of the modern travellers. When Prosper Alpinus was in Egypt the rose-red *nitrum* cost twice as much as the white. The red colour, in all probability, arises from a metallic admixture; yet the red *nitrum* may be purer than the other, as red or violet rock-salt is often clearer and purer than that which is colourless.

One of the darkest parts in the history of *nitrum* is the following passage of Pliny: “Faciunt ex his vasa, nec non frequenter liquatum cum sulphure, coquentes in carbonibus.” The latter words he seems soon after to repeat: “Sal nitrum sulphuri concoctum in lapidem vertitur.” From these words J. Rhodius[1242] concludes that *nitrum fixum* was at that time known, because he considered *nitrum* to be saltpetre; but in that case with the sulphur, Glaser’s sal polychrest must properly have been produced. This, however, was not the case, because *nitrum* was fixed alkali. The ancients therefore, when they placed it with sulphur in a crucible upon burning coals must have obtained liver of sulphur, which when it cools is hard, but soon becomes moist when exposed to the air. But I will not venture to determine whether anything of this kind is to be supposed in Pliny, who did not himself fully understand the subject on which he touches.

The account of vessels made of *nitrum* is still more singular. Michaelis conjectured[1243] that articles of various kinds were cut out of this substance, not for real use but merely for ornament, in the same manner as similar things are cut out of rock-salt in Transylvania, many specimens of which I have in my collection[1244]. But even if *nitrum* had been compact and strong enough for this purpose, there could not be the same inducement to employ it as rock-salt, which, in consequence of its solidity, transparency, brightness and smoothness, appears to be capable of furnishing vessels equal to those made of the most beautiful crystal. Dalechamp seems to explain the whole as applicable to glazing; but in this case *nitrum* could serve only as a flux.

Though it can be certainly proved that the *nitrum* of the ancients was an alkaline salt, it is difficult to determine the time when our saltpetre was discovered or made known. As many have conjectured that it was a component part of the Greek fire, invented about the year 678, which, in all probability, gave rise to the invention of gunpowder, I examined the prescriptions for the preparation of it. The oldest, and perhaps the most certain, is that given by the princess Anna Comnena; in which however I find only resin, sulphur and oil, but not saltpetre. Klingenstierna[1245] therefore judged very properly, that all recipes in which saltpetre occurs are either forged or of modern invention. Of this kind are those which Scaliger,

at least according to his own account, found in Arabic works, and in which mention is made of *oleum de nitro* and *sal petræ*[1246]. But it does not occur in that prescription given by Marcus Græcus, and copied by Albertus Magnus, who died in 1280[1247].

I must still believe that the first certain mention of saltpetre will be found in the oldest account of the preparation of gunpowder, which, in my opinion, became known in Europe in the thirteenth century, about the same time that the use of the Greek fire, of which there were many kinds, began to be lost. Among the oldest information on this subject is that found in the above-quoted work of Albertus Magnus, and the writings of Roger Bacon, who died in 1278. It is doubted whether the first-mentioned treatise belongs to Albertus; but it is certain that the author, whoever he may have been, and also Bacon, both derived their information from the same source.

When M. von Arretin lately announced that he was about to publish a manuscript preserved in the electoral library at Munich, which contained the true recipe for making the Greek fire and the oldest for gunpowder, the same writing, as appears, was printed from two manuscripts in the library at Paris. I have now before me a copy of it, which was transmitted to the library of our university by M. Laporte Dutheil, conservateur des Manuscrits de la Bibliothèque[1248].

It contains many recipes, but only with a few variations, as in Albertus Magnus; and it may be evidently seen that Roger Bacon employed this writing, which is mentioned by Jebb in the preface to his edition, from a copy preserved in the library of Dr. Mead. Of this Marcus Græcus nothing at present is known. According to some, he lived in the ninth century; but others, with more probability, place him in the thirteenth. Of his work, perhaps, we have only a translation; for, from the surname Græcus, there is reason to think that the original was written in the Greek language. I must, however, remark that Cardan, where he gives directions for making a fire which can be kindled by water, names Marcus Gracchus, but not Græcus. Scaliger, who, as is very probable, had this writing also, makes no mention of it or its author.

This Marcus speaks of saltpetre three times; first under the name of *sal petrosum*, which occurs also in the same prescription in Albertus Magnus;

but the addition, which Albertus does not repeat, is very remarkable. In my opinion, *scrophulæ contra lapides* means the incrustation found on walls, which was represented as a kind of leprosy. The addition of ashes, or alkaline salts, the author either forgot or omitted, because perhaps he did not consider it as indispensably necessary. In another place it is said, *Lapis qui dicitur petra solis*, or, as it is in other manuscripts, *salis*; but whether saltpetre is here understood I will not venture to determine. In a third passage we find the words *de sale petroso*, or *de salepetro*.

In the works of Bacon the term *sal petræ* occurs at least three times. According to Casiri, the term *pulvis nitratus* is to be found in an Arabic manuscript, the author of which lived about the year 1249[1249]. If the work of Geber, already quoted, be genuine, and if this writer lived, as some think, in the eighth century, it would be the oldest where saltpetre is mentioned, in a prescription for an *aqua solutiva* or *dissolutiva*, which almost seems to be aqua regia. I have not observed the name *sal petræ* in the works of Vincent Bellovacensis, who lived in the thirteenth century.

In a word, I am more than ever inclined to accede to the opinion of those who believe that gunpowder was invented in India, and brought by the Saracens from Africa to the Europeans, who however improved the preparation of it, and found out different ways of employing it in war, as well as small arms and cannon[1250]. In no country could saltpetre, and the various uses of it, be more easily discovered than in India, where the soil is so rich in nitrous particles that nothing is necessary but to lixiviate it in order to obtain saltpetre; and where this substance is so abundant, that almost all the gunpowder used in the different wars with which the sovereigns of Europe have tormented mankind was made from Indian saltpetre[1251]. If it be true that saltpetre was not known in Europe till the thirteenth century, neither gunpowder nor aquafortis could have been made before that time; for the former cannot be prepared without saltpetre, nor the latter without nitre. But if it be true that this salt was known at a much earlier period in India, it is not improbable that both gunpowder and aquafortis were used by the Indians and the Arabians before they were employed by the Europeans, especially as the former were the first teachers of chemistry to the latter. In my opinion, what I have already related proves

this in regard to gunpowder; and what I shall here add will afford an equal proof in regard to aquafortis.

It is difficult to discover the first mention of mineral acids in the writings of the ancient chemists. In the course of their numerous experiments they obtained indeed, at an early period, acids, the utility of which they extol; but each concealed the process by which they were made; and as they had no method of obtaining them pure, they were for a long time unacquainted with the difference between the kinds. Their prescriptions, when they are found, are so contradictory and so carelessly written, that it is almost impossible to conjecture which of the known acids forms the principal component parts in their recipes or mixtures.

It appears to me, that the first intelligible account of aquafortis occurs in the writings of the Arabians, or of the pupils of Arabian chemists. At present I am acquainted with none older than that to be found in the works of Geber. For though I do not believe that those of which we have Latin translations belong to a Geber of the eighth or ninth century, I am ready to admit that they may be, at any rate, of the twelfth. This appears probable, because about that period aquafortis and various arts are oftener mentioned, and in a much clearer manner, in these writings.

It is to be regretted in the history of chemistry, that it is impossible to determine the period of the Greek chemist or alchemist known under the name of Synesius; but it cannot be doubted that he borrowed a great deal from the works of the Arabians. This Synesius, among the chemical solvents, mentions water of saltpetre, which might be considered as aquafortis[1252]. But, as he mentions at the same time *aqua fæcis*, he appears to me to allude to the *nitrum* of the ancients, not to our saltpetre, and in general to strong alkaline leys, which indeed are capable of dissolving many bodies.

The monk Theophilus, of whom I have already spoken, and who in all probability lived in the twelfth century, appears also to have been acquainted with aquafortis; for in some of the passages quoted from his works by Raspe[1253], he speaks of an acid which dissolved all metals. In the writings of Vincent Bellovacensis, in the thirteenth century, some traces, but very doubtful, are found of aquafortis. Where he mentions the different

sorts of gold he speaks of dissolving it, but by this expression he does not allude to its treatment with fire, which he speaks of separately[1254]. In another place he mentions the different solvents, and among these names vegetable acids, a water of sal-ammoniac, and a water obtained from alum by distillation. He here means undoubtedly a mineral acid[1255]. Michael Meier, the most learned chemist of the seventeenth century, says that Vincentius speaks of aquafortis as of a secret; but the passage I have not yet been able to find[1256].

Spielman states that Lullius, who died in 1315, in the eightieth year of his age, gave an account of his obtaining aquafortis from saltpetre by the addition of vitriol, and that Basilius Valentin was acquainted with the use of clay for the same purpose. Picus Mirandula however declares it to be uncertain whether Arnoldus de Villa Nova was acquainted with the acid of saltpetre in the fourteenth century.

It appears to be an old tradition that this acid was first employed at Venice, by some Germans, for separating the noble metals, and conveyed thence as an article of merchandize to every part of Europe. The persons who prepared it were there narrowly watched, in order that the process might not become known. They were employed chiefly for separating the gold from the Spanish silver, and by these means acquired great riches. Hence arose the report that the people of Venice understood the art of making gold; and it is certain that in many countries the gold refiners were for a long time considered as gold makers; but in no period were there more gold makers than in that when separation in the moist way became known. I can however give less account of this art of the Venetians than of the introduction of it into France in the fifteenth or the beginning of the sixteenth century.

William Budæus, who was born in 1467, and died in 1540, speaks of it in his book, printed for the first time in 1516, as a thing entirely new at that period[1257]. A man of low extraction, named Le Cointe, first undertook to separate gold from silver at Paris, by means of a water which Budæus calls *aqua chrysulca*. It is very remarkable, that by means of this water he could separate the smallest particle of gold from silver, and from every other metal; nay, he could even take from vessels their gilding without altering

their form. By this art he acquired great wealth; which together with his secret descended to his son, who at the time was the only gold refiner at Paris.

He adds, that the art was exceedingly dangerous as well as unhealthy, and required great precaution. The possessor of it, when he became rich, left the execution of the work to a servant, whom he directed at a distance, that he might not expose himself to the pernicious fumes of the effervescing liquor. The fumes of the acid derived from saltpetre are indeed prejudicial to the health; but the danger has been much exaggerated, and no doubt with a view to deter people from attempting to discover the art, and to furnish a pretence for raising the price of the production[1258].

Budæus relates also, that the gold was left behind undissolved. The silver only was dissolved, and by another art was separated from the water and washed. It may here be easily perceived that Le Cointe employed aquafortis; but if he was able to loosen the gold from gilt vessels without destroying them, he must have used aqua regia, which consequently was not then unknown.

From other information, it appears that the mint at Paris purchased the art from Le Cointe's son, but still kept it a secret. On this account Francis I., by a decree issued at Blois on the 19th of March 1540, authorized the raising the value of coin, in order to defray the expense of fuel and assaying-water. In the middle of the seventeenth century, the preparation of aquafortis and the process of assaying in the moist way were fully known in France. At any rate, in the month of January 1637, the distillers obtained a guild letter, in which aquafortis is mentioned among the articles sold by them.

When saltpetre became necessary to governments for the manufacture of gunpowder, they endeavoured to obtain it at as cheap a rate as possible. No one before suspected that rulers would be justified in exclusively carrying away the incrustation of walls from private houses, which, when it could be used, became *accessorium fundi*. But the idea of regalia, so often abused, was extended so wide under various pretences, that the saltpetre regale and the letting of it was one of the severest oppressions to which the people were exposed by their rulers, and which occasioned almost as bitter complaints as the hunting regale, founded on no better grounds. I shall not

here attempt to delineate the sufferings which were thus occasioned in many countries; they are still fresh in remembrance.

The oldest mention of this hated regale which I myself have found is of the year 1419. At that time, Gunther, archbishop of Magdeburg, granted to some person the right of searching out saltpetre and boiling it, during a year, in the district of Gibichenstein, for which he was to pay a barrel of saltpetre, and deliver to the archbishop the remainder at the rate of five cross-groschens per pound. The succeeding archbishop, Frederick, let in the year 1460, to a burgher of Halle, all the earth and the saltpetre that could be collected from it in the bailiwick of Gibichenstein, for four years, at the annual rent of a barrel of good refined saltpetre. On the same conditions, bishop Ernest, in 1477, let to some one for his lifetime the collection of the saltpetre. In 1544, a certain person obtained the collection of saltpetre from two heaps of rubbish before the gates at Halle. The magistrates of Halle also in 1545 had a saltpetre-work and a powder-mill. In the year 1560, John VI., archbishop of Triers, gave to some one permission to search for and dig up saltpetre. In 1583, the saltpetre regale was confirmed by a Brandenburg decree as a thing long known, and the case was the same with a Hessian of the year 1589.

It is very probable that this example was soon followed by most sovereigns; but even if they had collected and scraped together the nitrous incrustation of all the walls in Europe, they certainly would not have found a quantity of saltpetre sufficient for the gunpowder used in the numerous wars which took place, had not a much greater supply been obtained from India, and particularly from Patna. I do not know whether the Portuguese brought this article to Europe; but that it was imported at a very early period by the Dutch is proved by the oldest ladings of their return ships; and they at length found means to appropriate this branch of trade so entirely to themselves, that the other Europeans for a long time could not obtain any saltpetre in India.

In the seventeenth century, when chemistry began to be studied with more care and attention in Europe, and particularly in Germany, and the component parts and production of saltpetre became better known, many conceived the idea of improving the methods of obtaining it in Europe so much, that it might be possible to dispense with the Indian saltpetre, and flattered themselves with the hopes of thence deriving great advantages.

Some proposed to fill tubes with putrifiable substances and earth capable of fixing of the nitric acid; others preferred building vaults of these substances, and Glauber recommended the filling of pits with them. The proposal, however, which met with the greatest approbation was that of building walls of them. Through a confidence in this idea, towns and villages were compelled to erect and maintain a certain number of saltpetre walls, under the most gracious promise that the collectors of saltpetre should no longer be allowed to spoil private dwellings, or render them unhealthful.

But experience has shown that all the means and coercive measures hitherto employed have rendered the European saltpetre much dearer than that obtained by commerce from Bengal. This will be readily comprehended, when it is known that earth richly impregnated with saltpetre abounds in India, and that it may be extracted by lixiviation without any addition, and brought to crystallize in that warm climate without the aid of fire; that the price of labour there is exceedingly low; that this salt is brought from India instead of ballast by all the commercial nations of Europe, where the competition of the sellers prevents the price from ever being extravagantly high, while the preparation of it in Europe, in consequence of the still increasing price of labour, fuel and ashes, is always becoming dearer. This regale will at length be everywhere scouted. In the duchy of Wurtemberg and the Prussian states, where it was most rigidly enforced, in consequence of an urgent representation from the States it was abolished in 1798; but in both countries an indemnification was given to government for the loss. The case also has been the same in Sweden[1259]. In the duchy of Brunswick it was soon suffered to drop; but in the electoral dominions it never was introduced.

[The greater part of our nitre is derived from Bengal, where, as in Egypt, Persia, Spain, &c., it exists in the soil. It is separated by lixiviation and crystallization. In France, Sweden and some other countries it is prepared artificially in nitre-beds. These are formed of various animal matters, mixed with lime or mortar-rubbish; the mixture is watered and stirred occasionally, and allowed to remain for a considerable time. The whole is then lixiviated and decomposed by carbonate of potash. The nitre is then separated and purified by crystallization. In some cases wood-ashes are mixed with the animal matters; the decomposition with potash is then unnecessary.

It is a question whether the nitric acid in the nitre arises from the nitrogen of the atmosphere or that in the animal matters. Dr. Davy has found nitre in a cave at Ceylon, where no nitrogenous matter was present; and in some parts of India, Spain, and some other countries, at a distance from all habitations, immense quantities of nitre are reproduced in soils which have been washed the year before. Nitre is directly brought into this country from Calcutta and Madras, in bags containing from 150 lbs. to 175 lbs. each. From 200,000 cwts. to 260,000 cwts. are annually imported into the United Kingdom.

In making gunpowder, the components, the sulphur, nitre, and charcoal should be as pure as possible, and reduced to the finest possible powder; they are sifted and mixed in the proper proportions. The mixture is then made into a cake with water, and ground between calcareous millstones. It is then granulated through sieves in another mill, and again sifted. It is then polished and hardened by revolving rapidly in a cask, and finally dried. The proportions of the constituents vary in different countries; at Waltham Abbey they are seventy-five nitre, fifteen charcoal and ten sulphur. The quantity of gunpowder consumed in this country is enormous; moreover, 4,000,000 lbs. are annually exported, the greater part of which is sent to the western coast of Africa.

The force of the explosion of gunpowder is owing to the sudden disengagement of gaseous products; these consist of nitrogen, carbonic oxide, carbonic acid, and sulphurous acid gases; and their volume has been calculated to amount to 2000 times the bulk of the powder.]

FOOTNOTES

1190 To this subject belong the following works:—Ars Magna Artilleriæ, Auct. Cas. Siomienowicz. Amst. 1650, fol. p. 61. The author thinks that the nitrum of the ancients is not at present known.

Natural History of Nitre, by W. Clarke. Lond. 1670, 8vo. It is here said that the nitrum of the ancients was impure saltpetre, and

that the latter is produced from the former by purification.

G. C. Schelhameri de Nitro, cum veterum, tum nostro commentatio, Amst. 1709, 8vo, contains good philological observations, particularly in regard to the period, but leaves the question undetermined.

Saggi sul ristabilimento dell' antica arte de' Greci e Romani pittori, del Sig. Doct. Vin. Requeno. Parma, 1787, 2 tomi in 8vo, ii. pp. 95, 131: a learned but diffuse work. He thinks that the *nitrum* of the ancients was our saltpetre; and what others consider as proofs of its being mineralized alkali, he understands as indicating alkalized saltpetre. I am not, however, convinced. Before I ascribe to the ancients a knowledge of our saltpetre, I must be shown in their writings properties of their *nitrum* sufficient to satisfy me that it was the same substance.

Commentat. de nitro Plinii, in J. D. Michaelis commentationes. Bremæ 1784, 4to. The author only illustrates the account of Pliny, and states what, according to his opinion, we are to understand in it in regard to alkali, and what in regard to our saltpetre.

1191 [Since the discovery of the immense deposits of nitrate of soda in Peru, this salt, from its being much cheaper, has replaced the nitrate of potash in the manufacture of aquafortis, but it is not adapted to the making of gunpowder owing to its deliquescent property.]

1192 I found the account of the Portuguese saltpetre in Mémoires Instructifs pour un Voyageur. The author of this work was the well-known Theodore king of Corsica.

1193 More accounts of native saltpetre may be found in Recueil de Mémoires sur la Formation du Salpetre. Par les Commissaires de l'Academie. Paris, 1776, 8vo. Del Nitro Minerale Memoria dell' ab. Fortis, 1787, 8vo.

1194 The first, or one of the first, who was acquainted with and made known the cubic saltpetre, was professor John Bohn of Leipsic, in

the Acta Eruditorum, 1683, p. 410; but with more precision in his Dissertat. Chymico-Physicæ, Lips. 1696, 8vo, p. 36.

1195 [It is scarcely necessary to inform the reader that the author understands the soda of commerce, which is a carbonate of soda, and not the hydrated or caustic soda of chemists.]

1196 [Crude soda or *kelp* was formerly manufactured to a very large extent in the Highlands, by burning the sea-weed, but since the tax has been taken off salt, most of the soda of British commerce is made by decomposing this with chalk and some carbonaceous matter.]

1197 In like manner, a heap of dung covered with earth is lixiviated, and the result, without the addition of ashes, used as saltpetre.

1198 The passage of Jerome relating to Proverbs, xxv. 20, I here insert entire, because I shall often have occasion to employ it:—"Nitrum a Nitria provincia, ubi maxime nasci solet, nomen accepit. Nec multum a salis Ammoniaci specie distat. Nam sicut salem in litore maris fervor solis conficit, durando in petram aquas marinas, quas major vis ventorum, vel ipsius maris fervor in litoris ulteriora projecerit; ita in Nitria, ubi æstate pluviæ prolixiores tellurem infundunt, adest ardor sideris tantus, quod ipsas aquas pluviales per latitudinem arenarum concoquat in petram; salis quidem vel glaciei aspectui simillimam; sed nil gelidi rigoris, nil salsi saporis habentem, quæ tamen, juxta naturam salis, in caumate durare, et in nubilos, aere fluere ac liquefieri solet. Hanc indigenæ sumentes servant, et ubi opus extiterit, pro lomento utuntur. Unde Judæo peccanti dicit propheta Jeremias: Si laveris te nitro, et multiplicaveris tibi herbam borith, maculata es in iniquitate tua, dicit Dominus Deus. Crepitat autem in aqua quomodo calx viva; et ipsum quidem disperit, sed aquam lavationi habilem reddit; cujus natura cui sit apta figuræ, cernens Solomon ait: Acetum in nitro, qui cantat carmina cordi pessimo. Acetum quippe si mittatur in nitrum, protinus ebullit."

1199 Herodot. ii. cap. 86 et 87.

1200 Histor. Ægypti Naturalis iii. 2. See also Forskäl Flora Ægyptiaco-Arabica, p. xlv.

1201 [Duhamel proved soda to be distinct from potash in 1736, Marggraf *confirmed* it in 1758.]

1202 Lib. xxxi. cap. 10.

1203 De Simplic. Med. Facult. ix. Dioscorides also, v. 131, speaks as if it had been well known that *nitrum* was commonly burnt.

1204 Phil. Transactions, 1771, vol. lxi. p. 567.

1205 De Igne, p. 435, ed. Heinsii, where he speaks of the heat produced in lime by slaking it. Aristotle also mentions together κονία and νίτρον, on account of similar properties. Problemat. i. 39. ed. Septalii, p. 71.

1206 Hist. Plant. iii. 9, p. 50.

1207 xxvi. 8.

1208 xiv. 20.

1209 De Re Rustica, lib. i. c. 7. Little, however, depended on the wood; the principal thing was the sprinkling with water.

1210 xxxi. 10.

1211 xxxi. 7. Here express mention is made of brine.

1212 Taciti Annal. xiii. 57.

1213 Lib. xxx. 7.

1214 This is particularly the case in regard to Aristot. Auscult. Mirab., as I have remarked in the preface to my edition.

1215 In the island of Dagebull, and also in Faretoft and Galmesbull, Frisio salt is made in the following manner. The inhabitants proceed along the coast in small vessels, and at low water go on shore on the mud, which they dig up till they come to a kind of earth called *torricht*; it is of a turfy nature, and interwoven with roots. This earth they convey to the islands, where they spread it out in the sun and leave it to dry, after which it is formed into a heap and burnt to ashes. What remains is again spread out, moistened and trod upon with the naked feet; the small stones and other useless parts are picked out, and being again dried and besprinkled with water, the ley is put into salt-pans and boiled into salt.

1216 Mémoires de l'Acad. de Bruxelles, 1777, i. p. 345.

1217 Elementa Chemiæ. Lugd. Bat. 1732, 4to, i. p. 767.

1218 Boyle considered the words of Solomon as a proof that *nether* must be fixed alkali; and he was the more convinced of it when he saw nitre obtained from Egypt effervesce with acids.

1219 See the History of Soap in vol. i.

1220 Plin. xxxvi. 26, § 65. The use of nitrum in making glass is often mentioned.

1221 Plin. xxxi. 10.

1222 Lib. xxx. 10.

1223 Forskäl Flora, p. xlvi.

1224 Plutarchi Sympos. lib. vi. at the end.

1225 Theophrasti Histor. Plant. ii. 5.—Geopon. ii. 35, 2; and ii. 41.—Palladius, xii. tit. i. 3, p. 996.

1226 Virg. Georg. i. 193.—Plin. xviii. 7. 845.—Geopon. ii. 36, p. 184.

1227 Columella, ii. 10, 11.

1228 Plin. xix. 8, § 41.—Pallad. iii. 24, 6.—Geopon. xii. 17, 1.—Theophrast. de Causa Plant. vi. 14.

1229 Plin. xxxi. 10; and xix. 5, § 26, 10.

1230 Apicius, iii. 1, p. 70.—Martial, lib. xiii. ep. 17.—Plin. xix. 8, §41, 3; xxx. 10.—Columella, xi. 3, 23. [Carbonate of soda, as is well known, is still frequently used for this purpose in culinary operations.]

1231 Herodot. ii. 87.

1232 Our tanners use unslaked lime for a similar purpose.

1233 Annot. to Dioscorides, v. 89, p. 951.

1234 A catalogue of such waters may be found in Baccii Liber de Thermis. Patavii, 1711, fol. v. 5, 6, 7, p. 160. [Carbonate of soda occurs for instance in the celebrated mineral waters of Seltzer and Carlsbad, and also in the volcanic springs of Iceland, especially the Geyser.]

1235 Plin. xxxi. 6, § 32, p. 556. Vitruv. viii. 3, p. 158.

1236 xxxi. 10.

1237 Plin. xxiv. 1; xxxi. 3, § 22. Geopon. ii. 5, 14, p. 85.

1238 Speculum Naturæ, vii. 87, p. 480.

1239 Hieronym. ad Jerem. ii. 22.

1240 “For though thou wash thee with nitre, and take much soap, yet thine iniquity is marked before me, saith the Lord God.”

1241 In regard to the two plants *usnee*, *asne*, and *usnem*, *assuan*, see Avicennæ Canon. Medic. Venet. 1608, fol. pp. 338, 406, 407. Serapio de Temperam. Simplic. p. 164. In Du Cange's Gloss. Gr. p. 12, *addend.* ἀλκαλη, and in Gloss. Lat. v. the word *alcali* is quoted only from modern writers. That *kali*, however, does not mean the plant, but the concrete ashes, is proved by the explanation in Castelli's Lexicon.

1242 In the annotations to Scribonius Largus, p. 228.

1243 Commentationes, p. 145. Recueil des Questions, &c., p. 231.

1244 Such things were known to Aristotle. See Mirab. Ausc. c. 146.

1245 Dissertat. de Igne Græco. Upsaliæ, 1752.

1246 De Subtilitate, xiii. 3. p. 71. ed. Francof. 1612, 8vo.

1247 De Mirabilibus Mundi, p. 201; at the end of the book De Secretis Mulierum. Amst. 1702, 12mo.

1248 Liber Ignium ad Comburendos Hostes, auctore Marco Græco; ou, Traité des Feux propres à détruire les Ennemies, composé par Marcus le Grec. Publié d'après deux manuscrits de la Bibliothèque Nationale. Paris, 1804, three sheets in quarto.

1249 Biblioth. Arab. Hisp. Escurial, ii.

1250 See the works quoted in Fabricii Bibliograph. Antiquar. p. 978. In the year 1798, M. Langles proved, in a paper read in the French National Institute, that the Arabians obtained a knowledge of gunpowder from the Indians, who had been acquainted with it in the earliest periods. The use of it in war was forbidden in their sacred books, the Veidam or Vede. It was employed in 690 at the battle of Mecca.

1251 The following may be advantageously consulted:—Archæologia, v. p. 148; Henry's Hist. of Great Britain, vol. iv.; Muratori Antiq.

Italiæ Medii Ævi, ii. p. 514; Watson's Chemical Essays, i. pp. 284, 327; Histoire de France, par Velly, xvi. p. 330; Dow's Hist. of Hindostan, vol. ii.; Erdbeschreibung der entferntesten Welttheile, ii. p. 159; Stettler Schweitzer Chronik. p. 109. The inhabitants of Berne purchased the first gunpowder from the people of Nuremberg in 1413.

1252 A fragment from the writings of Synesius was printed, for the first time, in Frabricii Bibliotheca Græca, viii. p. 236, where the words occur.

1253 Raspe on Oil-painting. London, 1781, 4to, p. 145.

1254 Speculum Naturale, vii. cap. 13, p. 432.

1255 Lib. vii. cap. 88, p. 480.

1256 Symbola Aureæ Mensæ. Francof. 1617, 4to, lib. vii. p. 335.

1257 De Asse, 1556, fol. lib. iii. p. 101.

1258 Les Anciens-Minéralogistes de France, par Gobet. Paris, 1779, 2 vols. 8vo, i. p. xxxiv. i. p. 51, 284; ii. p. 847.

1259 [The celebrated chemist Baron Berzelius, professor at Stockholm, states in his Manual of Chemistry (edit. 1835, vol. iv. p. 86), that every possessor of land in Sweden is still compelled to deliver a certain quantity of saltpetre yearly to the state, and gives directions for testing its goodness.]

BOOK-CENSORS.

"On account of the great ease," says M. Putter, "with which, after the invention of printing, copies of books could be multiplied and dispersed, it was necessary that some means should be devised to prevent a bad use from being made of this art, and to guard against its being employed to the prejudice of either religion or good morals, or to the injury of states. For this reason it was everywhere laid down as a general maxim, that no one should be allowed to establish a printing office at pleasure, but by the permission and under the inspection of government; and that no work should be suffered to go to press until it had been examined by a censor appointed for that purpose, or declared by a particular order to be of a harmless nature[1260]."

Many centuries however before the invention of printing, books were forbidden by different governments, and even condemned to the flames. A variety of proofs can be produced that this was the case among both the ancient Greeks and Romans. At Athens the works of Protagoras were prohibited; and all the copies of them which could be collected were burnt by the public crier[1261]. At Rome the writings of Numa, which had been found in his grave, were, by order of the senate, condemned to the fire, because they were contrary to the religion which he had introduced[1262]. As the populace at Rome were, in times of public calamity, more addicted to superstition than seemed proper to the government, an order was issued that all superstitious and astrological books should be delivered into the hands of the prætor. This order was often repeated; and the emperor Augustus caused more than two thousand of these books to be burnt at one time[1263]. Under the same emperor the satirical works of Labienus were condemned to the fire, which was the first instance of this nature; and it is related as something singular, that a few years after the writings of the person who had been the cause of the order for that purpose shared the like fate, and

were also publicly burnt[1264]. (In a manner somewhat similar the works of Ben. Arias Montanus, who assisted to make the first catalogue of prohibited books in the Netherlands, were afterwards inserted in a catalogue of the same kind). The burning of these works having induced Cassius Severus to say, in a sneering manner, that it would be necessary to burn him alive, as he had got by heart the writings of his friend Labienus, this expression gave rise to a law of Augustus against abusive writings[1265]. When Cremutius Cordus, in his History, called C. Cassius the last of the Romans, the senate, in order to flatter Tiberius, caused the book to be burnt; but a number of copies were saved by being concealed[1266]. Antiochus Epiphanes caused the books of the Jews to be burnt[1267]; and in the first centuries of our æra the books of the Christians were treated with equal severity, of which Arnobius bitterly complains[1268]. We are told by Eusebius, that Diocletian caused the sacred Scriptures to be burnt[1269]. After the spreading of the Christian religion the clergy exercised against books that were either unfavourable or disagreeable to them, the same severity which they had censured in the heathens as foolish and prejudicial to their own cause. Thus were the writings of Arius condemned to the flames at the council of Nice; and Constantine threatened with the punishment of death those who should conceal them[1270]. The clergy assembled at the council of Ephesus requested the emperor Theodosius II. to cause the works of Nestorius to be burnt; and this desire was complied with[1271]. The writings of Eutyches shared the like fate at the council of Chalcedon; and it would not be difficult to collect examples of the same kind from each of the following centuries.

We have instances also that, many centuries prior to the invention of printing, authors submitted their works, before they were published, to the judgement of their superiors. This was done principally by the clergy; partly to secure themselves from censure or punishment, and partly to show their respect to the pope or to bishops. It however does not appear that this was a duty, but a voluntary act. In the year 768, Ambrosius Autpert, a Benedictine monk, sent his Exposition of the book of Revelation to Pope Stephen III., and begged that he would publish the work and make it known. On this occasion he says expressly, that he is the first writer who ever requested

such a favour; that liberty to write belongs to every one who does not wish to depart from the doctrine of the fathers of the church; and he hopes that this freedom will not be lessened on account of his voluntary submission[1272].

Soon after the invention of printing, laws began to be made for subjecting books to examination; a regulation proposed even by Plato, and which has been wished for by many since. It is very probable that the fear under which the clergy were, lest publications should get abroad prejudicial to religion, and consequently to their power, contributed not a little to hasten the establishment of book-censors. The earliest instance of a book printed with a permission from government, is commonly supposed to occur in the year 1480; and Dom Liron, a Benedictine monk, is perhaps the first person who made that remark. He is the author of a work called Singularités Historiques et Litteraires[1273]; in the last part of which, where he speaks of the Heidelberg edition of the book Nosce te ipsum, in 1480, he says, "This is the first publication I found accompanied with several solemn approbations and attestations in its favour." The same thing is said by J. N. Weislinger, one of the most illiberal defenders of the Catholic church, in whose work, entitled Armamentarium Catholicum[1274], there is an account of that book. He there tells us in Latin, without mentioning Liron, "This is the first book which I have seen, subjected to the examination, reading, and approbation of the clergy;" and in the opinion of Mercier, it really is the oldest. It has four approbations (in Latin); the first and last of which I shall here insert (in English), as they will serve to show the foolish pride of the clergy at that period:—"I Philip Rota, doctor of laws, *though the least of all*, have read over carefully, and diligently examined, this small work, Nosce te; and as I have found it not only composed devoutly and catholically, but abounding also with matter of wonderful utility, I do not hesitate, in testimony of the above, to subscribe my name.... I Mapheus Girardo, by the divine mercy patriarch of Venice and primate of Dalmatia, confiding in the fidelity of the above gentlemen, who have examined and approved the above-mentioned book, do testify that it is a devout and orthodox work." There were, therefore, censors at this early period who gave their opinion of books without reading them.

I should have considered these instances as the oldest information respecting book-censors, had I not been induced by M. Eccard, the learned amanuensis belonging to our library, to look into the Literary Weekly Journal of Cologne, for the year 1778. In that work I found an ingenious account, by an anonymous author, of the early state of printing in that city, and of two books printed almost a year sooner than 1479, with the approbation of the public censor. The first is Wilhelmi episcopi Lugdunensis Summa de Virtutibus; at the end of which are the following words:—"Benedictus sit dominus virtutum, qui hoc opus earundem felici consummatione terminari dedit in laudabili civitate Coloniensi, temptatum, *admissumque et approbatum ab alma universitate studii* civitatis praedictae, *de consensu et voluntate* spectabilis et egregii viri pro tempore recteris ejusdem, impressum per Henr. Quentel." The other book is a Bible, with the following conclusion:—"Anno incarnationis dominice millesimo quadringentesimo LXXIX ipsa vigilia Matthaei apostoli. Quando insigne veteris novique testamenti opus cum canonibus evangelistarum et eorum concordantiis in laudem et gloriam sancte et individue trinitatis intemerateque virginis Marie impressum in Civitate Coloniensi per Conradum de Homborch, *admissum*, *approbatum* ab alma universitate Coloniensi."

The oldest mandate for appointing a book-censor is, as far as I know at present, that issued by Berthold, archbishop of Mentz, in the year 1486, and which may be found in the fourth volume of Guden's Codex Diplomaticus[1275].

In the year 1501, pope Alexander VI. published a bull, the first part of which may form an excellent companion to the mandate of the archbishop of Mentz[1276]. After some complaints against the devil, who sows tares among the wheat, his holiness proceeds thus: "Having been informed, that by means of the said art many books and treatises containing various errors and pernicious doctrines, even hostile to the holy Christian religion, have been printed, and are still printed in various parts of the world, particularly in the provinces of Cologne, Mentz, Triers, and Magdeburg; and being desirous, without further delay, to put a stop to this detestable evil ... we, by these presents, and by authority of the Apostolic chamber, strictly forbid all printers, their servants, and those exercising the art of printing under them,

in any manner whatsoever, in the abovesaid provinces, under pain of excommunication, and a pecuniary fine, to be imposed and exacted by our venerable brethren the archbishops of Cologne, Mentz, Triers, and Magdeburg, and their vicars-general or official in spirituals, according to the pleasure of each in his own province, to print hereafter any books, treatises, or writings, until they have consulted on this subject the archbishops, vicars, or officials above-mentioned, and obtained their special and express licence, to be granted free of all expense, whose consciences we charge, that before they grant any licence of this kind, they will carefully examine, or cause to be examined, by able and catholic persons, the works to be printed; and that they will take the utmost care that nothing may be printed wicked and scandalous, or contrary to the orthodox faith." The rest of the bull contains regulations to prevent works already printed from doing mischief. All catalogues and books printed before that period were to be examined, and those which contained anything prejudicial to the Catholic religion were to be burned.

In the beginning of the sixteenth century, it was ordered by the well-known council of the Lateran, held at Rome in the year 1515, that in future no books should be printed but such as had been inspected by ecclesiastical censors.

In France, the faculty of Theology usurped, as some say, the right of censuring books; but in the year 1650, when public censors, whom the faculty opposed, were appointed without their consent, they stated the antiquity of their right to be two hundred years. For they said, "It is above two hundred years since the doctors of Paris have had a right to approve books without being subjected but to their own faculty, to which they assert they are alone responsible for their decisions[1277]."

[In no country of Europe does the liberty of the press prevail to such an extent as with us, the only vestige of censorship being the censor for the drama. In Rome the same strictness prevails as ever, but a brighter day seems dawning. In Germany the censorship is excessively severe, especially in Austria, Bavaria, and Prussia. However, most of the prohibited works are printed in Switzerland, Hamburg, or Leipsig, and there being a very large demand for such works, they may be had of almost any bookseller in every principal town. To put a stop to this, the present monarch of Prussia,

professedly a liberal, placed under ban all the works issued by the firm of Hoffmann and Campe of Hamburg, because they published the political poems of Hoffmann von Fallersleben. Caricatures are, as the reader may suppose, subject to as strict a law, and no H.B. could be tolerated there.]

FOOTNOTES

[1260] Der Büchernachdruck nach ächten Grundsätzen des Rechts geprüft. 1774, 4to.

[1261] Diogenes Laert. lib. ix. 52.—Cicero de Nat. Deor. lib. i. cap. 23.—Lactantius De Ira, ix. 2.—Eusebius De Præparatione Evang. xiv. p. 19.—Minucius Felix, viii. 13.

[1262] Livius, lib. xl. c. 29.—Plin. xiii. 13.—Plutarchus in Vita Numæ.—Lactantius de Falsa Relig. i. 25, 5.—Valer. Max. i. cap. 1, 12.

[1263] Sueton. lib. ii. cap. 31.

[1264] The whole circumstance is related by Seneca the rhetorician, in the introduction to the fifth, or, as others reckon, the tenth book of his Controversiæ.

[1265] Taciti Annal. lib. i. c. 72. Bayle, in his Dictionary, has endeavoured to clear up some doubts respecting the history of Cassius and Labienus. See the article Cassius.

[1266] Tacit. Annal. lib. iv. cap. 35.

[1267] Maccab. ii.

[1268] Adversus Gentes, lib. iii.

[1269] Hist. Eccles. 1. viii. cap. 2. Suidas says the same.

[1270] Socrates, lib. i. cap. 6.

[1271] Digestor, lib. x. tit. 2, 4, 1.

[1272] Baillet, Jugemens des Sçavans, 4to, i. p. 26.

[1273] Paris, 1738–40, 4to, vol. viii.

[1274] Argentinæ 1749, fol.

[1275] Codex Diplomaticus. Franc. 1758, 4to, iv. p. 460. An account of the establishment of a book-censor at Mentz may be found also in G. C. Johannis Rerum Mogunt. i. p. 798.

[1276] The whole bull may be seen in Baronii Annales Ecclesiastici tom. xix. Colon. 1691, p. 514.

[1277] Baillet, Jugemens des Sçavans, i. p. 19.

EXCLUSIVE PRIVILEGE FOR PRINTING BOOKS.

I do not mean in this article to give a complete catalogue of all the books printed under a privilege in the fifteenth and sixteenth centuries, for such a list would be attended with very little utility. All I wish is to contribute something towards answering the question, What are the oldest privileges granted to books?

The oldest known at present is that granted in the year 1490, by Henry bishop of Bamberg, to the following book: Liber Missalis secundum ordinem ecclesiæ Bambergensis—Anno incarnationis dominice MCCCCXC. nono vero kal. April.—In civitate Babenbergn. per magistrum Johannem Sensenschmidt, prefate civitatis incolam, et Heinr. Petzensteiner. This privilege was first noticed by Panzer, in his History of the Nuremberg editions of the Bible, and afterwards by Mr. Am Ende, in Meusel's Collection for enlarging Historical Knowledge. The latter says, "One may readily believe that this bishop was not the inventor of such privileges, and that they are consequently of much greater antiquity than has hitherto been supposed." Mr. Am Ende mentions also a privilege of the year 1491, to a work called Hortus Sanitatis, typis Iacobi Meydenbach.... Impressum autem est hoc ipsum in incl. civ. Moguntina ... sub Archipraesulatu rever. et benigniss. principis et D. D. Bertholdi, archiep. Moguntinensis ac princ. elector. cujus felicissimo auspicio graditur, recipitur et auctorisatur. This, says Mr. Am Ende, may allude to a privilege, and perhaps not. For my part, I conjecture that it refers only to a permission to print, granted in consequence of the institution of book-censors by the archbishop Berthold, in the year 1486.

The oldest Venetian privilege at present known, is of the year 1491, found by M. Pütter to the following work: Foenix Magistri Petri memoriae Ravennatis. The Colophon is Bernardinus de Choris de Cremona impressor delectus impressit. Venetias die X Ianuarii MCCCCXCI. The book is in quarto,

and has the privilege on both the last pages. There is a Venetian privilege also of the year 1492, to Senecæ Tragediæ cum commento.... Cum privilegio ne quis audeat hoc opus cum hoc commento imprimere, sub pena in eo contenta, Venetiis per Lazarum Issarda de Saliviano 1492, die XII. Decembris.

The oldest Papal privilege hitherto known is of the year 1505, to Hervei Britonis in IV Petri Lombardi Sententiarum volumina, scripta subtilissima.

In the year 1495, Aldus published the works of Aristotle, at the end of the first part of which we find the following notice: "Concessum est eidem Aldo inventori ab illustrissimo senatu Veneto, ne quis queat imprimere neque hunc librum, neque caeteros quos is ipse impresserit; neque ejus uti invento." The last words allude to the Greek types which were employed in printing the Aldine editions of the Greek classics.

The following among other early privileges are quoted by Pütter[1278] and Hoffmann[1279] —

1495. A Milanese, by duke Louis Sforza, to Michael Ferner and Eustachius Silber for I. A. Campani Opera.

1501. Privilegium sodalitatis Celticæ a senatu Romani imperii impetratum, to Conrade Celtes' edition of the works of Hroswitha.

1506. A papal, of pope Julius II., to Evangelista Tosino the bookseller, for Ptolomaei Geographia.

1507. A French, of Louis XII. to Antoine Verard.

1510. The first Imperial, to Lectura aurea semper Domini abbatis antiqui.

1512. An Imperial, to Rosslin's Swangere Frauwen Rosegarten.

1527. A privilege from the duke of Saxony to the edition of the New Testament by Emser.

Anderson remarks on the year 1590, that the first exclusive patent, for printing a book in England, which occurs in Rymer's Fœdera[1280], was

granted in the above year by queen Elizabeth, to Richard Weight of Oxford, for a Translation of Tacitus. I am much astonished that Anderson, who was so often obliged to use Rymer's Fœdera, and who seems indeed to have consulted it with attention, should have overlooked the oldest patents which are to be found in that collection. In that laborious work, so important to those who wish to be acquainted with the history of British literature, Ames' Typographical Antiquities, there are privileges of still greater antiquity. The oldest which I observed in this work are the following:—

1510. The history of king Boccus ... printed at London by Thomas Godfry. Cum privilegio regali.

1518. Oratio Richardi Pacei ... Impressa per Richardum Pynson, regium impressorem, cum privilegio a rege indulto, ne quis hanc orationem intra biennium in regno Angliæ imprimat, aut alibi impressam et importatam in eodem regno Angliæ vendat.

Other works printed *cum gratia et privilegio* occur 1520, 1521, 1525, 1528, 1530, &c.

In the year 1483, when the well-known act was made against foreign merchants, foreigners however were permitted to import books and manuscripts, and also to print them in the kingdom; but this liberty was afterwards revoked by Henry VIII., in the year 1533, by an order which may be found in Ames. In 1538, Henry issued an order respecting the printing of bibles; and in 1542, he gave a bookseller an exclusive privilege during four years for that purpose[1281].

With a view of finding the oldest Spanish privilege, I consulted a variety of works, and among others Specimen Bibliothecae Hispano-Majansianae, but I met with none older than that to the following book: Aelii Antonii Nebrissensis Introductiones in Latinam Grammaticen. Logronii Cantabrorum Vasconum urbe nobilissima; anno salutis millesimo quingentesimo decimo. fol. That privileges to books were usual in Poland, has been shown by Am Ende, in Meusel's Collections before-mentioned.

FOOTNOTES

1278 Der Büchernachdruck nach ächten Grundsätzen des Rechts geprüft.

1279 Von denen altesten kayserlichen und landesherrlichen Bücherdruck-oder Verlag-privilegien, 1777, 8vo.

1280 Vol. xvi. p. 96.

1281 [Exclusive privileges for printing the English Bible and Prayer have been granted by the Crown at different periods up to the present time, with the exception of the period of the Commonwealth, during which they were abolished. In the 27th year of Charles II. a Royal patent was granted to Thomas Newcomb and Henry Hills. In the 12th of Anne to Benjamin Tooke and John Barber; in the 22nd of George I. to John Basket. Then came John Reeves, who received his patent from George III. in the 39th year of his reign, and in association with George Eyre and Andrew Strahan, printed the many editions of the Bible and Prayer described as Reeves' editions. The present patent was conferred by George IV. upon Andrew Strahan, George Eyre, and Andrew Spottiswoode, for a term of thirty years, which commenced January 21, 1830, and consequently ceases in 1860. By this last patent every one but the patentees is prohibited from printing in England any Bible or New Testament in the English tongue, of any translation, with or without notes; or any Prayers, Rites, or Ceremonies of the United Church of England and Ireland; or any books commanded to be used by the Crown; nor can either of the above be imported from abroad, if printed in English, or in English mixed with any other tongue. The Universities of Oxford and Cambridge also enjoy the right of printing Bibles, &c., in common with the patentees; but in their case it is a simple affair of permission, they having no power to prohibit or prosecute. The present patentees, it may be here observed, have not of late years

attempted to enforce their rights, and Bibles are now printed almost *ad libitum*.

In Scotland, prior to 1700, various persons held concurrent licenses, consequently it is very difficult to say who were king's printers and who were not. On July 6, 1716, George I. granted a patent to John Basket, the English patentee, and Agnes Campbell, jointly for forty-one years. To them succeeded Alexander Kincaird, whose patent dates from June 21, 1749; and then James Hunter Blair and John Bruce, whose patent commenced in 1798 and expired in the hands of their heirs, Sir D. H. Blair and Miss Bruce. In 1833 the patent ceased, and has never been renewed. Unlike either England or Ireland, the four Scotch Universities have never participated in this monopoly.

In Ireland, George III. in 1766 granted a Bible patent to Boulter Grierson for forty years. He was succeeded by his son George Grierson, who, in 1811, obtained a renewal, and is still with Mr. Keene, the Irish patentee. Trinity College, Dublin, has also a concurrent right, but both Oxford and Cambridge are, by the Irish printers' own patent, permitted to import their Bibles into Ireland. —*Dr. Campbell's Letters on the Bible Monopoly.*]

CATALOGUES OF BOOKS.

The first printers printed books at their own expense, and sold them themselves. It was necessary therefore that they should have large capitals. Paper and all other materials, as well as labour, were in the infancy of the art exceedingly dear for those periods; and on the other hand the purchasers of books were few, partly because the price of them was too high, and partly because, knowledge being less widely diffused, they were not so generally read as at present. For these reasons many of the principal printers, notwithstanding their learning and ingenuity, became poor[1282]. In this manner my countrymen Conrade Sweynheim and Arnold Pannarz, who were the first, and for a long time the only printers at Rome, a city which on many accounts, particularly in the sixteenth century, might be called the first in Christendom, were obliged, after the number of the volumes in their warehouses amounted to 12,475, to solicit support from the pope[1283]. In the course of time this profession was divided, and there arose booksellers. It appears that the printers themselves first gave up the bookselling part of the business, and retained only that of printing; at least this is said to have been the case with that well-known bookseller John Rainmann, who was born at Oehringen, and resided at Augsburg[1284]. He was at first a printer and letter-founder, and from him Aldus purchased his types. Books of his printing may be found from the year 1508 to 1524; and in many he is styled the celebrated German bookseller. About the same period lived the booksellers Jos. Burglin and George Diemar. Sometimes there were rich people of all conditions, particularly eminent merchants, who caused books which they sold to be printed at their own expense. In this manner that learned man Henry Stephens was printer at Paris to Ulric Fugger at Augsburg, from whom he received a salary for printing the many manuscripts which he purchased. In some editions, from the year 1558 to 1567, he subscribes himself Henricus Stephanus, illustris viri Hulderici Fuggeri typographus. In the like manner also, in the beginning of the seventeenth century, a society

of learned and rich citizens of Augsburg, at the head of whom was Marx Welser, the city-steward, printed a great number of books, which had commonly at the end these words, *ad insigne pinus*. Printing therefore thus gave rise to a new and important branch of trade, that of bookselling, which was established in Germany, chiefly at Frankfort on the Maine, where, particularly at the time of the fairs, there were several large bookseller's shops in that street which still retains the name of *Book-street*.

George Willer, whom some improperly call Viller, and others Walter, a bookseller at Augsburg, who kept a very large shop, and frequented the Frankfort fairs, first fell upon the plan of publishing every fair a catalogue of all the new books, adding the size, and publishing names. Le Mire, better known under the name of Miræus[1285], says, that catalogues were first printed in the year 1554; but Labbe[1286], Reimann[1287], and Heumann[1288], who took their information from Le Mire, make the year, perhaps erroneously, to be 1564. Willer's catalogues were printed till the year 1592, by Nicol. Bassæus, printer at Frankfort. Other booksellers however must have soon published catalogues of the like kind, though that of Willer continued a long time to be the principal[1289].

In all these catalogues, which are in quarto, and not paged, the following order is observed. The Latin books occupy the first place, beginning with the Protestant theological works, perhaps because Willer was a Lutheran; then come the Catholic; and after these, books of jurisprudence, medicine, philosophy, poetry, and music. The second place is assigned to German books, which are arranged in the same manner.

In the year 1604, the general Easter Catalogue was printed with a permission from government.

After this the Leipsic booksellers began not only to reprint the Frankfort catalogues, but to enlarge them with many books which had not been brought to the fairs in that city. I have, dated 1600, a catalogue of all the books on sale in Book-street, Frankfort, and also of the books published at Leipsic, which have not been brought to Frankfort; with the permission of his highness the elector of Saxony to those new works which have appeared at Leipsic. Printed at Leipsic, by Abraham Lamberg; and to be had at his shop. On the September catalogue of the same year, it is said that it is

printed from the Frankfort copy, with additions. I find an imperial privilege, for the first time, on the Frankfort September catalogue of 1616. Some imperial permissions however may be of an earlier date; for I have not seen a complete series of these catalogues.

Reimmann says that, after Willer's death, the catalogue was published by the Leipsic bookseller Henning Grosse, and by his son and grandson. The council of Frankfort caused several regulations to be issued respecting catalogues, an account of which may be seen in Orth's work on the Imperial Fairs at Frankfort[1290]. After the business of bookselling was drawn from Frankfort to Leipsic, occasioned principally by the restrictions to which it was subjected at the former by the censors, no more catalogues were printed there; and the shops in Book-street were gradually converted into taverns.

In perusing these old catalogues one cannot help being astonished at the sudden and great increase of books; and when one reflects that a great many of them no longer exist, this perishableness of human labours will excite the same sensations as those which arise in the mind when one reads in a church-yard the names and titles of persons long since mouldered into dust. In the sixteenth century there were few libraries; and these, which did not contain many books, were in monasteries, and consisted principally of theological, philosophical and historical works, with a few however on jurisprudence and medicine; while those which treated of agriculture, manufactures and trade, were thought unworthy of the notice of the learned, and of being preserved in large collections. The number of these works was, nevertheless, far from being inconsiderable; and at any rate many of them would have been of great use, as they would have served to illustrate the instructive history of the arts. Catalogues which might have given occasion to inquiries after books, that may be still somewhere preserved, have suffered the fate of tombstones, which, being wasted and crumbled to pieces by the destroying hand of time, become no longer legible. A complete series of them, perhaps, is nowhere to be found.

This loss might in some measure be supplied by two works, were they not now exceedingly scarce. I mean those of Cless and Draudius, who, by the desire of some booksellers, collected together, as Georg[1291] did at a later period, all the catalogues published at the different fairs in different years. The work of Cless has the following title:—Unius sæculi ejusque virorum

litteratorum monumentis tum florentissimi, tum fertilissimi, ab anno 1500 ad 1602 nundinarum autumnalium inclusive, elenchus consummatissimus—desumtus partim ex singularum nundinarum catalogis, partim ex bibliothecis. Auctore, Joanne Clessio, Wineccensi, Hannoio, philosopho ac medico[1292]. By the editor's preface it appears that the first edition was published in 1592. The order is almost the same as that observed by Willer in his catalogues.

The work of Draudius, which was printed in several quarto volumes, for the first time, in 1611, and afterwards in 1625, is far larger, more complete, and more methodical. I have never seen a perfect copy of either edition; but perhaps the following information may afford some satisfaction to those who are fond of bibliography. One part, which I consider as the first, has the title of Bibliotheca Classica, sive Catalogus officinalis, in quo singuli singularum facultatum ac professionum libri, qui in quavis fere lingua extant, recensentur; usque ad annum 1624 inclusive. Auctore M. Georgio Draudio. It contains Latin works on theology, jurisprudence, medicine, history, geography and politics. The copy in the library of our university ends at page 1304, which has however a catchword that seems to indicate a deficiency. The second part is entitled Bibliotheca Classica, sive Catalogus officinalis, in quo philosophici artiumque adeo humaniorum, poetici etiam et musici libri usque ad annum 1624 continentur.

This part, containing Latin books also, begins at page 1298, and ends with page 1654, which is followed by an index of all the authors mentioned. A smaller volume of 302 pages, without an index, has for title, Bibliotheca Exotica, sive Catalogus officinalis librorum peregrinis linguis usualibus scriptorum; and a fourth part, forming 759 pages besides an index of the authors, is called, Bibliotheca Librorum Germanicorum Classica; that is, A Catalogue of all the books printed in the German language till the year 1625. By the indices, and the proper arrangement of the matter, the use of this work is much facilitated. I must however observe that the oldest catalogues had the same faults as those of the present time, and that these have been copied by Draudius. Many books are mentioned which were never printed, and many titles, names and dates, are given incorrectly; but Draudius, nevertheless, is well worth the attention of any one who may be inclined to employ his time and ingenuity on the history of literature.

[Towards the end of the seventeenth and especially during the eighteenth century, book-catalogues of every description multiplied rapidly. Their progress is copiously treated of in Nichols's Literary Anecdotes, vol. iii. pp. 608–693, to which the reader is referred. Perhaps the most remarkable bookseller's-catalogue ever printed is Mr. Henry Bohn's so-called Guinea Catalogue, which is upwards of six inches thick, and contains, in about 2000 pages, merely the details of his own stock.]

FOOTNOTES

1282 Several of them were editors, printers, and proprietors of the books which they sold.

1283 Their lamentable petition of the year 1472 has been inserted by Fabricius in his Bibliotheca Latina. Hamburghi, 1772, 8vo, iii. p. 898. See also Pütter von Büchernachdruck, p. 29.

1284 Von Stetten, Kunst-geschichte von Augsburg, p. 43.

1285 Le Mire, a Catholic clergyman, who was born in 1598, and died in 1640, wrote a work De Scriptoribus Ecclesiasticis Sæculi xvi., which is printed in Fabricii Bibliotheca Ecclesiastica, Hamburgi 1718, fol. The passage to which I allude may be found p. 232; but perhaps 1564 has been given in Fabricius instead of 1554 by an error of the press.

1286 Labbe Bibliotheca Bibliothecarum, Lips. 1682, 12mo, p. 112.

1287 Hist. Lit. i. p. 203.

1288 Conspectus Reip. Litter, c. vi. § 2, p. 316.

1289 [The earliest known catalogue of English printed books on sale by a London bookseller, was published in 1595, by Andrew Maunsell, in folio. It was classed and consisted of two parts; the first

containing *Divinity*, the second the *Arts and Sciences*; a third, containing History and Polite Literature, was intended but never published.]

1290 Frankf. 1765, 4to, p. 500.

1291 [Bücher Lexicon; a Catalogue of books printed in Europe, to 1750; with supplements to 1758, 8 parts in 4 vols. folio. A very elaborate compilation, in which the title, place of publication, name of publisher, date, size, number of sheets, and publication price, of all the books known at the time, are given, including even those printed as early as 1462. It mentions however a great many books which never existed.]

1292 Francofurti, ex offic. Joannis Saurii, impensis Petri Kopffii, 1602, 4to. The first part contains 563 pages, and the second 292.

RIBBON-LOOM.

Among the inventions, which, by lessening labour, render a great number of workmen unnecessary, and consequently deprive many of bread, and which, with whatever ingenuity they may be contrived, have been considered as hurtful, and were for a long time suppressed by governments, may be reckoned the ribbon-loom. In its general construction, this machine approaches very near to that of the common weaving loom; but the workman, instead of weaving one piece, or one ribbon, as is the case when the latter is used, can, on the former when it has all the necessary apparatus, weave sixteen or twenty pieces at the same time, and even of different patterns. Such a loom is so made, that the workman can move the batten as in the common loom, towards him and from him, and also to the right and left, with all the shuttles it contains; or, it is furnished with certain machinery below, which can be moved by a boy unacquainted with the art of weaving, and which keeps the whole loom with all its shuttles in motion. Looms of the former kind are certainly much simpler than those of the latter, and in all probability are older. To the first kind belongs the loom at Erfurt, and that which was lately brought thence to Göttingen. Of the other kind there are two at Berlin; and some of them may be seen in many other places. The art has been discovered also of causing such looms to be driven by water; and an instance of this may be found, as I have been told, in the neighbourhood of Iserlohe[1293]. The proprietors however in most places keep the construction of their looms a secret, and, as far as appears, no complete description or figure of them has ever been published. There is reason to believe that this invention is as yet little used in France; no mention at least is made of it in the Encyclopedie, where, however, the common loom of the ribbon-weavers and lace-weavers is fully represented with all its parts in ten copper-plates.

Attempts were made in Europe to suppress this invention, as was the case with printing in Turkey. But without here inquiring whether inventions

may not save too much labour, and be therefore hurtful, as Montesquieu affirms, or whether it would be possible to suppress them throughout all Europe, I shall restrict myself to the history of the ribbon-loom as far as information is to be collected on the subject.

We are told by M. Jacobson, that it is believed the Swiss invented such looms above a hundred years ago; but I do not know any grounds upon which this conjecture can be supported. To me it appears much more probable that this invention had its rise in the Netherlands or Germany, either about the end of the sixteenth or beginning of the seventeenth century. The oldest account with which I am acquainted seems to be in favour of Germany and the sixteenth century. Lancellotti, in a work[1294] published at Venice in 1636, says "Anthony Moller of Dantzic relates, that he saw in that city about fifty years before a very ingenious machine, on which, from four to six pieces could be wove at the same time; but as the council were afraid that by this invention a great many workmen might be reduced to beggary, they suppressed it and caused the inventor to be privately strangled or drowned." Who this Anthony Moller was I do not know; but that he saw a ribbon-loom at Dantzic is beyond all doubt. If the date of the printing of the book be taken as the time in which Lancellotti wrote, there is reason to believe that there was a ribbon-loom at Dantzic about the year 1586; but it appears to me that the book was written in 1629, which would bring us to the year 1579.

The next oldest information with which I am acquainted, is that given by Boxhorn, who says, "About twenty years ago some persons in this city (Leyden) invented a weaving-machine on which one workman could with ease make more cloth than several others in the same space of time. This gave rise to rioting among the weavers, and to such loud complaints, that the use of this machine was at length prohibited by the magistrates." According to this account, Leyden was the place of the invention; but, in order to determine the time, it will be necessary to attend to the following circumstances. Boxhorn's Institutiones Politicæ have been often printed, as for example, at Amsterdam 1663, in 12mo. Boxhorn read lectures on the Institutiones Politicæ, and gave verbal illustrations of them to his scholars, one of whom, in the year 1641, carried a fairly written copy of the latter to Germany, and gave them to Professor C. F. Franckenstein, who caused them to be printed for the first time at Leipsic in 1658, and again in 1665, 12mo.

The passage above-quoted is to be found in the illustrations which are appended. Hence there is reason to conclude that the ribbon-loom was known in Holland about the year 1621.

It is some confirmation of Boxhorn's account, that the States-General, as early as the 11th of August 1623, if they did not totally prohibit the use of the ribbon-loom, as commonly asserted, at any rate greatly circumscribed it. The proclamation for that purpose may be found in the Groot Placaet-Boeck[1295], a valuable collection published at the Hague in seven large folio volumes, between the years 1658 and 1746. Nothing further however is found there respecting the history of ribbon-looms, which are called *Lint-molens*, than that they had been in use for several years to the great injury and even total ruin of many thousands of workmen, who were accustomed to weave ribbons on the common loom. This prohibition was renewed on the 14th of March 1639, and again on the 17th of September 1648, as appears by the same work[1296]. On the 5th of December 1661, the use of them was extended a little longer, and defined with more precision[1297]; but as far as I have been able to find, no other regulations were made respecting these machines in the Netherlands.

The council of Nuremberg, it is said, prohibited the use of them in 1664, as is mentioned in the Hanau work, which I shall soon have occasion to quote.

On the 24th of December, the same year, ribbon-looms were prohibited in the Spanish Netherlands. In the proclamation for that purpose, it is stated that a great number of articles manufactured on these looms were privately imported from Viane and Culenburg.

In the year 1665, there was to be seen at Frankfort-on-the-Maine, a loom which of itself wove all kinds of lace, tape, &c., provided the silk or yarn was properly arranged in the usual manner; but if a thread happened to break, it was necessary that some one should again join it by means of a knot[1298]. The year following, some person in that city applied not only to the council, but even to the emperor, for permission to establish such a loom, but was not able to obtain it.

In 1676 the ribbon-loom was prohibited at Cologne, and the same year some disturbance took place in consequence of its being introduced into England[1299]. It is probable that Anderson[1300] alludes to this loom when he says, speaking of the above year, "As was also brought from Holland to London, the weavers' loom-engine, then called the Dutch loom-engine." He however praises the machine without describing it; nor does he mention that it occasioned any commotion.

The lace-weavers in Germany, but in particular the councils of Augsburg and Cologne, applied to Frederick Casimir, count of Hanau, who had great influence in the empire, and requested that he would endeavour to procure a general prohibition of ribbon-looms throughout all Germany; and the count accordingly presented a representation on this subject to the electors and states.

On the 8th of January 1681, it was declared by Imperial authority that a prohibition of ribbon-looms was both useful and necessary. This was followed by an imperial decree, dated January the 5th, 1685, and on the first of September following it was strengthened by a *conclusum in senatu* of the council of Frankfort.

The council of Hamburg, it is said, ordered a loom to be publicly burnt; and the emperor Charles VI. caused the prohibition of 1685 to be renewed on the 19th of February 1719; though some mercantile people made considerable opposition to this measure. A general prohibition was likewise issued in the electorate of Saxony, on the 29th of July 1720. All these coercive means however were ineffectual; and the ribbon-loom, being found useful, has now become common.

In the year 1718, the first loom of this kind was brought from Holland to Charlottenburg on the Spree; but Nicolai, in his Description of Berlin, says that this circumstance took place in the year 1728. The workmen were then engaged from foreign countries; and the loom was supported at the king's expense. The electorate of Saxony also, in the year 1765, revoked its prohibition, and permitted such looms to be publicly used. In the rescript dated March the 20th, it is said, that as things were much changed, and as other German states had annulled the prohibitions against ribbon-looms, it was induced to grant full liberty to the lace-weavers to employ freely and publicly in future, ribbon and lace-looms, and to manufacture all kinds of

ribbons and other articles of the like kind that could be wove on them. It stated further, that the lace-weavers should give notice whether any of them wished to establish ribbon-looms, and how soon they could get them ready for work; that such of them as did not choose to be at the expense, should for every loom constructed receive a certain sum, besides being admitted a member of the company; and that three months after the publication of this order, fifty rix-dollars would be given, by way of premium, for every loom on which from twelve to fifteen pieces of silk-ribbon could be wove; and thirty rix-dollars for every loom employed to weave ferret and articles of woollen[1301].

[The profitable application of steam-power to silk weaving was long considered to be almost impossible; so much time being consumed in the handling and trimming of the silk, in proportion to the time that the loom is in motion, there was consequently a waste of power. A small factory was built in 1831, for the purpose of making the experiment on ribbons. It was, however, burnt during a disturbance relating to prices; and though the act was disclaimed by weavers in general, the feeling amongst them was so strong against the employment of inanimate labour whilst their own was superabundant, that the scheme was given up. Within a few years there were numerous steam-factories at work at Congleton, Leek, Derby and other places, which made large quantities of plain ribbons, chiefly black sarsenets. The Coventry manufacturers, alarmed for the interests of their trade, formed in 1836 a steam-company, and erected a large factory, but difficulties arose as to the apportionment of the power among the different parties, and it has never yet been fitted up for its original purpose. Another large factory was soon after built, and applied to the making of figured ribbons, but owing to the failure of the parties, the experiment was not in this instance fairly tested. One experiment on a smaller scale had some success. The factories of the North and of Derby have proved the advantage of steam-power as applied to plain ribbons. At Congleton there were in 1838, 254 power-looms engaged in the manufacture of plain silk, a few black satin and some plain coloured ribbons; at Leek there were 100 employed in the same way, and at Derby 233. In these, each loom is tended by one pair of hands, which pick up and keep the machinery in order: the gain consists, not in a more rapid motion of the shuttles, the delicacy of the materials not allowing of this; but in the shooting down being seldom

interrupted during the picking up, as in hand-loom weaving; in the greater regularity of the fabric, and also in the addition of from one-fifth to one-third more shuttles, for which one workman suffices, the loom being so constructed as to enable him to reach from the front over the batten to the warps behind. But when two pairs of hands are required for one loom, as is the case with the Jacquard loom, one before to tend the work and one behind to pick up, the advantage is much lessened. Steam-loom weaving is undoubtedly making great progress notwithstanding all disadvantages: in 1840, the steam-factory at Coventry, which formerly failed, was again at work under fresh parties, who were making both plain and fancy ribbons with a strong probability of ultimate success. The fine factory belonging to the Steam Company, which is now occupied by broad silk steam-looms, has one ribbon-loom at work; and in one other instance, in Coventry, Jacquard steam-looms are employed in making light figured ribbons with great beauty and precision, and in this case it is found that one man is able to tend the front and another the back of two looms. There can be little doubt that the time is approaching when steam will be the chief motive-power of the ribbon as of other manufacturing districts, and that the strength of English machinery will be called for to enter into competition with French taste.

Coventry is the great city for the manufacture of ribbons in England; in 1838, the number of persons employed there was 6000 or 7000, and in the rural parishes, 10,000 or 11,000[1302].]

FOOTNOTES

[1293] Looms of the first kind are seldom capable of weaving above sixteen pieces at one time: and very rarely eighteen, because the breadth necessary for that purpose would render them highly inconvenient. At a ribbon manufactory in the Milanese, there were some years ago, thirty looms of an excellent construction, each of which could weave twenty-four pieces together, so that sixty dozen of pieces were wove by the whole at the same time. See Voyage d'un François par Italie, i. p. 387. M. Escher, at Zurich, is said to

have had a large ribbon-loom which was driven by water; but the traveller who saw the work, assured me that it was a machine for winding silk; and this seems to be probable, from the short account given of it by M. Andreæ, in his Briefen aus der Schweitz, pp. 49, 50.

1294 L'Hoggidi overo gl'ingegni non inferiori a' passati.

1295 Page 7.

1296 Page 1191.

1297 Ibid. p. 2762.

1298 Von Lersner, Chronica der Stadt Frankfurt, ii. p. 566.

1299 Relatio Historica semestralis vernalis 1776, Art. 10.

1300 Hist. of Commerce.

1301 See this rescript in the Leipsiger Intelligenz-Blattern, 1765, p. 119.

1302 Penny Cyclopædia.

GUNS. GUN-LOCKS.

The first portable fire-arms were discharged by means of a match, which in the course of time was fastened to a cock, for the greater security of the hand while shooting. Afterwards a fire-stone was screwed into the cock, and a steel plate or small wheel, which could be cocked or wound up by a particular kind of key, was applied to the barrel. This fire-stone was not at first of a siliceous nature, like that used at present for striking fire, but a compact pyrites or marcasite, which was long distinguished by that name. But as an instrument of this kind often missed fire, a match till a late period was retained along with the wheel; and it was not till a considerable time after, that instead of a friable pyrites, so much exposed to decay, a siliceous stone came into use with the improved cock or present lock. On each new improvement, the piece, the caliber and length of which were sometimes enlarged and sometimes lessened, obtained various new names; such, for example, as *Büchse*, *Hakenbüchse*, *Arquebuse*; Matchlock, Musket, Pistol, *Flinte*, &c. But I shall leave it to those who are versed in matters of artillery to determine the difference between these kinds, and shall here add only what follows.

The first name undoubtedly arose from the oldest portable kind of fire-arms having some similarity to a box. There were long and short *büchse*, the latter of which, as Hortleder says, were peculiar to the cavalry. The long kind also, on account of their similarity to a pipe, were called *rohr*. Large pieces, which were conveyed on cars or carriages, were called *karrenbüchse*, but soon after also *canna*, cannon. Instead of artillery-man, artillery and arsenal, people used the terms *büchsenmeister*, *büchsenmeistery*, *büchsenhaus*, &c. The *hakenbüchsen* were so large and heavy that they could not be carried in the hand; it was necessary therefore to support them with a prop, called *bock*, because it had two horns, between which the piece was fixed with a hook that projected from the stock[1303]. Hence arose the name *hakenbüchse*, *hakenbüsse*, which the French and

different nations, along with many other German words, adopted, and corrupted till they at length became *arquebuse*, *archibugio*, *archibuso*, &c. From the passages of ancient writers collected by Daniel, it may be concluded that these *hakenbüchsen* with a wheel were invented in Germany, in the beginning of the sixteenth century; and this is confirmed by the testimony of Martin Bellay. Speaking of the league formed between the emperor Charles V. and pope Leo X. against France, and the siege of Parma undertaken in the year 1521, he says, "De ceste heure là furent inventées les harcquebouzes qu'on tiroit sur une fourchette."

Pistols also, which at first had a wheel, seem to have been used at an earlier period by the Germans than by the French. Bellay mentions them in the year 1544, in the time of Francis I., and under Henry II. the German horsemen, *des reiters*, were called *pistoliers*. De la Noue, who served under both these kings, says, in his Discours Politiques et Militaires, that the Germans first employed pistols. I know no probable derivation of this term. Frisch conjectures that it may have arisen from *Pistillo* or *Stiopo*, because pistols used to have large knobs on the handle. Daniel and others think that the name comes from Pistoia in Tuscany, because they were there first made. He says he saw an old pistol, which, except the ramrod, was entirely of iron.

Muskets received their name from the French *mouchet*, or the Latin *muschetus*, which signifies a male sparrow-hawk. This derivation is the less improbable, as it is certain that various kinds of fire-arms were named after ravenous animals, such, for example, as *falconet*. Daniel proves that they were known in France as early as the time of Francis I. Brantome however asserts, that they were first introduced by the duke of Alva, in the year 1567, when he exercised his cruelty in the Netherlands, in order to overawe and keep in subjection the people of that country; and that they were not then known in France. In another place he says that they were first made general in France by M. de Strozzi, under Charles IX.[1304]

That the lock was invented in Germany, and in the city of Nuremberg, in 1517, has been asserted by many, and not without probability; but I do not know whether it can be proved that we are here to understand a lock of the present construction. In my opinion, the principal proof rests on a passage made known by Wagenseil[1305], from an unprinted Nuremberg

Chronicle, the antiquity of which he has not determined. The same year is given by J. Guler von Weineck[1306], Walser[1307], M. von Murr and others. It is also certain that in the sixteenth century there were very expert makers of muskets and fire-locks; for example, George Kühfuss, who died in 1600, and also others, whose names may be seen in Doppelmayer. I must not omit here to remark, that many call the fire-lock the French lock, and ascribe the invention to these people; yet as, according even to Daniel's account, the far more inconvenient wheels on pistols were used in France in 1658, it is probable that our neighbours, as is commonly the case, may have made some improvement in the German invention. In the history of the Brunswick regiments, it is stated that the soldiers of that duchy first obtained, in 1687, flint-locks instead of match-locks. It has often been asserted, that fire-tubes, which took fire of themselves, were forbidden first in Bohemia and Moravia, and afterwards in the whole German empire, under a severe penalty, by the emperor Maximilian I.; but I have not found any allusion to this circumstance in the different police laws of that emperor.

That the first fire-stones were pyrites, appears from various accounts; and as a siliceous kind of stone was introduced in its stead, this circumstance gave often rise to confusion, some instances of which are related by Henkel, so that many applied to the stone what was related by our forefathers of pyrites. In the greater part of Europe[1308] people use at present that *hornstein* called by Wallerius *Silex igniarius*, and by Linnæus *S. cretaceus*. In Germany it was formerly called *Flins* or *Vlins*, which some consider as more proper; and in the Swedish, Danish and English, *Flinta* and *Flint*. This appellation is of great antiquity; for the Wends had a pagan deity of that name, which they erected on a stone called *Flynstein*[1309]. In some districts of Germany this word has been still retained; for example, white or grey ferruginous spar, *Minera ferri alba*, is called in Styria *Flins*, or, as it is often improperly written, *Pflinz*; and in Bayreuth that fire-stone is still called flint-stone[1310]. In our neighbourhood the same name is still used by the stone-cutters. It cannot be doubted that the weapon which is fired by the help of this stone, obtained from it, in German, the names of *Flintgewehr*, *Flint*, or *Flinte*; but since the old name of the stone has been forgotten, it is in general named from the weapon flint-stone. Those

acquainted with the German and northern antiquities, know that the knives employed at the ancient sacrifices, and other articles, were made of this kind of stone, as appears by the remains still found in old barrows and between urns[1311]. This proves that these stones were much used by the ancients. In England and France old buildings constructed of them are still to be seen, and the stones appear to have been cut with the greatest care[1312]. The above articles, which have lain in the earth more than a thousand years, and these edifices, among which some at Norwich were inhabited in 1403, show the wonderful durability of this kind of stone. Some imagine that the art of working it has been lost; but though our artists prefer employing their talents and dexterity on stones which have a more beautiful appearance and less brittleness, they are able to cut also the flint-stone. Enamel painters, for the most part, rub their glass enamel on plates made of it; but they are obliged to purchase them at a very dear rate[1313].

Many of my readers will perhaps be desirous to know in what manner our gun-flints are prepared. Considering the great use made of them, it will hardly be believed how much trouble I had to obtain information on this subject. One would laugh were I to repeat the various answers which I obtained to my inquiries. Many thought that the stones were cut down by grinding them; some conceived that they were formed by means of red-hot pincers; and many asserted that they were made in mills. On the least reflection it may be readily conjectured, that the double cuneiform shape is given to these stones without much labour, because they are so cheap; and as every country, at all times, with whatever other it may be engaged in war, can obtain them in sufficient quantity, no nation can have an exclusive trade in them. It is nevertheless difficult to discover the places whence they are procured; and in works which give an account of the different articles of merchandise they are not named. The best account with which I am acquainted, is that collected by my brother, and published in the Hanoverian Magazine for the year 1772. Shepherds, and other persons who gain little by their service, break the flint-stone merely by manual labour, and chiefly in Champagne and Picardy. Some years ago, Gilbert de Montmeau, a merchant at Troye, carried on the greatest trade with them, and sold them at the rate of five livres six sous per thousand. The Dutch always buy up large quantities of them, which they keep in reserve, in order to sell them when

the exportation of them is forbidden by France, in the time of war. Savary, however, relates that the largest quantity and best stones come from Berry, and particularly the neighbourhood of St. Agnau and Meusne. I know also that a great many are made at Stevensklint in Zeeland[1314], and exported from that country. In the year 1727, the chancery of war at Hanover sent some persons to learn the art of breaking flints; but after their return, it was given out that our horn-stone was unfit for that purpose. It is possible that those stones which occur in continued veins may be split easier in any required direction than those found in single pieces, as it appears to me that the latter are harder and more compact than the former. Perhaps the case is the same with flints as with vermilion, the preparation of which we endeavoured to learn from the English and Dutch, though from the earliest periods it had been made better in the very centre of Germany than anywhere else.

That stones were used at least in the middle of the sixteenth century, is confirmed by the account of an ingenious Italian, named Francis Angelerius. This artist had constructed a short piece of wood, to which he applied a wheel, and instead of a cock substituted a dog, which held the stone in its mouth, the whole so ingeniously made, that a person who appeared with it at a masquerade was arrested by the guard, because it was considered to be a real pistol[1315]. I have thought it proper to mention this circumstance, because it proves that the wheel was then invented and known under the appellation of pistol. In old arsenals and armouries, large collections of arms with the wheel are still to be seen. I have inspected those preserved in the arsenal at Hanover. What I consider to be the oldest, have on the barrel the figure of a hen with a musket in its mouth, because perhaps they were made at Henneberg. A pistol of this kind was entirely of brass without any part of wood, and therefore exceedingly heavy. On the lower part of the handle were the letters J. H. Z. S. perhaps John duke of Saxony. A piece with a wheel, which seemed to be one of the most modern, had on the barrel the date 1606.

Together with fire-stones, properly so called, pyrites, which is sometimes named fire-stone, continued long in use. In the year 1586, under duke Julius of Brunswick, when abundance of sulphureous pyrites was found near Seefen, the duke caused it to be collected, and formed it himself

into the necessary shape, though in doing so he often bruised his fingers, and was advised by the physicians not to expose himself to the sulphureous vapour emitted by that substance.

[The use of flint-locks to guns has, within the last few years, been almost entirely laid aside in this country; the percussion- or detonating-lock being substituted for it. The certainty and rapidity with which the discharge takes place, gives them a very great superiority. This ingenious invention belongs to a Scottish clergyman, the Rev. Mr. Forsyth, minister of Belhelvie in Aberdeenshire, but it has since received some great improvements, especially in the application of the copper cap, to which indeed may be attributed all its superiority.—*Brande.*]

FOOTNOTES

1303 A figure and description of the *Hakenbüchse*, the *bock*, the wheels and key, may be found in Daniel Histoire de la Milice Francaise. Amst. 1724, 2 vols. 4to, i. p. 334. At Dresden there is still preserved an old *Büchse*, on which, instead of a lock, there is a cock with a flint-stone placed opposite to the touch-hole, and this flint was rubbed with a file till it emitted a spark.

1304 [The musquet or musket is said to be a Spanish invention, and to have been first used at the battle of Pavia. They were so long and heavy as to require the support of a rest. In the time of Elizabeth and long after, the English musqueteer was very different from one at the present day. In addition to the musquet itself, he had to carry a flask of coarse powder for loading, and a touch-box of fine powder for priming; the bullets were contained in a leathern bag, the strings of which he had to draw to get at them; while in his hand was his burning match and musquet-rest.]

1305 De Civitate Noribergensi Commentat. 1697, 4to, p. 150: In chronico quodam MS. legitur: the fire-locks belonging to the shooting tubes were first found out at Nuremberg in 1517.

1306 Raetia das ist Beschreibung, &c. Zurich, 1616, fol. p. 152.

1307 Appenzeller Chronik. St. Gall, 1740, 8vo, p. 194.

1308 This kind of stone is not everywhere used for this purpose. In the Tyrol, for example, the hardest ferruginous granite, which consists of corneous, partly irregular and partly polyedral, pieces, is employed as flints, which therefore are called Tyrol flints. In other places, jasper, such as that found in great abundance in Turkey, is formed by grinding, and used in the same manner.

1309 Of this deity an account may be found in Schedii Syntagma de Diis Germanis. Halæ, 1728, 8vo, p. 726.

1310 Esper Nachricht von neu entdeckten Zoolithen, Nurnberg, 1774, fol. Mr. Esper says, those fire-stones only which contain fossils or petrifactions are called *flins*, flint; and it is possible that the singular formation may be the cause why they have retained longest the name of the pagan deity.

1311 Figures of such instruments may be found in the fifth volume of the Archæologia Britannica.

1312 Philosophical Transactions, No. 474.

1313 A polished plate a foot square is sold at the Vienna porcelain manufactory for five hundred florins.

1314 Chemnitz regrets that the largest and most beautiful pieces are broken in many thousand fragments, and afterwards sold for a trifle as gun-flints.—Berliner Beschäftigungen, p. 213.

1315 Hippolytus Angelerius, in a work entitled De Antiquitate Atestinæ, p. 14, in vol. vii. of Thes. Antiquit. Italiæ.

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Transcribers' Notes

Text contains Greek, Hebrew, Arabic, and astronomical symbols. Equipment that cannot display these characters may substitute question marks or other placeholders.

Punctuation, hyphenation, and spelling were made consistent when a predominant preference was found in this book; otherwise they were not changed. Words spelled differently in quoted text than elsewhere were not changed.

Simple typographical errors were silently corrected, except as noted below; ambiguous unbalanced quotation marks and hyphens at the ends of lines were retained.

Text often uses periods where commas might be expected. As the author's intent is unknown, all of them have been retained.

In some cases, it was not possible to distinguish between the letter "l." and the number "1.", usually in footnotes, and usually followed by a period.

The spelling and accent marks of non-English words have been retained as printed in the original book; some possible or likely errors are noted below, but not comprehensively.

Footnotes, originally at the bottom of the page, have been renumbered and moved to the end of each chapter.

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Text uses both “lye” and “ley”; both retained.

Text uses both “Duhamel” and “Du Hamel”; both retained.

Frontispiece: The artist’s initials actually were “J. J.”

Page 19: “give then in return” was printed that way.

Footnote 67, referenced on page 26: contains an extra closing quotation mark or is missing an opening one.

Page 35: “βοτρυίτις” is a typographical error for “βοτρυΐτις”.

Footnote 119, referenced on page 50: “Greek names” was misprinted as “games”; changed here.

Page 57: “interpretators” was printed that way.

Page 196: “one of the principle is the art” was printed that way.

The footnotes within footnote 524 do not include return links because several of them are referenced more than once.

Page 300: “אדות שכער” is a typographical error for “אדרת שנער”.

Page 300: “אדרת שעו” probably is a typographical error for “אדרת שער”.

Page 317: One “*vech*” in “*vech*, *veh*, *vech*,” probably is a misprint for “*veeh*”.

Page 353: “μόνα γἀρ” is a typographical error for “μόνα γὰρ”.

Page 423: “January 1569” was printed as “January 1659” and has been changed here, based on the dates earlier in the same sentence.

Page 448: “scarcely ten” and “54½ died” were printed that way.

Page 451: Some of the Roman Numerals were overlined in the original; those overlines may not be shown on some reading devices. In the same paragraph, “55 5 55” was printed with the digits sideways.

Page 468: “ἂλλον” is a typographical error for “ἄλλον”.

Page 478: “Περσικός” is a typographical error for “Περσικὸς”.

Footnote 1219, referenced on page 495, references “Soap” in vol. i., but it's actually in this volume.

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