A general view of the nature and objects of chemistry and its application to arts and manufactures / by William Henry.

A

GENERAL VIEW

of the

NATURE AND OBJECTS

of

CHEMISTRY,

and of its

APPLICATION

to

ARTS AND MANUFACTURES.

BY

WILLIAM HENRY,

MEMBER OF THE ROYAL MEDICAL, AND NATURAL HISTORY SOCIETIES
OF EDINBURGH;
OF THE CHEMICAL SOCIETY OF JENA, IN SAXONY;
AND OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF MANCHESTER.

Manchester,
PRINTED BY R. AND W. DEAN, No. 9, SPRING-GARDENS;
for
J. Johnson, 72, St. Paul's Church Yard, London.

1799.

ADVERTISEMENT.

THE following pages contain the substance of an introductory address to a course of chemical lectures, delivered in Manchester, during the last winter. As it is my intention to repeat these lectures, it may be satisfactory to some persons, to receive fuller information respecting their objects and plan, than can be conveyed within the compass of a newspaper advertisement. To others at a distance, it has been thought by a few friends, for whose judgment I have the highest respect, that this pamphlet may be acceptable, from its affording a more ample detail, than has perhaps been hitherto published, of the general uses and applications of chemistry.

Manchester, Nov. 21, 1799.

ERRATA.

Page 6, line 9, before *for*, place a semicolon.
10, — 7, after *clouds*, insert a comma.
16, — 10, after *analogy*, place ?
20, — 14, after *Chemistry*, place ?
33, — 14, dele *there*.
34, — 18, 19, for *possess-selves*, read *possessing themselves*.
21, for *selzes*, read *selves*.
36, — 12, for *opposite*, read *apposite*.
40, — 19, for *earthly*, read *earthy*.
42, — 12, for *latter*, read *former*.

A

GENERAL VIEW,

&c.

THE custom has been so long established of prefacing a course of Lectures with the History of the Science which is their subject, ~~that~~ it may be necessary to state, briefly, the reasons that have induced me to depart from this unvaried usage.

The History of Chemistry may either be a mere history of the science, that is, of the gradual developement of the facts and doctrines of which

which the science is composed, or it may comprehend, also, the biography of Chemists. The detail of the progress of discovery, however, concerning particular objects of chemical research, would certainly be premature at so early a period of the course. Respecting Chemists themselves, little can be said, at present, that can contribute to information or amusement; for their lives, devoted to the abstract pursuits of science, have seldom been productive of events, that are suited to awaken or gratify general curiosity. Our interest, indeed, respecting philosophers, is seldom excited, unless by a knowledge of the additions they have made to the facts or theories of a science; and with these a Lecturer may fairly presume, however the fact may really be, that his hearers, at the commencement of a course, are wholly unacquainted. It may be added, that the History of Chemistry admits of little illustration from experiment; and I shall always be reluctant to bestow time on those subjects, which, requiring

quiring not the aid of an appeal to the senses, are equally well adapted for private study.

On these grounds, therefore, I hope to be excused for infringing the general plan of Lectures on Chemistry, and devoting, to other purposes, the time that would have been allotted to the history of the science. For this, will be substituted, a brief view of the nature and objects of Chemistry—of its connection with the arts, and with other sciences—and an outline of the plan on which the following Lectures will be conducted.

NATURAL PHILOSOPHY, in its most extensive sense, is a term comprehending every science, that has for its objects the properties and affections of matter. But it has attained, by the sanction of common language, a more limited signification; and chemistry, tho' strictly a branch of natural philosophy, is generally re-

garded

garded as a distinct science. Between the two, it may, perhaps, be difficult to mark out precisely the line of separation: but, an obvious character of the facts of natural philosophy, is, that they are always attended with sensible motion; and the determination of the laws of motion, is peculiarly the office of its cultivators. Chemical changes, on the other hand, of the most important kind, often take place without any apparent motion, either of the mass, or of its minute parts; and where the eye is unable to perceive that any change has occurred. The laws of gravitation, of central forces, and all the other powers that fall under the cognizance of the natural philosopher, produce, at most, only a change of place, in the bodies that are influenced by them. But, in chemical changes, we may always observe an important difference in the outward properties of things. Two highly corrosive substances, by uniting chemically together, may become mild and harmless; the combination of two colourless substances

may

may present us with a compound of brilliant complection; and the union of two fluids, with a compact and solid mass.

Chemistry, therefore, may be defined that Science, whose object is to discover and explain the changes of composition, that occur among the integrant and constituent parts of bodies.

From this definition, it may readily be conceived how wide is the range of chemical enquiry; and by applying it to the various events that daily occur in the order of nature, we shall be enabled to separate them with accuracy, and to allot, to the sciences of Natural Philosophy and Chemistry, the proper objects of the cultivation of each. Whenever a change of place is a necessary part of any event, we shall call in the aid of the former. When this condition may be dispensed with, we shall re-

sort

sort to Chemistry for the light of its principles. But it will be often found, that the concurrence of the two sciences is essential to the full explanation of phenomena. The water of the ocean, for example, is raised into the atmosphere by its chemical combination with the matter of heat; but the clouds that are thus formed, maintain their elevated situation, by virtue of a specific gravity, less than that of the lower regions of the air, a law, whose discovery, and application, are due to the natural philosopher, strictly so called.

Chemistry may be considered in two views; firstly, as a Science, that is, as a collection of general principles, or general laws, under which are arranged individual facts; and secondly as an Art, instructing us in the practical use and application of these laws to the purposes of common life.

The

The possession of its general principles, enables us to comprehend the relation to each other, of a great variety of events, that form a part of the established order of the universe, and of which we are only spectators, devoid of all power of directing or changing them.—That knowledge, it may be objected, however, can be of little utility, which does not enable us to alter, in the minutest circumstance, the fixed and immutable succession of things. But the indulgence of an enlightened and liberal curiosity, is surely no mean reward of the attainment of knowledge; and the mind is not only gratified, but improved in its moral views, by tracing the connection and dependencies of all the lesser parts, that fill up the great plan of Providence.

The class of natural events, that call for the explanations of chemical science, is of very considerable magnitude; and the Natural Philosopher (using this term in its common acceptation)

tation) is wholly incompetent to unfold their connection. He may explain, for example, on the principles of his own science, the annual and diurnal revolutions of the earth, and part of the train of consequences depending on these rotations. But here he must stop, and the Chemist must trace the effects, on the earth's surface, of the heat and light derived from the sun; the absorption of heat by the various bodies on which it falls; the consequent fluidity of some, and volatilization of others; the production of clouds, and their condensation in the form of rain; and the effects of this rain, as well as of the sun's heat, on the animal, vegetable, and mineral kingdoms. In these minuter changes, we shall find, there is not less excellence of contrivance, than in the stupendous movements of the planetary system. And they even interest us more nearly, because, tho' not more connected with our existence or comforts, yet they occur more within our sphere of observation, and our acquaintance with

their

their laws, admits of a more direct application to human affairs.

But the science of Chemistry demands respect and attention, on grounds that are more likely to ensure them, even than the indulgence of an enlightened curiosity; for it is capable of ministering to our wants and our luxuries, and teaches us to convert, to the purposes of common life, many substances, which nature presents to us in a rude and useless form. The extraction of metals from their ores; the conversion of the rudest materials into the beautiful fabrics of glass and porcelain; the production of wine, ardent spirits, and vinegar; and the dying of linen and woollen manufactures, are only a few of the arts that are dependent on Chemistry for their improvement, and, even for their successful practice.

It cannot, however, be denied, that all the arts, which have been mentioned, were practised in times, when the rank of Chemistry as a science was very degraded; and that they are daily the employment of unlettered and ignorant men.—But to what does this confession amount, and how far does it prove the independence of the above arts on the science of Chemistry?

The skill of an artist is compounded of knowledge and of manual dexterity. The latter, it is obvious, no science can teach. But the acquirement of experience,—in other words, a talent for accurate observation of facts, and the habit of arranging facts in the best manner, may be greatly facilitated by the possession of scientific principles. Indeed, it is hardly possible to frame rules for the practice of a chemical art, or to profit by the rules of others, without an acquaintance with the general doctrines of the science. For in all rules it is implied, that

the

the promised effect will only take place, when circumstances are precisely the same, as in the case under which the rule was formed. To insure an unerring uniformity of result, the substances employed in chemical processes, must be of uniform composition and excellence; or when it is not possible to obtain them thus unvaried, the artist should be able to judge precisely of the defect or redundancy, that he may proportion his agents according to their qualities. Were chemical knowledge more generally possessed, we should hear less of failures and disappointments in chemical operations; and the artist would commence his proceedings, not as at present, with distrust and uncertainty, but with a well grounded expectation of success.

No one will be presumptuous enough to contend, that any art has hitherto attained the extent of its possible perfection. In all there is yet a wide scope for improvement, and an extensive

extensive range for ingenuity and invention. But from what class of men are we to expect useful discoveries? Are we to trust, as hitherto, to the favour of chance and accident, —to the fortuitous success of men not guided in their experiments by the light of any principles? Or shall we not rather endeavour to inform the artist, and to induce him to substitute, for vague and random conjecture, the torch of induction, and of rational analogy? In the present imperfect state of his knowledge, the artist is even unable fully to avail himself of those fortunate accidents, by which improvements sometimes occur in his processes, because, to the eye of common observation, he has acted agreeably to established rules, and has varied in circumstances, which he can neither perceive nor appreciate. The man of science, in these instances, sees more deeply, and by availing himself of a minute and fortuitous difference, contributes at once to the promotion of his own interest, and to the amendment of his art.

But

various operations of nature -

p. 21 -

But it is the union of theory with practice, that is now contended for. "And when theo- "retical knowledge and practical skill, are "happily combined in the same person, the "intellectual power of man appears in its full "perfection; and fits him equally to conduct, "with a masterly hand, the details of ordinary "business, and to contend successfully with "the untried difficulties of new and perplexing "situations. In conducting the former, mere "experience may frequently be a sufficient "guide, but experience and speculation "must be combined, to prepare us for new "combinations of circumstances."* "Expert men," says Lord Bacon, "can execute and "judge of particulars one by one; but the "general counsels, and the plots, and the mar- "shalling of affairs, come best from those that "are learned."

This

* Stewart's Elements of the Philosophy of the Human Mind.

This recommendation to artists of the acquirement of scientific knowledge, is happily sanctioned by the illustrious success in our days of the application of theory to the practice of certain arts. Few persons are ignorant of the benefits, that have resulted to the manufactures of this country, from the inventions of Mr. Watt and Mr. Wedgwood; both of whom have been not less benefactors of philosophy, than eminent for practical skill. The former, by a clear insight into the doctrine of latent heat, ~~resulting, in a great measure, from his own acuteness~~ and patience of investigation, and seconded by an unusual share of mechanical skill, has perhaps brought the Steam Engine to its acme of perfection. Mr. Wedgwood, aided by the possession of extensive chemical knowledge, made rapid advances in the improvement of the art of pottery, and, besides raising himself to great opulence and distinction, has created, for this country, a source of most profitable and extensive

sive industry. In an art, also, which is nearly connected with the manufactures of our own town, and the improvement of which must therefore "come home to our business and bosoms," we owe unspeakable obligations to two speculative Chemists—to Scheele, who first discovered the Oxygenated Muriatic Acid; and to Berthollet, who first instructed us in its application to the art of bleaching.

Examples, however, may be urged against indulgence in theory; and instances are not wanting, in which the love of speculative refinement has withdrawn men entirely from the straight path of useful industry, and led them on gradually to the ruin of their fortunes. But from such instances, it would be unfair to deduce a general condemnation of theoretical knowledge. It would be the common error of arguing against things that are useful, from their occasional abuse. In truth, projects

which

which have, for their foundation, a dependance on chemical principles, may be undertaken with a more rational confidence, than such as have in view the accomplishment of mechanical purposes; because, in Chemistry, we are better able, than in Mechanics, to predict, from an experiment on a small scale, the probable issue of more extensive attempts. No one, from the successful trial of a small machine, can affirm, with unfailing certainty, that the same success will attend one on a greatly enlarged plan: For the amount of the resistances, that are opposed to motion, increases often in a ratio greater than, from theory, could ever have been foreseen. But the same law, by which the mineral alcali is extracted from a pound of common salt, must equally operate on a thousand times the quantity; and even when we augment our proportions in this great degree, the chemical affinities, by which so large a mass is decomposed, are exerted only between very small particles. The failures of the mechanic, therefore, arise from the nature

of

of things; they occur, because he has not in his power the means of foreseeing and calculating the causes that produce them. But if the Chemist fail in perfecting an œconomical scheme on a large scale, it is either because he has not sufficiently ascertained his facts on a small one, or has rashly embarked in extensive speculations, without having previously ensured the accuracy of his estimates.

The benefits, we are entitled to expect from the efforts of the artist, and the man of science, united in the same character, and at the same time tempered and directed by prudential wisdom, affect not only individual, but national prosperity. To the support of its distinction, as a commercial nation, this country is to look for the permanency of its riches, its power, and, perhaps, even of its liberties: And this pre-eminence is to be maintained, not only by local advantages, but on the surer ground of superiority in the productions of

its arts. Impressed with a full conviction of this influence of the sciences, our neighbours and rivals, the French, offer the most public and respectful incitements to the application of theory in the improvement of the chemical arts; and with the view of promoting this object, national institutions have been formed among them, which have been already, in several instances, attended with the most encouraging success. It may be sufficient, at present, to mention as an example, that France has supplied, from her own native resources, her enormous, and, perhaps, unequalled, consumption of nitre.

The general uses of Chemistry have been thus fully enlarged upon; because it is a conviction of the utility of the science, that can alone recommend it to attentive and persevering study. It may now be proper, to point out, in detail, a few of its more striking applications.

I. The

I. The art which is of all others most interesting, from its subserviency to wants that are interwoven with our nature, is Agriculture, or the art of obtaining, from the earth, the largest crops of useful vegetables, at the smallest expence.

The vegetable kingdom agrees with the animal one, in the possession of a living principle. Every individual of this kingdom is regularly organized, and requires for its support an unceasing supply of food, which is converted, as in the animal body, into substances of various forms and qualities. Each plant has its periods of growth, health, disease, decay, and death, and is affected, in all these particulars, by the varying condition of external circumstances. A perfect state of agricultural knowledge would require, therefore, not only a minute acquaintance with the structure and economy of vegetables, but with the nature and effects of the great variety of external agents, that contribute

to their nutriment, or influence their state of health and vigour. The former attainment, it can hardly be expected, will ever be generally made by practical farmers; and it is in bringing the agriculturist acquainted with the precise composition of soils and manures, that Chemistry promises the most solid advantages. Indeed, any knowledge that can be acquired on this subject, without the aid of chemistry, must be vague and indistinct, and can neither enable its possessor to produce an intended effect with certainty, nor be communicated to others in language sufficiently intelligible. Thus we are told by Mr. Arthur Young, that in some parts of England, any loose clay is called marl, in others marl is called chalk; and in others clay is called loam. From this confused application of terms, all general benefits of experience in agriculture must be greatly limited.

Chemistry may, to agriculturists, become an

an universal language, in which the facts, that are observed in this art, may be so cloathed, as to be intelligible to all nations and ages. It would be desirable, for example, when a writer speaks of clay, loam, or marl, that he should explain his conception of these terms, by stating the chemical composition of each substance expressed by them. For all the variety of soils and manures, and all the diversified productions of the vegetable kingdom, are capable of being resolved, by chemical analysis, into a small number of elementary ingredients. The formation of a well-defined language, expressing the proportion of these elements, in the various soils and manures now so vaguely characterised, would give an accuracy and precision, hitherto unknown, to the experience of the tillers of the earth.

It has been said, by those who contend for pure empiricism in the art of agriculture, that it has remained stationary, notwithstanding all improvements

improvements in the sciences, for more than 2000 years. "To refute this assertion," says Mr. Kirwan, "we need only compare the writings of Cato, Columella, or Pliny, with many modern tracts, or, still better, with the modern practice of our best farmers." "If the exact connection of effects with their causes," he adds, "has not been so fully and extensively traced in this as in other subjects, we must attribute it to the peculiar difficulty of the investigation. In other subjects, exposed to the joint operation of many causes, the effect of each, singly and exclusively taken, may be particularly examined, and the experimenter may work in his laboratory with the object always in his view. But the secret processes of vegetation take place in the dark, exposed to the various and indeterminable influences of the atmosphere, and require, at least, half a year for their completion. Hence the difficulty of determining on what peculiar circumstance success or failure depends; for the diversified experience of many years can alone

afford

afford a rational foundation for solid, specific conclusions."*

II. To those who study MEDICINE as a branch of general science, or with the more important view of practical utility, Chemistry may be recommended with peculiar force and propriety.——The animal body may be regarded as a living machine, obeying the same laws of motion as are daily exemplified in the productions of human art. The arteries are long, flexible, and elastic canals, admitting, in some measure, the application of the doctrine of Hydraulics; and the muscles are so many levers, of precisely the same effect, with those which are employed to gain power in mechanical contrivances. But there is another view, in which, with equal justice, the living body may be contemplated. It is a laboratory, in which are constantly going forwards processes of various kinds, dependent on the operation of chemical affinities. The conversion of the various

* See Kirwan on Manures.

various kinds of food into blood, a fluid of comparatively uniform composition and qualities; the production of animal heat by the action of the air on that fluid, as it passes thro' the lungs; and the changes, which the blood afterwards undergoes in its course through the body, are all exclusively subjects of chemical enquiry. To these, and many other questions of physiology, Chemistry has of late years been applied with the most encouraging success; and it is to a long continued prosecution of the same plan, that we are to look for a system of physiological science, which shall derive new vigour and lustre from the passing series of years. It would be easy to enlarge on this subject, but there are others more generally interesting, and to them, therefore, let us hasten.

III. There is an extensive class of arts, forming, when viewed collectively, a great part of the objects of human industry, which do

do not, on a loose and hasty observation, present any general principle of dependency or connection. But they appear thus unconnected, because we have been accustomed to attend only to the productions of these arts, which are, in truth, subservient to widely different purposes. Who would conceive, for instance, that iron and common salt, the one a metal whose use results from its hardness, ductility, and malleability, the other a substance chiefly valuable from its acting as a preservative and seasoner of food, are furnished by arts alike dependent on the general principles of Chemistry. The application of science, in discovering the principles of these arts, constitutes what has been termed Œconomical Chemistry; amongst the numerous objects of which, the following stand most distinguished:

1stly. Metallurgy, or the act of extracting metals from their ores, comprehending that of assaying, by which we are enabled to judge,

from the composition of a small portion, of the propriety of working large and extensive strata. To the metallurgist, also, belong the various modifications of the metals when obtained, and the union of them together, in different proportions, so as to afford compounds adapted to particular uses. Throughout the whole of this art, much practical knowledge may be suggested by attention to the general doctrines of Chemistry. The artist may receive useful hints respecting the construction of furnaces for the fusion of ores and metals; the employment of the proper fluxes; the utility of the admission or exclusion of air; and the conversion to useful purposes of the refuse of his several operations. When the metals have been separated from their ores, they are to be again subjected to various chemical processes. Cast or pig iron is to be changed into the forms of wrought or malleable iron and of steel. Copper, by combination with zinc or tin, affords the various compounds of brass, pinchbeck, bell-metal, gun-metal, &c. Even the art of printing owes something of its

present

present unexampled perfection to the improvement of the metal of types.

2dly. Chemistry is the foundation of those arts that furnish us with saline substances, an order of bodies highly useful in the business of common life. Amongst these, the most conspicuous are, sugar in all its various forms; the vegetable and mineral alkalis, known in commerce by the names of potash, pearlash, and barilla; common salt; green and blue vitriol, and alum; nitre or saltpetre; sugar of lead; borax; and a long catalogue, which it is needless to extend farther.

3dly. The manufacturer of Glass, and of various kinds of pottery and porcelain, should be thoroughly acquainted with the nature of the substances he employs; with their fusibility, as affected by difference of proportion, or by the admixture of foreign ingredients;

with

with the means of regulating and measuring high degrees of heat; with the principles on which depend the hardness of his products, and their fitness for bearing the vicissitudes of heat and cold; and with the chemical properties of the best adapted colours and glazings.—Even the humble art of making bricks and tiles, has received from the chemical knowledge of Bergman, the addition of several interesting facts.

4thly. The preparation of various kinds of fermented liquors, of wine, and ardent spirits, is intimately connected with chemical principles. Malting, the first step in the production of some of these liquors, consists in the conversion of part of the grain into saccharine matter, essential in every instance to the success of the fermentative change. To acquire a precise acquaintance with the circumstances that favour or injure the process of fermentation, no small share of chemical knowledge is

required

required. The ~~brewer~~ should be able to ascertain, and regulate exactly, the strength of his infusions, which will vary greatly when he has seemingly followed the same routine. He should be aware of the influence of minute changes of temperature in retarding or advancing fermentation; of the means of promoting it by proper ferments; and of the influence of the presence or exclusion of atmospherical air. A complete acquaintance with the chemical principles of his art, can hardly fail to afford him essential aid in its practice.

The production of ardent spirits, is only a sequel of the vinous fermentation, and is therefore, alike dependent on the doctrines of Chemistry.

5thly. The arts of bleaching, dyeing, and printing, are throughout a tissue of chemical operations. It is not unusual to hear the new

mode

mode of bleaching, distinguished by the appellation of the chemical method; but it is, in fact, not more dependent on the principles of this science, than the one which it has superseded, nor than the kindred arts of dyeing, and printing. In the instance of bleaching, the obligation due to the speculative Chemist is universally felt and acknowledged. But the dyer and printer have yet to receive from the philosopher, some splendid invention, which shall command their respect, and excite their attention to chemical science. From purely speculative men, however, much less is to be expected, than from men of enlightened experience, who endeavour to discover the design and reason of each step in the processes of their arts, and fit themselves for more effectual observation of particulars, by diligently possessing themselves of general truths.

The objects of enquiry that present themselves to the dyer and printer, are of considerable

rable number and importance. The preparation of goods for the reception of colouring matter; the application of the best bases, or means of fixing fugitive colours; the improvement of colouring ingredients themselves; and the means of rendering them permanent, so that they shall not be affected by soap, or by the accidental contact of acids, or other corrosive bodies; are amongst the subjects of chemical investigation. It is the business of the dyer, therefore, to become a Chemist; and, he may be assured, that even if no brilliant discovery should be the reward of the acquisition, he will yet be better fitted by it for conducting common operations, with certain and unvaried success.

Many other chemical arts might be mentioned; but enough, I trust, has been said to evince the connection between practical skill, and the possession of scientific knowledge. I shall now proceed to ~~develope~~ the

the plan on which the following ~~course of~~ Lectures will be conducted.

So much has been said of the importance of Chemistry in promoting the improvement of the arts, that ~~the Lectures~~, which are now to be delivered, may, perhaps, be expected to point out, in detail, all the practical uses that may be made of the doctrines of this science. Such, however, is not the purpose of the present course, which will be limited in its objects, to the general principles of the science only, and their illustration, by the most ~~oppo-~~ ~~site~~ facts. It would be a tedious and useless labour, to enter at present into all the minuteness of technical description; for the mind requires to be well grounded in the general truths of a science, before it can successfully direct them to the advantage of the arts. Thus, before any proficiency can be made in the arts of Navigation, Tactics, Surveying, ~~&c.~~, the general principles of mathematics must

must first be clearly apprehended. Just so in Chemistry:—A full and accurate knowledge must be gained of its principles, before any practical benefits can result from the attainment; and to the artist, who attentively studies this science, many applications of its doctrines will occur, without their being specifically pointed out. At some future period, however, it will, perhaps, be the object of a distinct course of Lectures, to trace the various useful applications of Chemistry, especially in those arts, that are most interesting from their connection with the manufactures of this town.

There are two methods of delivering the general doctrines of Chemistry, and the facts connected with them. The one consists in an historical detail of the gradual progress of the science; and, in pursuing this plan, we follow the natural progress of the human mind, ascending from particular facts, to the establishment of general truths. But a strong objec-

tion to its adoption is, that we are thus led into a minuteness of detail, that is ill suited to the plan of elementary Lectures. In the other mode of arrangement, we neglect wholly the order of time in which facts were discovered, and class them under general divisions, so framed, as to assist the mind in apprehending and retaining the almost infinite variety of particular truths. The latter method appears most eligible, and I shall begin, therefore, with the exposition of those principles, that are most extensively concerned in the production of chemical effects.

Attraction, or affinity, is the great cause of all chemical changes; and has, therefore, the first claim to attentive consideration. Next to that of attraction, the influence of heat, over the forms and qualities of bodies, is the most generally observed fact; and as this is a power, that often counteracts chemical affinity, there is the more propriety in contrasting the operation

ration of the two. The phenomena and laws of heat, will conduct, naturally, to the great source or reservoir of it, which will be traced to a class of bodies, agreeing, in many properties, with the air of our atmosphere, and called airs and gasses. These gasses, we shall find, consist partly of solid gravitating matter, and partly of an extremely subtile fluid, which impresses on our organs the sensation of heat, and is termed Caloric. When the solid ingredients of these gasses, usually called their bases, combine together or with other bodies, Caloric is given out, and new compounds formed. And as the gaseous bases, are, generally speaking, simple or elementary substances, the consideration of the gasses, in ~~this~~ at an early period of the course, will be strictly conformable to the plan of beginning with simple substances, and proceeding gradually to the more complex. In treating of compound substances, those will first come under our review, that are formed by the action of the gasseous bases on each other, as water and the alcalis.

We

We shall then be prepared to understand the most remarkable qualities of various other elementary bodies, which qualities appear generally in their action on the gasses. Thus, for example, the most remarkable property of sulphur, is its forming with the basis of oxygene gas, the sulphuric acid, or oil of vitriol. As the acids are a very important class of the objects of Chemistry, they will be introduced early in the course; and their effects will be exhibited and explained on the bodies which may have been already described; reserving the display of their action, on other substances, till these come to be separately considered. In treating of the sulphuric acid, for example, its relation to water and the alkalis only, will be then described; for it would be unseasonable to detail its effects on metallic and earthy bodies, before that class of substances has been specifically discussed.

Having dismissed the consideration of such elementary

elementary bodies, as are distinguished by affording acids when combined with oxygen; of the properties of the acids thus generated; and of the compounds afforded by the union of acids with alkalis, two interesting divisions of elementary substances will next claim our attention, viz. the earths and the metals. In the introduction of the earths before the metals, I have been influenced by reflecting, that the natural history of the latter, of which it will be proper to present a general view, cannot be well understood, till that of the earths has been fully developed.

The more complex productions of the vegetable and animal kingdoms, will be the next step in our progress thro' the science. The economy of the vegetable tribes, has, of late years, received so much elucidation from Chemistry, that it would be unpardonable to omit an account of the functions and productions of vegetable life, especially as this is a subject of extensive utility, from its connection with

agricultural

agricultural improvement. The course will be concluded by a view of the chemistry of the animal creation, and of the beautiful connection and subserviency to each other, of the vegetable and animal kingdoms.

For the exclusive adoption of the new doctrines of Chemistry, and of the nomenclature connected with them, no apology is necessary. Every one who will be at the pains of attentively comparing the new with the old theory, I can venture to predict, will prefer the lucid arrangements and precision of the ~~latter~~ former, to the confused order and illogical inferences of the phlogistic sect. From those who have been in the habit of teaching Chemistry, both before and since the revolution in this science, we have the strongest testimony, that the labour of acquiring a knowledge of it is diminished beyond all comparison.——"I have adopted "the new nomenclature," says Mr. Chaptal, "in my lectures and writings; and I have not "failed to perceive how very advantageous it

"is

" is to the teacher; how much it relieves the " memory; how greatly it tends to produce a " taste for Chemistry; and with what facility " and precision the ideas and principles con- " cerning the nature of bodies, fix themselves " in the minds of the auditors." We have the approbation, also, of the most distinguished metaphysicians of the age, of the connection of new doctrines with a new and more accurate language. " The new nomenclature of Che- " mistry," it is observed by Mr. Dugald Stew- " art, in his Elements of the Philosophy of " the Human Mind, " seems to furnish a strik- " ing illustration of the effect of appropriate " and well defined expressions, in aiding the " the intellectual powers, and the period is " probably not far distant when similar inno- " vations will be attempted in other sciences."

These doctrines, and the nomenclature dependent on them, have not, it must be acknowledged, been long established, and tho' the progress of Chemistry, during and since their

devellopment, has advanced with unexampled rapidity, we should still so limit our approbation, as not to esteem them beyond the reach of improvement.—For my own part, I adopt them, not from a belief that they are perfect, but because they are better adapted than any hitherto offered, for explaining and classing phenomena, and with this qualification, I strongly recommend them to general acceptance.

FINIS.

Manchester,
Printed by R. and W. Dean, No. 9, Spring-Gardens.