ALCHEMY AND THE ALCHEMISTS.

IN the case of a purely modern science, like geology or statistics, there can be little dispute and no mystery about its origin and progress. It is analogous to the United States of America. Its history lies, first and last, under the eye of present daylight: hour after hour recorded by the press, that chronometer of recent ages. Such sciences as astrology and alchemy, on the other hand, ran their courses in the twilight of time, having taken rise in the starlit night of history. Resembling the nations of antiquity in these respects, they resemble them also in tracing their origin to giants, prophets, superhuman heroes, or demigods. This fabulous character of the early annals of those dark-age mysteries—for they were schemes of esoteric dogma rather than explicit fabrics of knowledge—is the first thing that attracts the attention of the historical student of alchemy.

The very etymology of the word is lost in hopeless obscurity. Scaliger says he saw a work in the king of France's library, written in Greek, by Zozimus the Panapolite, in the fifth century; and Olaus Borrichius seems to intimate that he also had read it, although it is in a somewhat ambiguous passage that the hint occurs. They represent it as 'a faithful description of the sacred and divine art of making gold and silver.' Borrichius gives what professes to be an extract from it, in which the writer first refers to a fact which he had managed to deduce from the Scriptures, Hermes Trismegistus, and many other sources—namely, that there is a tribe of genii possessed of an unhappy propensity to fall in love with women. 'The ancient and divine Scriptures inform us,' he gravely assures the worthy Olaus, the learned Scaliger, and others his readers, 'that the angels, captivated by women, taught them all the operations of nature. Offence being taken at this, they remained out of heaven because they had taught mankind all manner of evil, and things which could not be advantageous to their souls. The Scriptures inform us that the giants sprang from these embraces. Chema is the first of the traditions respecting these arts. The book itself is called Chema; hence the art is called Chemia.'

Even supposing for a moment that the preamble of this singular account is true, and that the 'Sons of God' did impart many a primitive secret to the 'daughters of men,' it is not easy to perceive how a tradition could also be a book; and there would remain for explanation the name of the book itself. Plutarch, however, asserts that Egypt was sometimes called Chemia, and Panapolis was an Egyptian city. It was, moreover, another

of the favourite opinions among the Arabian as well as the earlier European alchemists (an opinion entertained by Albertus Magnus amongst others) that Hermes Trismegistus was the father of their science. That august personage is represented as having flourished two thousand years before the appearance of Christ. According to Kriegsmann, Avicenna and other Arabian polypharmists believed that Sarah took a table made of zatadi, supposed to have been emeralds, from the hands of Hermes, entombed in a cave near Hebron. On this table were inscribed the dogmas of the master concerning his chemical secrets, in thirteen mysterious sentences. In the twelfth of these enunciations, he informs the discerning public that on him 'was imposed the name of Hermes Trismegistus, because he was the ordained doctor of three parts of the wisdom of the world.' Now, although the very name of this supposed interpreter, not to speak of still more obvious internal evidences, is quite sufficient to prove the purely mythical character of the whole story, the existence of this tradition among both the eastern and the western adepts, seems to render it not unlikely that the etymology of the word is connected with Egypt. Borrichius's own private opinion is clearly to the effect, that the hermetic art descended from Tubal-Cain or Vulcan; but he allows that there is much to be said in favour of Trismegistus, who has been supposed by some to have been Chanaan, the son of Ham, whose son Mizraim first occupied Egypt.

It has to be mentioned, in fact, that the word Thoth, the Egyptian name for Hermes Trismegistus, means a pillar, according to Josephus and Manetho; in which, it seems, they are corroborated by Jablonski. The truth of the matter appears to be, that pillars were early used by the Egyptians for the same purposes as parchment and paper have been employed by the literary men of more modern nations. These pillars were their books and standard body of literature. It further appears that there were three successive Thoths or schemes of inscription; that is to say, three dispensations or epochs of pillared literature. The first set are said to have reached down to the time of the Flood; the second contained all that was discovered or thought during the infancy of the scientific knowledge of these ancient people; and the third was the embodiment or publication of the full-grown science of Egypt. Hence the whole system of pillars was readily impersonated under the mythical appellation of Hermes Trismegistus, the thrice-great interpreter, as the name implies. It is, accordingly, easy to understand how that illustrious and encyclopædical author was subsequently represented as having composed thirty thousand volumes! It must be confessed that all this looks very satisfactory, not only as explaining the traditionary story of Trismegistus, but also as confirmatory of the historic hint that the word chemistry is of Egyptian origin, as has already been shewn to be not unlikely.

On the other hand, it has been customary among more recent critics than these mediæval speculators to make the root of alchemy a Greek word. It has been supposed to be derived from χυμη, which signifies *juice* or menstruum; and to refer to the acids, leys, and other solvents in use among chemists and alchemists. This was the favourite etymology among the very latest of the European adepts; and it gave rise to the spelling of the word with *y*—alchymy. Boerhaave contended that it was drawn from the Greek verb meaning *to fuse* or melt, χεω; and ever since the inculca-

tion of this etymology, both alchemy and chemistry have been written as they are printed here, in deference to established custom. Webster resists this derivation; spells them *alchimy* and *chimistry;* and remarks upon the noticeable circumstance, that the southern nations of Europe have never yielded to the Teutonic innovation.

It is unfortunate for these specimens of Græco-mania, that neither the word *chemia* (χημεια), nor any etymon connected with the notion of alchemy or chemistry, occurs in any Greek author before Suidas, who is said to have produced his lexicon in the eleventh century, under the Emperor Alexander Comnenus. That lexicographer explains *chemia* to be the conversion of silver and gold; and is of opinion that the art of doing so was known to the Egyptians in the time of Dioclesian, who is said to have burned all the manuscripts in Egypt, in order to put an end to the pursuit. Suidas also suggests, under another head (Δερας, a skin), that the invaluable fleece, which Jason and his Argonauts carried off from Colchis along with Medea, was nothing less than a treatise on gold-making written on hides. This is of course a piece of private and personal ingenuity on the part of Suidas; and, as such, it is not unlike another esoteric doctrine which some one has fetched us from the East, to the effect that the 'Arabian Nights' is a symbolic setting forth of alchemy! In fine, there seems to be not the shadow of a reason for surmising that the ancient Greeks ever dreamed of the matter. They had neither the name nor the thing.

In whatever way this significant question concerning the origin of the substantive root of the word be eventually settled, there can be no dispute about the prefix. The unquestionably Arabic character of that particle, indeed, appears to indicate the fact that Al-chemy, as such, had its historical, though, probably enough, not its traditional origin in Arabia. Johannes Chrysippus Fanianus, or an author under that somewhat too significant name (for there is no department of literature so overcrowded with spurious productions as that of the Spagyric art), is careful to insist that the polypharmists meant more than is apparent in denominating the doctrine of transmutation *the chemia*. According to him, they recognised a difference between all common chemical operations and the 'great projection.' Such operations belonged to the domain of vulgar chemistry, but transmutation was represented as being dependent on more secret and interior principles. It was the chemistry of chemistries, or Alchemy.

There has been implied in these observations on the derivation of alchemy a certain degree of discussion of the origin of the science itself. It is needless to inquire into the tradition, for example, which traces it to Moses, whose empirical knowledge of metallic reactions must have been not only considerable, but almost beyond that of the present day, if the Hebrew word be correctly translated in the account of Aaron's golden calf, given in the book of Exodus. It is said that the Jewish leader and legislator burned the idol, strewed the ashes of it upon the waters, and imbittered the drink of his impatient host. Now it has been remarked that, in order to produce such effects upon gold, he must have been, at least practically, acquainted with the properties of the sulphur salts—a class of compounds which have been discovered by the modern experimentalist only in very recent times. It is impossible, however, to come to anything like a satisfactory conclusion on such a point, after men like Spinoza and Fabre

d'Olivet have united, with the rabbinical school of these ages, in asserting that the Old Testament is far from being properly rendered, even in the Septuagint, in a multitude of particulars. It is, indeed, almost universally allowed, even amongst the most bibliolatrous of Protestant interpreters, that the glory of our version resides in its conveyance of the spirit of the Sacred Writings, and not in its literal fidelity concerning every petty detail. There can be no manner of doubt, for instance, that the word translated *nitre* ought to have been expressed by *natron*—that is, soda, or, more strictly speaking, the carbonate of soda. Hence Solomon illustrates one of his sharpest proverbs by the action of 'vinegar upon nitre,' referring to the violent commotion and effervescence which ensues on the mingling of natron and that acid; the principle, in fact, upon which the effervescing draughts of the modern apothecary are prepared. It is not altogether improbable, therefore, that the gold of Aaron and his rebellious brethren may have been a kind of brass or pinchbeck, with a large proportion of gold—a supposition which would render its calcination quite intelligible, without assigning anything like remarkable chemical information to the indignant prophet. Howsoever all this may really be, moreover, it is not to be overlooked that the practical acquaintance with even very complicated processes of this sort does by no means implicate a scientific knowledge or rationale of chemistry. The arts of baking and of brewing, for instance, are dependent on very complicated and recondite principles of action and reaction; yet it is generally understood that they were found out by 'rule of thumb,' and not discovered by induction.

Accordingly, one is prepared to find a positive and methodical chemist like Dumas setting all those antique claims imperiously aside; putting that of Maria the Jewess, a kind of mythological Joan of Arc in this fantastical region of fabulous history, among the rest. 'We can no longer,' says that eloquent philosopher, 'place the cradle of chemistry exclusively even in the laboratory of the ancient pharmacopolists, to whom some are willing to attribute its discovery. The services we have done raise us quite high enough to enable us to remember, and that without embarrassment, our obscure parentage. Let us confess at once, then, without going round about it, that practical chemistry took its rise in the workshops of the smith, the potter, or the glass-blower, and in the shop of the perfumer; and let us just agree that the first elements of scientific chemistry date no farther back than yesterday.'

Although this judgment seems to be very sensible and very natural, as coming from so great an ornament of the present school of chemistry, neither the one nor the other of the terms of which it is composed can stand the scrutiny of a stricter dialectics. In the first place, practical chemistry is not practical chemistry until it has first been theoretical or doctrinal chemistry. The moment an inventor bethought himself of using some chemical discovery or other for the purposes of economical art, the idea of practical chemistry was conceived. The origin of practical chemistry must therefore have been posterior to, or, at the earliest, coincident with, that of theoretical chemistry, be the date of the latter what it may. If, however, this criticism appear to be nothing better than a verbal or logical refinement, there is another consideration which is as unobjectionable as it is obvious. Accepting any less precise definition of practical

chemistry than has just been given, why stop at the workshops of civilised, or even of semi-civilised life, in tracing it to its rise? Why not ascend at once to Adam and his primeval family? If practical chemistry consist in the performance of operations which are essentially chemical in their nature, then the first man who kindled a fire, roasted an ox, or seethed a kid, was the father of all such as deal in that manifold art. These observations are certainly very unimportant, but so is the question which they concern; and they are offered for no other purpose than to prepare for the serious discussion of Dumas's second opinion about the history of chemistry. He asks us to grant that the first elements of scientific chemistry date no farther back than yesterday. It is the common opinion among the chemists of to-day. They are for the most part so dazzled by the really brilliant results of very modern chemistry, and so blind to the possibility of any of its first principles being only temporary and remote approximations to the truth, as to be incapable of tracing the theory of chemistry any farther back than the memorable days of Lavoisier, in the light of whose thought they still rejoice and work. Without caring to protest against this amiable idol-worship of the immortal Lavoisier, we deny that doctrinal or scientific chemistry is the contemporary of either the printing-press or any other modern instrument, whether of thought or of handiwork.

The Lavoisierian chemistry was only one of the epochs of the life of the science. But there were epochal developments before that of Lavoisier, just as the Daltonian era has come after it. Each of these movements had not only its grand and abiding truth to bring forward, but also some important and deciduous error to leave behind it, as might easily be shewn to have been the case with the French chemistry itself. In one word, alchemy (to say nothing of the post-alchemical doctrine of Phlogiston at present) had its genuine scientific function to perform, and its distinct scientific value in the history of chemistry. A true history of the science, in fact, would exhibit one continuous stream of truth mingled with error, from the origin of alchemy down to the latest discoveries and views. In the meantime, we shall unfold the story of the early progress of chemistry, with the aid of the competent authorities: and in doing so, we shall find a sufficient deliverance of all that is necessary, in the present connection, concerning the alchemists; and concerning their relation to science in general, as well as to chemistry in particular. It is desirable, however, to take a preliminary glance at the ideas of classical Greece respecting the theory of nature, for it will be found that those ideas have had not a little to do not only with alchemy in all its stages of evolution, but also with the chemistry of Dalton and the future.

Nor will the reader grudge the time and the labour of thought bestowed on such distant topics, when he finds that the consideration of them is fraught with lessons of importance. He will learn that man never labours in vain when he is sincere, devout, and industrious in his endeavours, as the alchemists will be discovered to have been. He will perceive to his delight, moreover, that there is no such thing as revolution in the progress of science, but only the large and solemn growth of a living creature. Nor will it be difficult to extend such precious verities from this, their private and particular sphere, into the grander domain of universal history.

It was Thales of Miletus, the father of Greek philosophy, who methodically originated the conception that *water* is the first principle of things. He inculcated the scientific dogma that water is the one substantial or underlying essence, of which the rest of nature is but the manifold expression. Water was represented in his system as the sole and primeval matter, convertible and actually converted, by some plastic power, into the thousand-and-one familiar creatures in the universe: now into this one, and now into that; now into wood, and now into stone; now into the grass of the fields, and now into the body of man himself! Nor does this doctrine appear to be fantastical, as has been remarked by Ritter, when one reflects how rocks and salts can be extracted by mere boiling and evaporation not only out of the sea, but also from the most insipid of lakes and streams, and even from rain. It is not yet beyond the memory of man, that Lavoisier was careful to distil water backwards and forwards in an alembic, for many long days and nights together, in order to settle the question whether water were actually convertible into earthy matter, as had been asserted and believed by his immediate predecessors. Scheele, one of his most distinguished contemporaries, instituted another sort of experiment upon water, with a view to the determination of the very same point. It is not fifty years since Davy conducted his celebrated experiments on the electrolysis of water by means of the galvanic current, with very much the same object in view. It is, accordingly, easy to perceive that the ceaseless circulation of the liquid element from the ocean into the air, and through the air again to the earth in dews and mists and rains, only to run once more from springs and streams and lakes and rivers down to the ocean whence it rose, must have impressed the youthful science of ancient and imaginative times with the supreme importance of water in the economy of creation. But this contemplation of nature as one vast alembic, for the revolution of that beautiful and lifelike creature, was not the only motive to its exaltation as the best and first of things in the mind of Thales. The marvellous effects of moisture in its varying forms of river, rain, and dew, in covering the hills, the valleys, and the plains with verdure, during the flushing spring of Asia Minor and the Archipelago, to say nothing of the indispensable necessity of water not only to vegetation, but also to animal vitality itself, must have gone deeper still into the thoughts of those venerable seers who were first visited by the inquisitive spirit of wonder.

Willing to forget the moon and all sublunary science, we have stood beside the sea a whole year round, and abandoned ourselves to its first impressions in the spirit of antique faith and awe. It moved forever at our feet, now driving us before it, and then drawing us after it, its everlasting voices in our ear. One day it murmured about our steps, kissing the brown earth, and kissing it again, never weary of kissing the softened beach; another, it was testy as a great wayward child, and chid the world the livelong day; on a third, it was as angry as a brawling woman, and chafed along the shore; another time it panted and heaved and lashed, like a hundred orators arousing the nations with their ire. Anon it swelled and roared, like an assailing host or an infuriated people; and again it thundered responsive to the heavens, flashing back flash for flash, reflecting an infernal blackness upon the chaos of the falling sky.

Its variety of expressions were as many as the days of the year, and far more; but always it was moved from its very inmost, and always it moved to the impulse that stirred it, whatever that might be. It never lay still; it could not be at rest; it could not get away from itself. In vain it threw up spray and vapour and clouds; they returned to its unresting bosom through unerring channels. They went and they came as surely as it ebbed and flowed. They and it were always one; and all nature was penetrated by the unity. Wherever it touched, living things sprang into being: plants, animals, and man; only to be resolved again into the mighty organism of the waters when their lives were done. The ocean, reaching down to Hades, and stretching beyond the clouds, was the very blood of nature—'the blood which is the life.' Blind to sun, moon, and stars, insensible to the firm earth on which we stood, and deaf to the solicitation of the air and all its winds, we were lost in the contemplation of what seemed more alive than they; and then we understood how the first-born of the Wise Men of old pronounced the great deep to be at once the womb and the grave, the beginning and the end, of all created things!

Nor is it difficult to comprehend how Anaximenes, one of the earliest of the successors of Thales in what has been called the physiological school of Greek philosophy, should modify the doctrine of his predecessor, and assign the foremost place in the theory of nature to *air*. The ingenious reader will easily place himself in this new point of view, with the help of that imaginative sympathy which has just been extended to the earlier tenet. It is to be particularly noticed, however, that air was not the same kind of thing to those primitive doctrinaries as it is to us. Thales and Anaximenes, in fact, did not fix their eye upon the actual ocean and atmosphere, so much as upon an abstract conception which they had formed for themselves of the interior essence of these elements. It must not be forgotten, that in the childhood of human thought, as in the childhood of the human individual, there is no unmistakable distinction yet drawn between the world of sensation and the world of consciousness. The external world is still little more than a wondrous procession of perceptions, thought as sensation not being yet differentiated in the mind from thought as knowledge. The universe is still a passing scheme of shows and shifting modes of the perceiving spirit. Thales and Anaximenes beheld the green tree, the blue sea, the brown earth; and not, like Bacon and Locke, not merely a tree (or a somewhat) so propertied as to produce the image of a green tree in the mind, through means of the laws of light and the retina of the eye; not merely an earth (or another somewhat) which optics and physiology make into a brown earth; not merely a sea uniting with the eye to produce a blue sea between them; and so forth. In one word, those sagacious children of thought, the ancestors of Plato and Aristotle, were natural idealists: they were born idealists, not knowing that they were so; for they had never reached the point of scientific scepticism even for a moment.

Hence Anaximenes is represented as discoursing concerning air as the equivalent of intelligence or soul. It was his god—one, eternal, and unchangeable in essence; so that he stood at no great distance from that ancient and public spirit of poetry which fashioned the languages of mankind. The grand difference, indeed, between Orpheus and Hesiod on the

one hand, and the first teachers of philosophy on the other, consists in the circumstance, that the latter had developed for themselves and for all succeeding ages the idea of methodical investigation; a fact which constitutes them the fathers of science, notwithstanding that their specific doctrines are now of little use. The conception of one aboriginal source of all visible things, common to the schemes of Anaximenes and Thales, is a scientific statement of the poetic myth which pictures Proteus as the solitary and god-begotten shepherd, eternally driving innumerable herds and flocks of all kinds of creatures before him. It is remarkable, in connection with the Thalesian form of this idea, that all those subordinate deities which regulate the affairs of nature are figured, in the orphic theogony, as the children of Oceanus and Thetis: Oceanus the monarch of the sea, and Thetis the ocean-bride; Oceanus the male energy of essential water, and Thetis the female; Oceanus the positive, and Thetis the negative forces, which constitute the visible unity of that omnipresent radical moisture, from whose exhaustless bosom all other things proceed. It is impossible for the imagination of 1851 not to descry the subtle thread of thought which seems to associate this venerable pair, Oceanus and his Thetis, with the oxygen and hydrogen of our own chemistry; especially when it is remembered that chemists so thoroughly accomplished as Davy and Prout have seen nothing repugnant to the genius of modern research in the conjecture that oxygen and hydrogen, the married coefficients of water, may prove to be the original elements of the whole world!

It may be mentioned, in passing, that in all the cosmogonical myths of the Greek mind there flickers the idea of polarity, the law of the inevitable dualism of things, the fact of the universal chemistry of nature: two in one, active and passive, positive and negative, male and female, and the unity of such mutually-conditioned pairs in this single creature and in that. We say the universal chemistry of nature; for it is the essential aim of chemistry to discover two constituents in every one thing: sulphuric acid and soda in the wonderful salt of Glauber; sulphur and oxygen in sulphuric acid; sodium and oxygen in soda:—and what pairs in sodium, oxygen, and sulphur? Nor is it necessary, in the present connection, to do more than state the fact, that this very idea of the bipolar unity of all sensible phenomena, generalised to the utmost, is at once the deepest and the widest of the grand principles fairly established by the genius and industry of recent science.

Diogenes Laertius asserts that the illustrious doctrine of the *Four Elements*, with the unspent echo of which we have all been familiar since the Christmas-games of childhood, was first promulgated by Pythagoras; one of those gigantic spirits of antiquity whose personality history can scarcely catch a steady glimpse of, but whose shadow lies large and long upon the world of old. If this report be true, it were probable that the Quaternion was filched from Egypt; and that might be the ground of the tenacious conviction of the alchemists, that their mystery descended from that land of wonders aud the Nile. It seems, however, to have been Empedocles who not only gained the dogma a footing in the world, but also elaborated it into a consistent hypothesis of nature. Empedocles, a man of condition, a legislator, a theologue and a poet, belonged, as a philosopher, to the second movement of Grecian science. Thales and his

schoolmen had attempted to solve the nature of the universe, including under that significant epithet the all-embracing unity which results from the three worlds of sensation, consciousness and conscience turned into one; a comprehensive definition implied in the very word itself. They approached and contemplated that universe as one and divine: they aspired to the solution of absolute being. Heraclitus, Anaxagoras, Empedocles and Democritus, on the other hand, were content to fly a lower pitch. They investigated the theory of nature, properly so called; and also, like Descartes and Bacon, the origin and methodology of science. If we had to discuss the great discoveries of Dalton and his compeers in chemistry, we should have occasion to adduce the atomic theory of Anaxagoras and Democritus; but at present it is only the doctrine of the Four Elements that falls in our way.

That famous dogma may be considered from two several points of view. It may be taken as a concrete proposition, or as an abstract one. It may be studied as a particular or as a general tenet. It has indeed been presented under both these aspects, since the days of its origin down to the period of its adoption by Oken, a contemporary of our own. Viewed as a particular proposition, the theory of Empedocles was simply this:—A handful of wood, or of any other ordinary combustible, is kindled and burned upon the surface of some cool body: the experimentalist observes that, while it burns, there rises smoke or *air;* the smoke is followed by flame or *fire;* moisture or *water* is deposited on the settle, or any other cold substance in the way; and ash or *earth* remains. The wood has been resolved into its coefficients, factors, or elements; and these are four—fire, air, earth, and water. But the burning of some wood had never been a scientific experiment before. It was not a chemical experiment; and from the very nature of the subject it could not become so, until such time as it was intentionally observed with a view to the determination of the composition of wood. A thunderbolt was not an electrical experiment until Franklin conceived of it as such, and varied it at will. An initiative idea must always accompany, if not precede, some natural phenomenon, in order to render that phenomenon an experiment or scientific observation. The intention, the observation, and the conclusion of Empedocles concerning the world-old process of combustion, then, constitute the first methodical or consciously scientific reflection ever made upon a chemical transformation. It is therefore nothing less than the long-sought origin of chemical science! For what is a science? It is the body of methodical or consciously scientific reflection on the observed phenomena of any one department of nature. Is it necessary to the nature of a science that it be all true, and that it contain no admixture of error? By no means: else chemistry was no science during the reign of Phlogiston; optics no science during the predominance of the materialistic theory of light; the Lavoisierian chemistry no science as long as oxygen was taken for the principle of acidity; ay, and the chemistry of to-day might very easily be proved to be no science any more than the rest. We have put our finger on the very fountain-head of all succeeding chemistries at last.

The Greek mind, however, could never hold exclusively by the concrete. It did not delight in details: it hastened to generalise: it loved particular nature indeed, but it never rested until it had glorified the particulars of

nature into types of the universal. Hence their sculpture, their drama, their philosophy; and hence their want of a self-fulfilling science of nature like ours. Fire, air, earth, and water were not only chronicled as the constituents of wood or common combustibles, as they would have been had it been possible for Empedocles to have sat at the feet of either Roger or Francis Bacon. The four elements were at once canonised as the sufficient and indispensable components of the whole of nature. There was, accordingly, an end of chemistry proper among the Greeks at once and for ever. The first step nobly taken, they never took another. On the contrary, they soon refined upon the elements they had discovered. Demetrius of Abelæa fell back upon the Thalesian notion, that there is necessarily only one true and primitive substance; and he represented the four elements of Empedocles as its visible representatives. Plato seems to have followed Demetrius in this conception to a certain extent, complicating it with speculations concerning the shapes of fire-atoms, air-atoms, and so forth; and maintaining, on the strength of apparent observation, that fire, air, and water are transmutable into one another, but not earth. There therefore remained only two permanent elements in the Platonic scheme. One of these was the common principle of fire, air and water, mobile, penetrating and quickening; the other, the earthy principle of things, was fixed, penetrable, and capable of being vivified. Plato, in fact, reduced the analysis of Empedocles to a shadowy doctrine of dualism. Aristotle, on the other hand, rejected the Platonic tenets concerning both ideas and matter, as well as the numerical idealism of Pythagoras. He held by the Demetrian idea of one underlying substance as the ground of all natural phenomena. He believed in the one radical matter of the universe, and argued that the four so-called elements are not such in reality, seeing they can be converted into one another. What subtleties and mysticism men are sometimes led into when they leave the path of observation! But every nation has its function. It was that of Greece, in so far as knowledge is concerned, to furnish the rest of time with nothing more than clews to the arcana of nature. But it was still more emphatically the mission of the Greeks, as philosophers, to discover those laws of investigation according to which alone such threads could be followed into the labyrinths of creation with advantage. The great result of all their centuries of striving was accordingly the invention of the inductive method by Aristotle; that mighty organon which, almost rediscovered, and certainly restated in a more practicable form by Bacon, has made us what we now undoubtedly are—the entering heirs of nature and all her inexhaustible wealth.

Such is the doctrine of the four elements. It has been domesticated with literature for more than two thousand years: it has been sung in the poetry of every land: it has been attacked, overthrown, and proscribed by modern science; yet it has actually been revived in our own days as the basis of the philosophy of nature! There is only one thing more to be said of it, considered as a particular proposition. That primitive analysis of wood by Empedocles, viewed as a chemical experiment, was actually a good one so far as it went. Wood is in reality composed of fire, air, earth, and water. They are its proximate constituents in a manner. Only modern analysis has gone farther still: it has divided

the phenomenon of fire into the phenomena of heat and light: it has found smoke to contain carbon, oxygen and hydrogen, not to be too minute: it has resolved water into oxygen and hydrogen. The ash or earth has been decomposed into several other substances by its more relentless methods.

The four elements, however, were also regarded in a more abstract and classific light in the Grecian schools, as has already been observed and slightly exemplificd. Each of them was a type; each of them stood for a vast class of things. Air represented gasiformity; water, liquidity; earth, solidity; and fire, the imponderable forces of nature. Fire, air, water, and earth were frequently used as the philosophical symbols of what we now denominate the imponderables—gases, liquids, and solids respectively. They became abstract terms, and were constantly losing their chemical or particular significance in the besetting tendency of the Hellenic mind to excessive abstraction. It is scarcely necessary to add that, in this abstract phraseology, three of the four elements are at length demonstrated to be actually convertible into one another. When a solid body is heated, it swells and swells until it falls down liquid. On the elevation of its temperature, the liquid swells in the same way, and is finally converted into a steam, dry gas, or air. The atmosphere we breathe is the steam of a liquid or water, which boils at an incredibly low heat; and that liquid is a melted solid. There is a temperature at which gold itself would be changed into a thin dry air, fit for the breath of some imaginable creature. The experiments of Faraday and Thilorier on the liquefaction and solidification of the gases warrant such conclusions. The relationship of those three generic forms of matter, in truth, is now understood to be unexceptionable and sure; and the consideration of it casts not a little light on the prattle of Plato and Aristotle about the mutual convertibility of the elements. Nor will this twofold meaning of the doctrine of Empedocles be without its importance in the elaboration of a just conception of alchemy and the alchemists, as will soon be seen. In the meantime, we cannot proceed to that department of the subject in hand without quoting the opinion of Professor Necker of Berlin, as translated by Dr Babington for the Sydenham Society. 'No mediæval author,' says he, 'omits an opportunity of representing conjunctions of the planets as among the general prognostics of great plagues; nor can we, for our parts, regard the astrology of the middle ages as a mere offspring of imposition. It has not only, in common with all ideas which inspire and guide mankind, a high historical importance, entirely independent of its truth or error; but there are also contained in it, as in alchemy, grand thoughts of antiquity which modern natural philosophy is so little ashamed of, that she claims them as her property.'

A good deal has already been said about the substantive root of the word alchemy, and it has thereby been made apparent how little that is certain can be said about the matter. It seems that we must be content to accept it at the hand of one or other of the veiled figures of antiquity, of whom we can see and say nothing. The reader has likewise glanced into the structure of certain doctrines concerning the theory of nature entertained by the Greeks. It has been found that Empedocles's canon of the four elements must be considered as the veritable origin of the science of chemistry, although the science was not known under any such name till

many hundred years after the days of that early speculator. Chemistry, in fact, did not advance among the Greeks beyond its illustrious first experiment, and the broad but unwarrantable generalisation that was erected on it; a thing quite intelligible, when viewed in connection with the intellectual proclivities of the national mind. There was a more urgent task before them than the working out of particular sciences; namely, the discovery and the exposition of the science of sciences—the science of method. Before they could invent sciences, they had to invent an intellectual organ, or conscious instrumentation, according to the laws of which the sciences were to be invented. Before discovering chemistry, they had to discover the art of discovering chemistry, to use a strong expression. Their progress in positive knowledge was accordingly small in extent, and great only in depth; while the successive schools, with or without a very distinct consciousness of what they were accomplishing, lavished all the energies of the most wonderful national intellect the world ever saw on the excogitation of the principles of discovery, the methodology of science, and the laws of thought. The consummation of the whole movement has been represented as having transpired in the person and the works of Aristotle; that is to say, its consummation in so far as the interests of physical, and indeed all positive science, were concerned. It would be more catholic to say, the intellectual career of those schools found its apotheosis in Plato and Aristotle, viewed as the opposite terms of one result, and actually embodied as one, with some degree of development in Socrates their predecessor. Philosophy is the true Janus and keeper of peace. It has an eye for the earth, and an eye for the heavens: an eye for the sensuous, and all that arises from it by intellectual transformation and exaltation; and an eye for the ideal, and all that descends therefrom upon the daily life of man: an eye for nature, and an eye for God. Aristotle was the perfection of the one, Plato of the other, of those philosophic functions; and the union of these master-spirits in the person of one sage would make a complete philosopher, in so far as methodology could render him complete. Were such an imaginary and perhaps impossible being as complete in mere panoply as Pallas when fresh from the brain of Jove, however, he would have to live and labour for ever and ever ere he should become a completed philosopher in the larger sense of the phrase; for the sphere of objective truth is as unbounded as the empyrean. That is to say, there is only one complete philosopher—even the Spirit of Omniscience, of whom Plato has said it is perhaps better not to name Him, in case we should degrade his idea. As it is, Plato was the greater philosopher, for philosophy is primarily conversant with ideas; and Aristotle was the greater man of science, for science has its dealings with the concrete in the first instance. To use a chemical figure of speech, less appropriate than in character, philosophy and the Platos of the world are occupied with the process of distillation by descent, while science and the Aristotles are engaged with that of sublimation. At the same time, Aristotle could not escape the habit of mind which distinguished his countrymen—namely, an overweening tendency towards excessive abstraction; and he philosophised upon science more than he invented sciences, amazing though the amount of his information and knowledge undoubtedly was. That is one of the reasons why the methodology of Aristotle, essentially practicable although it was, was so

unproductive in the hands of his disciples. The methodology of science did nothing but degenerate after its great development in the philosophy of Aristotle, and that more especially in the department of physics. We have seen that, in so far as a possible chemistry was concerned, the prospect of anything like advancement was at once foreclosed by the vast over-generalisation made by Empedocles and his critics upon the analysis of common combustibles by fire. It was nearly the same in every other direction, always excepting those purely mechanical subjects which were susceptible of illustration by geometry. Unable to use the Organon invented for the use of thinkers by Aristotle—namely, that inductive philosophy which Lord Bacon has taught us the art of bringing to bear upon the castellated secrets of nature—they were content to make it the object of endless and unprofitable discussions. Unequal to the task of carrying out the intellectual life of Aristotle into the amplitudes of an external and a victorious development (as Locke, Newton, La Place and Lavoisier, Herschel and Dalton, have carried out that of Bacon), they were reduced to the alternative of setting him up as an infallible authority, the monarch of their thoughts, and the idol of their hearts. Long, too, did he reign, in spite of many an indignant protest by the masters in alchemy, as we shall find, until the final overthrow of the scholastic philosophy by Descartes and Bacon. Nor would the world have suffered greatly from this protracted domination, if it had really been Aristotle that reigned. But it was not. It was Aristotle misunderstood and perverted. It was an Aristotle scarcely read, known only by transmission, and distorted by the vision of the schools. It was not the sun of Aristotle that these scholastics beheld and adored: it was only his zodiacal light. They did not study his great principles of investigation: they merely adopted his opinions regarding a host of special points; a thing which, done now-a-days to Bacon, would reduce him as low as ever Aristotle was degraded by his mistaken followers. The true Aristoteles, that best ending or greatest and last representative of the most illustrious line of royal thinkers this world has yet produced, remains intact. In reality, the methodologies of Aristotle and of Bacon are substantially the same. They are one method or doctrine of knowledge stated in two several ways. The Greek stated the inductive method subjectively; the Briton puts it objectively. The Greek developed it from within outwards, like the growth of palms; the Briton grows it from without inwards, like an oak. The Greek constructed the telescope, leaving it in the workshop of the mind where it was put together; and no man was strong enough to move it from the tressles, until the chancellor of Great Britain wheeled it to the air, and directed its resistless eye upon the heavens.

One has simply to understand, then, in the present connection, that during those centuries in which alchemy shall be found to have been working in the mind of Europe, the dogma of the four elements, the vague idea of their mutual convertibility, and the supposition of some fifth element common to the four, or rather the very soul of all the four, were predominant among the learned. This, indeed, is one of the undeniable origins of alchemy; but there is another, for alchemy has two historical sources: this one in old Europe, and another in Asia. The attention of the reader must now be directed to the latter.

It was during the caliphates of the Abassides, and apparently under their patronage, that the school of polypharmacy flourished in Arabia. The earliest work connected with that movement which is now known in Europe is the *Summa Perfectionis*, or 'Summit of Perfection,' composed by Gebir. It is consequently the oldest veritable book on chemistry proper in the world, although it dates no farther back than the eighth century. Nor does the science derive much credit from this performance, when judged from one point of view; for it contains so much of what sounds very like jargon in our ears, that, according to Dr Johnson, the name of its compiler has been transmuted into gibberish for the use of indignant English tongues. Viewed under its legitimate aspect, however, it is a wonderful thing. It is a kind of text-book, or collection of all that was then and there known and believed for nobody knows how long back. It appears that those Arabian polypharmists had long been engaged in firing and boiling, dissolving and precipitating, subliming and coagulating, chemical substances. They worked with gold and mercury, arsenic and sulphur, salts and acids. They had, in short, become familiar with a goodly number of what we call chemicals in ordinary parlance; although there is in reality no such thing as a chemical, for everything is one.

To these Arabians, however, chemistry was by no means a theory of all nature, considered under the chemical point of view, as it is to us. It was only the theory of a laboratory full of curious, rare, and aristocratical substances. Nor were they without their deep-reaching conjectures or dogmas respecting these strange things. Gebir taught the principle that there are three elemental chemicals—mercury, sulphur, and arsenic. The penetrating and victorious qualities of these bodies fascinated his thoughts. Even gold itself, which its weight, its beauty, and its incorruptibility by the fire united to signalise as the most perfect of matters, is dissolved by quicksilver almost as easily as sugar is dissolved in water. Brimstone pierces iron like a spirit the moment they touch one another, if the metal be white-hot from the furnace; and they run down together in a shower of solid drops, a new and remarkable substance, possessed of properties belonging neither to iron nor to sulphur.

But they had their alchemical theory as well as this chemical one. They inculcated the proposition that all the metals are compound bodies. This was a very natural opinion, and it prevailed during the whole of the long subsequent reign of Phlogiston. It not only lasted, indeed, till the time of Lavoisier, but neither Cavendish nor Priestley ever gave it fairly up. The metals are for the most part extracted from what are called calxes, on account of their resemblance to so many chalks of different colours. These calxes, rusts, or earthy ores are endowed with neither the weight nor the lustre of metals. They are as unlike iron, lead, or gold as things could be. Yet it is easy to change them into metals: iron rust into iron, lead calx into lead, and so forth. They are heated along with carbonaceous materials in exclusion from the air, whereupon the respective metals are melted out, and flow to the bottom of the apparatus. Thanks to the Lavoisierian chemistry, we know the meaning of this operation. It is the carbon that carries away oxygen from the ores, and leaves the metals free; for those ores or rusts are composed of that oxygen and the metals respectively. But at first sight, it must have looked as if the ores got

something in the furnace, instead of giving away anything: it must have seemed that they took some principle from the furnace, and so became metals. It required many a long and weary day's work, alas! to make it even possible for Lavoisier to discover that it was exactly the reverse.

According to Gebir and his successors, however, the metals were not only compound creatures, but they were also all composed of the same two substances. Now both Prout and Davy have lent their names to ideas not unlike this. 'The improvements,' says the latter, 'taking place in the methods of examining bodies, are constantly changing the opinions of chemists with respect to their nature; and there is no reason to suppose that any real indestructible principle has yet been discovered. Matter may ultimately be found to be the same in essence, differing only in the arrangement of its particles; or two or three simple substances may produce all the varieties of compound bodies.' Those ancient ideas, therefore, of Demetrius the Greek physicist, and of Gebir the Arabian polypharmist, are still hovering about the horizon of the most recent system of chemistry.

The Arabians taught, in the third place, that the metals are composed of mercury and sulphur in different proportions. It was at one time a favourite hypothesis of Davy's, that the metallic and other elements are the compounds of hydrogen (a kind of gaseous mercury) with a yet unknown base, in different proportions. He tugged hard at more than one of the elements to prove it. The fact is, that both the polypharmists and he are in error. Mercury and sulphur are just as much (and as little) elementary bodies as silver and gold, lead or tin, copper or iron, on one hand; and on the other, the hydrogen extracted from certain so-called simple substances, by the British chemist, was only hydrogen mechanically condensed within their pores, as he discovered in good time. The oldest and the youngest schools of chemistry, then, are equally at fault in this particular; and this brings us to the remark, that Gebir, Phazes, Avicenna, Mesuë, Averröes, and their compeers, did no more bestow their principal attention upon those speculations anent mercury and sulphur, than Davy or Berzelius expended his labour on analogous hypotheses. They were, in truth, genuine polypharmists; neither more nor less than is implied in that business-like denomination. They toiled away at the art of making many medicines out of the various mixtures and reactions of the few chemicals at their command. They believed in transmutation, but they did not strive to effect it. It belonged to their creed rather than to their practice. They were simply a race of hard-working, scientific artizans, with their pestles and mortars, their crucibles and furnaces, their alembics and aludels, their vessels for infusion, for decoction, for cohobation, sublimation, fixation, lixiviation, filtration, coagulation, and botherations of every sort. Many a new body they found; many a useful process they invented; many a good thing they did. The chief and remarkable difference between these excellent doctors and the young men at work in the *officinum* of a reputable chemist and druggist consisted, perhaps, in the circumstance, that they had a kind of scientific religion over their sweating heads. They believed in transmutation, in the first matter, and in the correspondence of the metals with the planets, to say nothing of potable gold; whereas their modern counterparts see through every species of humbug—carbon and silicon, homœopathy, *et hoc genus omne!*

Whence the Arabians derived the sublimer articles of their scientific faith, is not known to any European historian. Perhaps they were the conjectures of their ancestors according to the flesh. Perhaps they had them from the Fatimites of Northern Africa, among whose local predecessors it has been seen that it is just possible the doctrine of the four elements and their mutual convertibility may have arisen. Perhaps they drew them from Greece; modifying and adapting them to their own specific forms of matter, mercury, sulphur, and arsenic. But be those high dogmas the direct produce of Arabian thought, or be they a cross between Greek ideas and Arabian facts (an opinion to which we incline), there they are; and they must now be traced into European alchemy.

Partly carried by the Moors by way of Africa, and partly borne by the currents of returning Crusaders, this Arabian chemistry was brought to Europe; and it speedily became inextricably entangled with the fantastic subtleties of the scholastic philosophy. It was in Spain that it found its earliest opportunities of this new and not uncongenial development. It flourished there, in an unprogressive way, under the patronage of the Ommiades; but not until the tenth century. It spread from Spain to England, Germany, France, and Italy successively, from the eleventh to the sixteenth centuries inclusive. It is interesting to learn that the earliest authentic works of European alchemy now extant are those of our wonderful countryman Roger Bacon; or, as the name imports, Roger Beacon, a word which is pronounced Bacon in some districts of England yet. In fact, he is the foremost man in all the school; the first in substantial knowledge, and the greatest in faculty. He was born in the county of Somerset, in the year 1214, and he lived seventy years. Having studied at Oxford and Paris, he became a Franciscan friar. Little is now known about his outward life and conversation. The people suspected, dreaded, and slandered him. He was accused of having fabricated a brazen head, according to the rules of the occult philosophy and judicial astrology, which uttered oracles to him when consulted by magical incantation; he was imprisoned more than once; and at last he was poisoned by his monastic brethren. A man of vigorous and erected intellect, he saw far before his age. In a book concerning 'The Wonderful Power of Art,' he condemns magic, necromancy, the doctrine of charms, and all such things. Acquainted with the Latin, Greek, Hebrew, and Arabic tongues, he exhausted all the real physical knowledge of the day. So passionate an instinct had he for what is positive in science, that, in the department of nature, he actually claimed an equal rank for observation with reason; a claim which was advanced again, and achieved, nearly 400 years after, by his more illustrious but not more sagacious namesake, Francis Bacon, the liberator of the sciences.

To say nothing of his philosophical ideas and his other information, in chemistry he was acquainted with gunpowder. In giving the *récipé* for its preparation, however, he expresses charcoal by a word of his own—*luruvopovircanutriet;* either with the view of hindering so perilous a substance from being made by the vulgar, or for the purpose of slurring over his own ignorance of the ingredient in question. In fact, gunpowder seems to have been known to the Chinese before the Christian era. Bacon asserts that the thunder, lightning and magic, witnessed by the Macedonians at Oxy-

drakes, when besieged by Alexander, were nothing but the fulminations of that mixture. It was not introduced into Spain by the Moors, however, until 1343; and it is therefore probable that the friar derived his incomplete acquaintance with it from his Oriental readings. He believed in the convertibility of the inferior metals into gold; but, like his Eastern teachers, he does not profess to have ever effected the conversion. He was eminently practical in the tendencies of his mind, although he retained some of those speculative views, which we have seen to be deficient neither in sublimity nor in a species of truth. His faith in the elixir of life was somewhat deeper rooted than his confidence in gold-making. He followed Gebir in regarding potable gold—that is, gold dissolved in nitro-hydrochloric acid or aqua-regia—as nothing less than that terrestrial hypocrene. Urging it on the attention of Pope Nicholas IV., he informs his holiness of an old man who found some yellow liquor (the solution of gold is yellow) in a golden phial, when ploughing one day in Sicily. Supposing it to be dew, he drank it off. He was thereupon transformed into a hale, robust, and highly-accomplished youth. Having abandoned his day-labouring, he was received into the service of the Sicilian king, and served the court some eighty years. The philosopher, it is to be presumed, must assuredly have taken many a dose of this golden water himself, and, if the Gray Friars had not made away with him, he might therefore have been alive at this moment, as stout a positivist as Monsieur Conte! At all events, it is curious to think that Descartes, the father of psychology, regarded by many as the inventor of the inductive philosophy, and the rival of Bacon the Second, should have been as credulous as Bacon the First about long life. Descartes also believed he had attained to the art of living a few hundred years, and so did some of his friends. When he died before reaching the climacteric of sixty, nothing would convince one of his most intimate associates that he had not been poisoned! In truth, we should never look at the little particular beliefs and notions of great spirits in the history of science, but to their great ideas; otherwise we shall run the risk of despising men so exalted in character as to remain for ever incapable of despising us. But, some thoroughgoing Baconian will perhaps observe, it is important to take notice of the ridiculous opinions to which their wrong method was able to conduct such men. Well, one might reply, be just, and apply the same scrutiny to the second Bacon and ourselves: for the day will soon enough be here when posterity will smile at the Baconians of the eighteenth century, who brought themselves to think of the Bible, for example, as nothing more than an organon of priestcraft; at the positivists of the nineteenth, who discovered that thought, emotion, passion, and will are but the imponderable products of chemical or other physical actions in the brain; at the physicists of to-day, who have entertained such images of the materialising fancy as the matter of light, caloric, electric fluids, and what not! Perhaps the time is not distant when young children will wonder at not a few things, belonging to the truth of ingenuous observation, which we are yet slow to receive; for credulity of temper is even more strikingly exemplified in bigoted unbelief of the credible, than in too great a facility of conviction. In fine, there is probably as much nonsense believed, and as much truth rejected, in these our own times, as at any other period. But it must never be forgotten, that there has also been accomplished a vast

increase of real and positive knowledge in the progress of these centuries; that increase being quite as much owing to Roger Bacon and his compeers as to us; for their part of the task was a far harder one to perform than ours. There is indeed no room for national or epochal vanity in the study of the history of science: there is rather occasion for humility and emulation; for those old men worked with grand ideals and small means, upon an obdurate and an unbroken soil; while we stand on fields which they have ploughed, armed with an elaborate instrumentation, and too often guided by ideals which savour more of the shop than of the universe.

The next great name in the authentic history of alchemy is a German one. Albrecht Groot, or Albertus Magnus, was born at Bollstadt of Suabia in 1193, some twenty-one years before Roger Bacon; and he died two years before him; but he was rather later than the friar as an author. Remarkable for his early appearance of stupidity, he studied medicine at Padua, and taught it at Cologne and Paris. He then travelled all Germany as provincial to the fraternity of Dominicans, and sojourned at Rome some time in all the odour of renown. He was finally appointed to the bishopric of Ratisbon. A theologian, a physician, an astronomer, a magician, a necromancer, and not a little of the man of the world, he addressed himself with particular emphasis to the study of the polypharmacy of the times, and wrote many works on that and other cognate subjects. He describes the chemical waterbath, the alembec, the aludel, and various lutes; and shews himself acquainted with alum, caustic alkali, the purification of the royal metals by means of lead, and the purging of gold by cementation, to say nothing of his knowing how to determine the purity of gold. Red lead, arsenic, and liver of sulphur, are among the chemicals on which he multiplied experiments. His style of exposition is generally plain and intelligible. In addition to the sulphur-and-mercury theory of the metals, drawn from Gebir, he regarded the element water as still nearer to the soul of nature than either of these bodies. He appears, indeed, to have thought it the radical source of all things, along with Thales, the father of Greek speculation. Like all the true masters, however, he was more of a workman than a visionary.

Thomas Aquinas, the Dominican, was a pupil of Albrecht's. A divine and a scholar, that canonized personage wrote several obscure treatises of alchemy. He is chiefly notable here, however, as having first employed the word amalgam. Quicksilver penetrates tin, lead, silver, and some other metals; opens them up, and makes a homogeneous paste or liquid with them. Aquinas denominated the resulting compound in such cases an amalgam, little weeting how much his good word should be abused in the days of English railways.

Raymond Lully is said to have been a pupil of Friar Bacon's. He was born at Majorca in 1235. His father was seneschal to James I. of Arragon. He entered the army very early in life, whence he soon passed to court. Being yet young, and having subsequently studied at Paris, he became not only a doctor, but likewise a member of the order of Minorites; and he persuaded King James to found a cloister of his ecclesiastical brethren in Majorca. He journeyed through Italy, Germany, England; visiting kings' courts and rich abbeys, for the purpose of rousing Europe to one grand missionary effort for the salvation of the heathen. It is said that he

was never a whole year in one place, from his youth upwards. He visited Cyprus, Armenia, and Palestine in the character of an impassioned preacher of Christianity. According to one account, he was stoned to death on the coast of Africa in the course of a sermon; but according to another, he died at home in 1315, at eighty years of age, having sunk into fatuity before that event; and he was buried in his native isle. Notwithstanding of this impassioned and erratic career, he dabbled industriously among the chemicals of the time; and produced more than sixteen chemical works. They are much disfigured by unintelligible jargon, and present a powerful contrast to Roger and Albrecht in respect of vigour and common-sense. Yet he was the first to introduce the use of chemical symbols, his system consisting of a scheme of arbitrary hieroglyphs. Nor are his books deficient in observation. They contain many observations on the distillation of cream of tartar; the deliquescence of the alkalis; the separation of an aqua-fortis from saltpetre by means of the oil of vitriol; the preparation of aqua-regia by mixing nitric acid with sal-ammoniac or common salt; the volatile alcali; alum; marcasite of some sort; white and red mercurial precipitates; and other things. He made much of the spirit of wine, imposing on it the name of *aqua vitæ ardens*, which it retains to the present time in some quarters. In his enthusiasm he pronounced it the very elixir of life, an opinion which is still a favourite among our countrymen in the north. In a word, he was a restless, intelligent, inventive, and somewhat fanatical busybody in the affairs of the church, of science, and of life: an ardent and generous spirit withal; probably not unlike our own Priestley, and not without a great degree of utility in his day and generation.

Arnaldus de Villâ Novâ was not a churchman like his predecessors. On the contrary, he was condemned as a heretic, but the pope protected him from the extreme penalty; as the pope of his day would have consented to protect Galileo, if the impetuous Tuscan would only have suffered himself to be advised. Born in Provence, somewhere about 1240, and educated under the famous John Casamilla at Barcelona, he had to fly to Paris through Italy for forecasting the deathday of Peter of Arragon. He afterwards taught in the university of Montpelier, and was consulted far and wide by kings and popes. Guided by the rules of judicial astrology, he discovered that the world was to have been blown up in 1335; a discovery which is surpassed by soothsayers of another species, almost every month of every year, in these more illuminated days of ours. Unable, however, to await the fulfilment of the horoscope he had drawn out for the Mighty Mother, he died in 1313, on his way to visit Clement V., who was lying sick at Avignon. He wrote twenty-one works; of which the 'Rosarium,' a compend of alchemy, is the most curious, if not instructive. The theory of the author is very plain, but his practical directions are far from lucid now. Mercury is an element of all the metals. Gold and gold-water are the most precious of medicines. Bismuth is called marcasite. The preparation of the essential oil of turpentine, the oil of rosemary, the spirit of rosemary, long known as Hungary-water, and many other gentle distillations, are all to be traced to this heretical experimentalist.

A couple of Dutchmen are the next to figure in this alchemical calendar—Isaacus Hollandus, and either his brother or his son. These Hollanders belong to the thirteenth century, later in the day than Arnaldus, whom

they quote with reverence. Their treatises are remarkable for clearness and precision. They were the first to give figures of apparatus, a thing which renders them memorable in the history of physics. Writing mostly in Latin, they sometimes used the German tongue, being probably the earliest vernacular authors in European science—another claim to distinguished remembrance. With all their plain dealing and plain speaking, however, they cannot be said to have advanced chemistry otherwise than as honest, sagacious, and penetrating compilers. It is curious that your clear, cautious, ultra-sensible men do so very little that is new and great. It would appear that vigorous impulses, and a certain poetical extravagance of character, are quite as characteristic of the Keplers, the Hunters, the Herschels, and the Davys of science, as even that cardinal faculty of the soul, that first and last of the intellectual virtues, common-sense itself.

These qualities were combined in an excellent proportion in the person of Basil Valentine, one of the most celebrated of all the alchemists. Born at Erfurd, a Saxon town, in 1394, he became a Benedictine monk. He bestowed the larger part of his attention upon the preparation of chemical medicines. It was he who introduced antimony into medical use; the 'anti-monk metal,' the name assigned it, one might surmise without uncharity, after some wicked experiments on the stomachs of his monastic brethren. He made a vast deal of that curious metal. All he writes about it is as clear as glass, and quite abreast of our knowledge in the present century, so far as it goes. He makes no mistakes so long as he treats the chemistry of the subject. The 'Currus Triumphalis Antimonii,' or 'Triumphal Chariot of Antimony,' were almost a model of positive observation, if it were stripped of its chemico-medical speculations. Drawing a beautiful but fallacious analogy between gold-making and the restoration of health, he maintains that antimony is the best for both! He followed the Hollanduses in regarding salt, sulphur, and mercury as the three bodies contained in the metals. He inferred that the philosophers' stone, or peristrophè, must be the same sort of combination—a compound, namely, of mercury, sulphur, and salt; so pure that its projection on the baser metals should be able to work them up into greater and greater purity, bringing them at last to the state of silver and gold. But Basil Valentine, the steady-eyed charioteer, knew something more substantial than these things. He knew arsenic and its red sulphuret, zinc, bismuth, manganese ores, nitrate of mercury, corrosive sublimate, red mercury, nearly all the antimonials in the pharmacopeias of 1851, litharge, sugar of lead, white lead, and many things besides, under these or other names. He precipitated iron from solution by potash. He was aware that tin sometimes contains copper, and that Hungarian silver contains gold. He knew how to extract gold from the red elixir by means of quicksilver, and he makes mention of fulminating gold. In fine, he may be characterised as the founder of analytical chemistry, that inevitable art which now leaves nothing untouched; which is furnishing new wonders every year; which resolves the food of nations into water and air, and suggests the possibility of air and water being some day made into food; which is drawing nigh the very threshold of vitality with fearless hands; and which is undoubtedly destined to change the whole economy of the outward life of man.

Roger Bacon having thus set the example of enormous industry, and

having exalted experiment to its legitimate rank in the logic of chemistry; Albrecht Groot having supported the dignity of the science by the universality of his accomplishments and the elegance of his style; Arnauld having applied the art of common distillation to chemical research; Raymond Lully having summoned the attention of the adepts to the products of destructive distillation; and Basil Valentine having opened up the science of metallurgy and analysis, there came upon the field a gigantic creature more celebrated than them all: it was Paracelsus. As strong-headed as Bacon, as inventive as Albrecht and Arnauld, as indomitable as Lully, and as mighty an enthusiast as Basil Valentine, this remarkable man wanted the truthfulness of character which animated all his predecessors; and he fell. He was born near Zurich, at the beginning of the sixteenth century, his name being Theophrastus Bombastes; and it is from that surname that the word bombast is derived—so arrogant, so insulting, and withal so 'great and swelling' were the 'words of vanity' he uttered, when little Theophrast grew a famous revolutionist under the far-sounding title of Theophrastus Aureolus Bombastes Paracelsus! His boyhood and youth appear to have been engaging, though impassioned and ambitious. He began life as a purist, having drunk nothing but water, and eaten little else than bread, until he was appointed to the first professorship of chemistry at Bâle in 1527, the earliest chair of chemistry ever established. As a physician, early famous like Simpson, he was amazingly successful and amazingly presumptuous, having been as unlike the great Edinburgh doctor in every other respect as he was like him in unresting enterprise. As a professor, he was eloquent, learned, and insolent in the extreme. He burned the books of many of the authorities before his hustling crowds of students; poured his contempt upon both the Arabian shop-doctors and the scholastic pedants; sounded anew the praises of Hippocrates; magnified his proper self even more than the sagacious Greek; played all sorts of mad pranks; surcharged his fascinated disciples with his overweening spirit; and kept up such a storm in poor little Bâle, that the magistrates had to banish him from his chair. After many alternations of fortune, and after having abandoned himself to debauchery, this 'erring and extravagant spirit,' this man of extremes, this mighty agitator, actually died in an obscure tavern at Salzburg, at forty-eight years of age. We may lament his ungracious life and his miserable end; but there is no denying that he was a great reformer; and he is certainly an important figure in the history of chemistry and medicine. He descried the utter hollowness of the prevalent scholasticism, as respected physical investigation, with an eye as clear as Francis Bacon's. On the other hand, he looked with the contempt of a Carus or an Oken on the bootless ploddings of the mere pharmaceutical chemists of the day. He also perceived the value of the long-neglected descriptions and practical rules of Hippocrates, with the sagacity almost of a Sydenham or a Cullen. In truth, if he had been content to do these three things, and to do them well, he might have become the father of modern science; but Old Legion was in him, and he could not govern his noble intellect. Ambition, vanity, the love of opposition and destruction, and all unkindliness would not let him be. He would amaze as well as instruct the world forsooth! He would put it under everlasting obligations to him, while he despised its gratitude! Athirst for true glory in his earlier years, he early became the

victim of a lowlived hunger for power and reputation. The great positive aim of his efforts was to pluck the panacea or elixir from the secret-keeping heart of nature, and thereby shew how omnipotent he was. He did not succeed of course; but he was too proud to own his failure, and so he talked 'an infinite deal of nothing.' What with private brawling, public haranguing, and ceaseless publication, the student feels as if this magnifico had only talked and talked, and died in ignominy. Yet he was a vigorous thinker, and actually originated a practical movement in our science, while he certainly brought mere alchemy to an end. Holding by Basil Valentine's principles of mixts or elements of compound bodies, salt, sulphur, and mercury (representing respectively earth, air, and water, fire being already regarded as an imponderable), he generalised the properties of those four first principles of nature with great breadth. They were purely representative in his system of doctrine, as their counterparts had soon become in the systems of the Greeks. All kinds of matter were reducible under one or other of those typical forms: everything was either a salt, a sulphur, or a mercury; or, like the metals, it was a mixt. There was one element, however, common to the four; a fifth element, the quintessence of creation; an unknown and only true element, of which the four generic principles were nothing but derivative forms or embodiments. In other words, he inculcated the dogma that there is only one real elementary matter—nobody knows what; a dogma like that of Demetrius and Aristotle, which is metachemical rather than chemical, and therefore of little or no practical importance. It gave his experimental pursuits a useful bias however. It set him upon the search after the essences and quintessences of things. By a natural, but no less sophistical slip in his logic, he considered alcohol as the quintessence of wines; and blue as the quintessence of blue stuffs and stones! It was in this way, however, that he set agoing that prosecution of the active principles of mixed or complex medicaments, which has ended in the extraction of quinine, morphia, veratria, thëine, and a multitude of valuable proximates. It was Paracelsus, also, who began that tendency to mingle chemical considerations with the physiology of the human body in health, with its pathology in disease, and with the practice of the art of healing; a tendency which is still far from being exhausted. The works of Dumas and Liebig, and of the whole school which they represent, may be described as the very consummation of this iatro-chemistry, as it has been styled. It was likewise our present hero who introduced the word alcahest into alchemy, the term usually applied to the universal solvent; a word supposed by some to mean *alcali est*, is it an alcali?—but sometimes said to be composed of the two German vocables, *alle geist*, all spirit. It does not appear that Bombastes was a seeker of this universal solvent himself; but the name perhaps imports his idea that the one prime element of things, or fontal matter, was also the veritable alcahest. High above his practice of physic, his criticism of the predominant methods of inquiry, and his multifarious manipulations, there seems to have flitted the sublime conception of an unattained, perhaps an unattainable, quintessence or fifth element of things, which should prove to be at once the philosophers' stone, the universal medicine, and the irresistible solvent. In order to seize this triple aureola of existence, and put it on his heavy-laden head, as a crown

of joy, he knew that it behoved him, at the very least, to lead the natural life of a child in the intellectual life of a free man; but he paltered with his idea of his mission, sank into infamy, and died unannealed. Yet something that is charitable and thankful, and even affectionate, is surely to be pronounced over the squalid public-house where so magnificent, so outspoken, so effective, so celebrated, and withal so wretched a Protestant fell asleep at last. But that is a task for the orator or the poet rather than for the man of science; and the reader is therefore referred to Browning's philosophical drama, entitled 'Paracelsus,' for the emotions with which it becomes us to pronounce his motley but splendid name, and to remember his stormy but beneficent career.

We have now considered the ideas of the Greek physiologists concerning the world of matter, in so far as they are capable of being represented as standing in connection with the history of early chemistry; having omitted taking any notice of the atomic theory of Democritus, because it has no relation to that history until the time of Dalton, our own contemporary. We have also glanced at the nature of Gebir and the Arabian polypharmists, and seen as far into them as Sprengel and other authors have enabled us to do. We have likewise spoken briefly about the series of grand-masters in that dim and somewhat free-masonic department of scientific history, that of European alchemy, from that proto-martyr of science in Christendom, Roger Bacon, down to Paracelsus, the magnificent victim of his own presumption and the hatred of his age; and found them to be for the most part a race of brawny inquisitors, inspired by ideas great enough to enable them to live aside from the world, if not above it, on one hand, and to do a good day's work for the world, on the other.

To take the ludicrous view of the character of these Arabian, English, Spanish, German, French, and Dutch enthusiasts for a moment, it was of such men that the fantastical Becher exclaimed—'De gustibus non disputandum est—There is no disputing about tastes;' a proverb which agrees with reason and experience. Some folks will have sweet food, others like sour better, and a third prefers what is bitter. Some delight in gaiety, some in sadness. Some love music, others have no pleasure in it at all. But who would have thought that there is a taste to which you must sacrifice honour, health, fortune, time, and even life? You say that those who are addicted to it must be madmen. No! They are only men of an eccentric, heteroclitic, heterogeneous, abnormal turn of mind. They are chemists—

> 'Nasty, soaking, greasy fellows,
> Knaves would brain you with their bellows;
> Hapless, sapless, crusty sticks,
> Blind as smoke can make the bricks!'

Chemists of lively parts and wide views, such as Joachim Becher was, must sometimes make a pause in the toilsome career of their life in the laboratory, and smile at the grim earnestness with which they hang over their furnaces, batteries, mercurial troughs, Bohemian tubes, thermometers, and balances, denying themselves the freedoms of nature, and many of the dearer interests of other men. There are poets who wonder at the spec-

tacle of such keen spirits as Humphry Davy, for example, labouring with might and main at the dry births of stone and iron, when they might well be abroad among the strong and the beautiful, stirring the life of man in its auguster depths. But a man must work where he is placed; and he must also obey the hint of his peculiar talent, else he will never do the most he can for the race and for himself. These are two of the great rules of duty. There is little matter what a man finds to be his proper task, so he rest not until he have won all it can teach him; so he relax not until he have made the most of it for the world; so he relent not before he has adorned it with his proper virtue, and ennobled it by his proper genius. Truth is a globe like the world; and it is of small moment where you begin to dig, for you will come as near the centre as another if you dig deep enough. It is at the same time an important, though a secondary duty of the industrious miner, to ascend every now and then from his particular shaft, both to see what others are about, in case he should become the egotist of a single pursuit, and to refresh himself with the inexhaustible variety of nature and of life.

To return to the alchemists, who were wiser in this very respect than their successors in these days of the extreme division of labour, the historian finds that soon after Paracelsus the adepts of Europe spontaneously fell into two classes. One of these comprised a multitude of weak men, who rode the hobby of the older school; and that very hobbihorsically too, to quote a whimsical adverb of Sterne's for the purpose of characterising a set of whimsical fellows. The other class was composed of men of diligence and sense, who devoted themselves with infinite labour to the discovery of new compounds and reactions. The two constituent elements of the genuine alchemist, in fact, fell asunder after Paracelsus; and both of them suffered from the separation. The fantastical element found a host of foolish representatives, and the practical one incarnated itself in a company of plain and painstaking men. The celebrated Van Helmont was an alchemist of the first water in his youth, and a very practical chemist in his old age. Nor can it have been an easy thing for such as him to renounce the sublimities of alchemical ideal, and content themselves with the practicable aims of common chemistry. Van Helmont had actually convinced himself that not only gold—that sun-bright and almost beatified body of the soul of matter—but everything else, consists essentially of nothing but water, as had been told the ancients by Thales, the eldest of the seven wise men of Greece. He had planted a sprig of willow in a vesselful of such a soil as appeared incapable of yielding it any nutriment; suspended the little willow and its pot in the air; fed it on pure water; and yet the creature had grown apace, stretching forth its branches, and covering itself with leaves! What was to be inferred from this seemingly crucial experiment? Why, surely that wood, and bark, and foliage, and acids, and salts, and earths, and all things do lie folded up in some mysterious but not inscrutable manner within the elemental substance of water. Alas, the experiment was fallacious! The experimentalist did not know that the air around his expanding plant contains both carbon and nitrogen; that water results from the union of oxygen and hydrogen; and that these three gases, and that one solid body, are in reality the essential constituents of the vegetable tissue. Van Helmont,

however, must on the whole be regarded as belonging distinctly to the new school of practical chemists, and not to the post-paracelsian brotherhoods of degenerated alchemy. It must be confessed, at the same time, that the chief circumstance which lent any dignity to the pursuits of him and his companions in arms, was the stupendous chaos of phenomena in which they had to work. Libavius, Cassius, Glauber, Agricola, and the rest of them, deserve to be remembered for their indefatigable zeal, and for the multitude of single facts they managed to quarry out of nature. It has also to be recorded of them that, although they were a race of pedantic artisans rather than men of science, it was more particularly in their persons that the metaphysical era of scientific history was aspiring towards a more exalted stage of development; namely, towards the epoch of positivism, the era of Descartes and Bacon, the day of experimental observation under the guidance of the inductive syllogism.

It is unnecessary to trace the alchemists so-called after this decomposition of the old alchemical character. They are no longer historical; they are no longer with their age: they are behind it. The vitality is gone from them: they merely drivel on in a kind of questionable existence. They are poor ghosts, being *restants* that cannot get away; not *revenants* come back with some important secret. The life of the time is all on the side of the practical chemists after Paracelsus. The misnamed alchemists are mere inanities after that period. They can do no one useful thing: they can only compile mystical trash into books, and father them on Hermes, Aristotle, Albertus Magnus, Paracelsus, and other potentates that never wrote such nonsense in their lives. They can only form themselves into secret associations, Rosicrucian fraternities, and what not! Their anonymous gabble is all about suns and moons, kings and queens, red bridegrooms and lily brides, flying birds, green dragons, ruby lions, virginal fountains, royal baths, waters of life, salts of wisdom. The seven metals correspond with the seven planets, the seven cosmical angels; and with the seven openings of the head, the eyes, the ears, the nostrils, and the mouth. Silver was Diana, gold was Apollo, iron was Mars, tin was Jupiter, lead was Saturn, and so forth. They had essential spirits so fine, that drop after drop let fall from the phial's lip did never one of them reach the ground. They prated for ever concerning the powder of attraction, which drew all men and women after the possessor; the alcahest; and the grand elixir, which was destined to confer immortal youth upon the student who should approve himself pure and brave enough to kiss and quaff the golden wavelet as it mantled over the cup of life, the fortunate Endymion of their fantastical mythology. There was the great mystery, the mother of the elements, the grandmother of the stars. There was the philosophers' stone, and there was the philosophical stone: the philosophical stone was younger than the elements, yet at her virgin touch the grossest calx among them all would blush before her into perfect gold. The philosophers' stone, on the other hand, was the first-born of nature, and older than the king of metals. In the famous dialogue of the 'Ancient War of the Knights,' he exclaims with fond remonstrance, 'Good God, my dear gold, I am older than you!'

Yet it was this wretched remnant of a great school that gave the earlier men of the present age its impression of alchemy! Now, visionaries of this

caste exist in 1851. There are actually a number of as genuine scientific fanatics as these, possessed by the very same fantasies, and using the self-same phraseology, astrological and pseudo-alchemical, in the Europe of the present day; but no one would ever think of according any historical significance to such a second nursery of innocents as that. Yet the sole difference between these poor creatures and the post-paracelsians of the seventeenth century, is to be found in the circumstance, that the latter had many temptations and opportunities to play the Dousterswivel; and accordingly many a queer imposture was then practised in the name of Aristotle, Gebir, or Raymond Lully. One might relate innumerable stories of that sort; but it is impossible to see how such narratives could be of the slightest use towards the right understanding of true and historical alchemy, from Friar Bacon to Paracelsus inclusive.

It is enough to notice the fact, that, after Paracelsus's protest against the intellectual methods of old alchemy, a multitude of weaklings continued to dream away their lives among the verbiage of an exhausted movement in all countries; while a race of sturdy, positive chemists were living to some useful purpose, and finding out all sorts of new chemical substances in preparation for the unpretending logic of a better day. The two streams, like the unmingling waters of the Soane and the Rhone, ran together a space side by side before dividing for ever: one of them to sink into the sands, like Arethusa, and be lost; the other to gather a hundred tributary streams, and come flowing right onwards. Alchemy has, accordingly, be it repeated, no historical meaning—one might almost say, no historical existence, after Paracelsus; just as the critical doctrine of Voltaire and the encyclopædists cannot boast of anything like a historical life in Europe after the close of the last century, although there are still men in Paris, Berlin, or London, who will swear by it to the last. Nor would the historian ever dream of illustrating the scepticism of the senses from the timid and feeble performances of those fond and lingering disciples of that inverted psychological alchemy of the eighteenth century: inverted alchemy, for its 'grand projection,' consisted in the attempt to transmute everything into nothing; reminding one of that unhappy votary of Rosicrucian vanity, who chronicled the sad result of all his life in one melancholy couplet—

> 'From out of nothing God fetched everything,
> But out of all poor I can nothing bring!'

Yet it appears, as has just been said, that the current notions of alchemy are drawn from the etiolated and partycoloured literary remains of those posthumous votaries of the spagiric mystery. It is from that too-questionable epoch, for example, that we have the story of a venerable stranger entering the famous city of Nobody-cares-what at eventide, in the gray month of November in the memorable year of 1600; of his inveigling the ingenuous son of his landlord into recondite talk anent the stone; about their going privily to a great rich goldsmith, and making a huge dollop of gold out of tin and lead with his utensils; of their selling it at a just price to the hospitable jeweller; and of the venerable rascal stealing out of the city before cock-crow with all the good money in his pocket. It was during the same period, in fact, that quackery and imposture abounded in con-

nection with mock-alchemy. It was then that ape-headed, nut-hearted, sly knaves easily found their dupes among fools in high places, as avaricious and ignoble as they were credulous. It was then, to take an instance, that the former scamps made up large nails, half of iron and half of gold, well joined together, and varnished with lacker, so as to pass for veritable tenpennies; and then that the latter equally wretched creatures opened their eyes with amazement, and their hands with greed, when they saw a good golden ingot extracted from plain pig-iron!

It was then, also, that the majority of the accessible alchemical tracts and treatises were compiled. The miserable anonymities who put them together generally inscribed the name of some grand authority upon these inane productions, to give them currency. They consisted for the most part of the wilder passages of the old masters, unaccompanied by any of their real knowledge and practical remark, mangled, inflated beyond bearing, and maddened by the poor cross-lights of the actual editors. The reader accordingly comes upon striking and even beautiful passages in some of those vile performances, which are frequently just so coherent, and no more, as to suggest the perception that there is a 'method in their madness.' For example, one of some score of masquerading Paracelsuses opens his creed with these words:—'All composed things are of a frail and perishing nature, and had at first but one only principle. In this all things under the cope of heaven were enclosed, and there they lay hid; which is thus to be understood—that all things proceeded out of one matter, and not every particular thing out of its own private matter by itself. This common matter of all things is the great mystery, which no certain essence or prefigurated idea could comprehend. Nor could it comply with any property, it being altogether void of colour and elementary nature. The scope of this great mystery is as large as the firmament. And this great mystery is the mother of all the elements; the grandmother of all the stars, trees, and carnal creatures.'

Such is the preamble of the book; but nothing follows; for the substance of the treatise is just this same preamble, with variations over and over again. The penman's science is like a street-organ of old and even elaborate construction; but all its tunes are gone dumb except this one; and for the life of him he can grind nothing out of it but the overture!

The only supposable method, of course, in which this common matter or great mystery could produce all the other bodies in nature, was a species of self-involution; a rolling of itself into this shape and that, so as to pass from the unity and monotony of chaos into the multiplicity and harmoniousness of creation. Such is probably the meaning of those passages in the later Hermetics, where it is said 'to kill itself—to espouse itself—to impregnate itself—to engender itself—to be born again of itself—to make itself red—to make itself white;' and so forth. Says the Stone to Gold in the 'Ancient War:' 'Aristotle says of me—We add nothing more to it, and we change nothing in it: Oh, how admirable is this thing which contains all things in itself!'

The modern chemist cannot escape the sense of surprise when, in connection with such extracts, he bethinks himself of the transformations of isomeric substances and the action of catalysis—two of the latest discoveries of importance in the science. For example, the gas cyanogen

is transmuted in certain circumstances into the solid substance paracyanogen. Nobody knows precisely the difference between them, considered from the chemical point of view. The colourless pungent gas and the tasteless brown solid, cyanogen and paracyanogen, are of the same chemical composition, notwithstanding of the fact, that their sensible and chemical properties are as distinct as possible. They both contain carbon and nitrogen in the proportion of 6 to 7. Cyanogen can be made into paracyanogen, and paracyanogen into cyanogen again. Cyanogen can literally be transmuted into paracyanogen, without either addition to or subtraction from its substance; for 'we add nothing more to it, we change nothing in it: Oh, how admirable is this thing (cyanogen) which contains that thing (paracyanogen) in itself!' Cyanogen in becoming paracyanogen 'kills itself, espouses itself, engenders itself, impregnates itself, is born again of itself, and makes itself' brown. Cyanogen may also be said to be convertible into at least other two substances. Cyanogen, the radical of fulminic acid, the radical of cyanuric acid, and paracyanogen are all composed of carbon and nitrogen in the ratio of 6 to 7. Yet these four bodies produce, by combination with oxygen, four acids as different from one another as they well could be, although they all contain carbon, nitrogen, and the newly-added oxygen in the same proportion—namely, carbon 6, nitrogen 7, and oxygen 4. In fact, these three things, the radicals of the fulminic and cyanuric acids, and paracyanogen, are only three of any possible number of isomeric forms of cyanogen; the resultants, that is, of the self-involution of that gaseous body. Cyanogen is the 'one only principle,' at all events, of those three quasi-elements or compound radicals. In cyanogen they were 'enclosed, and there they lay hid;' 'which is thus to be understood, that (these three) things proceeded out of one matter (cyanogen), and not' each of them 'out of its own private matter by itself.' Cyanogen, in short, is 'the great mystery' in relation to these three radicals, and in relation to all similar ones which may yet be discovered. And this great mystery, cyanogen, is the mother of those quasi-elements, fulminigen, cyanuren, and paracyanogen; the grandmother of fulminic, cyanuric, and paracyanic acids; of the fulminates, cyanurates, and paracyanates; and of all the thousand-and-one compounds proceeding from this great stock!

We could entertain the reader with such new glosses on old texts by the sheet; but space forbids. We must also omit all reference to the Roman de la Rose, the Chanon of Brydlington, and other Rosicrucian rhymes, although we have made some notes on both subjects, which are not without interest. It is now time to say a few decided words concerning alchemy proper, considered as one great movement of the human mind in Europe, by way of bringing these excursions to an end.

The true alchemists, then, while they were also diligent experimentalists in pharmaceutical and other practical chemistry, cherished three sacred beliefs and objects of enthusiastic hope, which we shall now arrange not in their historical, but in a convenient order.

I. They believed in the alcahest, or universal solvent. Taking that epithet, even in its most literal signification, it has simply to be stated, that modern chemistry has actually realised it. The element fluorine is nothing less than the alcahest. Lavoisier once expressed his surprise that it should

never have occurred to the masters that no vessel on earth could hold the universal solvent, because it would solve the vessel too! That is precisely the difficulty to contend with in the attempt to isolate fluorine. It is a good many years now that it has been well understood by chemists that Derbyshire spar is composed of calcium—the metal of which quicklime is the rust or oxide—and of fluorine, another element, the latter of which ingredients could not be presented separate, just because no substance could withstand the intensity of its chemical action. No one doubted the existence of fluorine—thanks to Davy's discovery of iodine, and the sagacity of Ampère—notwithstanding of the circumstance that it could not be handled and seen, owing to its irresistible powers of solution. It at length occurred to two brothers of the name of Knox, that vessels cut out of fluor-spar itself, seeing it is a substance already saturated with fluorine, might serve the purpose of catching some fluorine in; and their experiments have been in a great degree successful. Faraday has also experimented on this subject. Fluorine seems to be an orange-coloured gas; chlorine is a green gas; iodine is a solid at ordinary temperatures, but a gentle heat converts it into a deep purple vapour. Bromine is liquid, and resembles iodine vapour when in the gaseous state; but it is more ruddy than purple. These four elements are deeply connected with one another; but be that connection what it may, and even suppose that fluorine has not yet been separated in the state of absolute chemical purity, it cannot be denied that there lies the alcahest of old alchemy.

II. They believed in the transmutability of the metals; it has already been seen on what kind of grounds. The idea of transmutation, stripped of all particularity of form, is as old as Thales and recent as Davy, to profane this page with no meaner name. In one shape or another, it is ineradicable from the instincts of the science. It is hardly necessary to add, that if any one element were satisfactorily converted into any other, this the second problem of alchemy were solved as well as the first. It is enough to observe that such a thing is being prosecuted with ardour and conviction in the present day. *Festina lentè!*

III. Those European alchemists also believed in the elixir of life, or universal medicine, capable of curing all curable diseases, and of prolonging life long beyond its present average of duration. It was not till the dotage of alchemy that the conception of an elixir of immortality amused the world. In connection with this unattainable ideal of theirs, it has just to be mentioned that Lord Bacon and Descartes, who are always regarded as the Castor and Pollux of that luminous epoch of science which extinguished the mediæval schools, were quite as much bent upon the invention of means for the prolongation of life as any alchemist of them all. We have already seen that the French methodologist actually supposed himself to have added a few hundred years to existence; and anybody that has read Bacon's precepts on the subject, will testify that the elixir-hunters could not exceed him either in the largeness of his expectations or in the absurdity of his plans. Neither is it very easy at first sight to perceive the practical superiority of the successive medical schemes of Stahl, Boerhaave, Cullen, Broussais, and the rest of the modern doctrinaries, over those equally successful and more poetical dreamers. If a scientific spectator may judge from the recent writings of certain of our own physicians—

from the articles and letters, for example, of Dr Forbes, the editor of the 'British and Foreign Medical Review,' of the late Dr Andrew Combe, and of a host of anonymous abettors of these able men, the predominant school of physic appears to be coming to the conclusion, that it can scarcely do better than go back to the time of Hippocrates, sit a while at his feet, and begin afresh. It is the very counsel which poor Paracelsus thundered into the astonished and insulted ears of his contemporaries.

Such, then, was alchemy; such the heaven, the horizon, and the neighbourhood of the third of the ancestors of the modern chemist. To the man of the nineteenth century, it must always be interesting to grope away back into those dim and spectral regions of scientific development. Were circumstances favourable, we should be glad to accompany the student into some of the more quaint and questionable of those recesses of the past. We should visit the weak as well as the strong; for there were the weaker brethren in those religious days of science as well as now. What buried figures we should descry, intent with sweating brains upon the last projection; what minglings of the glare of the furnace with the unearthly glow of a magnificent, but misdirected spirit of enthusiasm; what perilous balancings of the spirit between the dread extremes of imposture and insanity; what thin lights and solid shadows we should behold in the murkier hours of that merely starlit night of history; what agonies of mind and heart! Ideals how sublime, realities how paltry! It was their lifelong struggle, to bring a lofty but imperfect theory of nature into effective unison with the inflexible phenomena of the world of facts. They did not succeed, and they have passed away. Peace be with them; for alas! the life of the visionary is the same feverish, uncalculating, unsatisfying, weary, and maddening discipline in all ages; and there are as many of those not unlovely maniacs in the epoch of Chancellor Bacon and Humboldt as ever there were in that of Friar Bacon and Paracelsus.

The history of chemistry, subsequently to the apotheosis of the alchemical epoch, was not without its extravagances; but it became remarkable for the unprecedented rapidity with which the accumulation of facts procceded. In the hands of the practical chemists, who have already been alluded to as the legitimate successors of the alchemists-proper, the science became more unreservedly directed to the positive labours of the laboratory; and there rapidly ensued a very remarkable extension of the boundaries of concrete or practical chemistry. Hence the great multiplication of chemical substances, experimental apparatuses, and new processes, that succeeded the euthanasy of alchemy. Stones and rocks, earths and ashes, ores and meteors and lavas of every species, were triturated, lixiviated, roasted, ignited, dissolved in acids, crystallised, precipitated. It was soon perceived that there is one not only salt, one elemental salt, but an endless variety of salts: oil-of-vitriol salts, aqua-fortis salts, spirit-of-salt salts, earthy salts, alkaline salts, metallic salts, and so forth. There were forthwith found to be more metals than seven, the seven planets and holes in the human head notwithstanding. These were discriminated the mineral, the vegetable, and the volatile alkalis. At length a great chemical principle began to dawn in the midst of all these gathering and crowding details, like the gleam of untouched phosphorus in the dark. In short, the

new chemists began to surmise that the chemical act of burning, or the process of combustion, as it is now called, is a process of first-rate importance and significance in the science of chemistry. They descried that the right explanation of the burning of wood, of brimstone, of anything, in fine, that is susceptible of combustion, would reveal a critical secret of this department of knowledge. It was the distinct perception of this, and the invention of a hypothesis or theory of combustion, that constituted, or rather consummated, the new movement, and fairly consolidated a new epoch of chemical development. Beccher and Stahl were the patriarchs of this great school—the former as the inventor, the latter as the illustrator of the doctrine of phlogiston; a doctrine which sufficed for the needs of the growing science nearly a hundred years. They observed that the common phenomenon of combustion concealed within its glowing bosom one of those central or fontal facts, on the discovery of which the history of science is continually turning. Pursuing this clew, which the reader of this outline will now recognise as older than the time of Aristotle, although never laid firmly hold of until that of Beccher, they generalised the phenomenon itself in the first place. Their metals, with the quite intelligible exceptions of gold and silver, were changed into rusts or calces, or artificial ores, resembling chalk-powder or brick-dust when heated in exposure to the air of the fire; and this change they perceived to be identical with what is passed upon brimstone, phosphorus, or any other ordinary combustible when it burns with flame. Indeed, the metal tin burns with a surrounding glow, which resembles flame so closely as to have hinted the rest of the secret; no secret now-a-days, since we have metals which take fire when thrown into water, and since we burn iron-wire in oxygen like a wax-match in the air; but a great attainment for the day, or rather the morning twilight, in which it was first made. Thus, then, in brief, was the whole science of chemistry, as it then stood, classified under two distinct and intelligible parts: the study of bodies before combustion, and that of bodies after combustion, implying of course the study of the vital act of combustion itself; a very true and useful division so far as it reached, and certainly most important for the exigencies of the epoch. The chaos of chemical fact was thereby reduced to intellectual order, and made to revolve round one great phenomenon as a centre. Similar things were brought together in spite of apparent dissimilarity, while unlike things were duly separated, notwithstanding of superficial resemblances, and a genuine reformation or new creation was fairly begun, with amazing sagacity and intelligence. It is surely difficult to understand how men like Dumas and Liebig (to name no smaller names) can content themselves with asserting that chemistry began with Lavoisier, except by supposing them wholly destitute of the historical sense, and incapable of seeing that their own rockfast-Lavoisierianism is also doomed; not indeed to be overthrown (for nothing that is partly true can ever be wholly overthrown), but superseded just as completely as phlogiston, alchemy, or polypharmacy. It would be quite as rational for a geologist to date the origin of the visible world from the tertiary series, or the diluvial beds of Paris and London, as to trace the rise of chemistry no farther back than the great Parisian lawgiver of the science.

But the old chemists of whom we now speak were of course not satisfied

with the discovery of the true analogy that exists between the metallic calces and the acids, and their consequent new classification of bodies; but they proceeded to interpret the phenomenon of combustion itself, that seemingly sole and singular agent of chemical transformations. Nor was an interpretation far to seek, although it required astonishing ingenuity to apply it right and left, so as to compact the rude and disjected members of a growing chemistry into one luminous body of scientific thought. It has already been hinted that Greece has ever been the Ariadnè to furnish our sturdy, erratic, and triumphant European Theseus with the clew to the labyrinth it behoves him from time to time to penetrate. The notion that fire is an actual and substantial, though subtile element of nature, was first kindled by Empedocles long centuries before Christ: before it was handed over to the Arabians, it had begun to flicker, and it played a very small part in their doctrine: brought back to Europe, and fanned by the scholastic philosophy, it shot up its flames once more; but it was now destined to quicken the whole mass of chemistry; and impart that *callida junctura*, or glowing unity to all its parts, of which they again stood more in need than ever. The matter of fire was at length set apart and consecrated under the illustrious name of phlogiston.

It is impossible to prosecute this interesting subject any further in the present connection. Having fairly traversed the epoch of chemical history ostensibly under consideration, and having even crossed the boundary which separates it from its immediate successor, we leave the greater part of the story untouched. Suffice it that an affectionate yet critical study of the successive schools, and their respective leaders, would certainly prove as interesting as that of the Greeks, the Arabians, and the European alchemists; while it might be still more instructive. The phlogistians, the pneumatic chemists, the Lavoisierians, the atomicians, the electro-chemists, and the votaries of the new organic chemistry, have all brought us their proper trophies and treasures; and the investigation of their several histories and characteristics could not fail to be fraught with the noblest lessons of courage, perseverance, and devotion.