An introductory lecture, delivered in King's College, London, October 11, 1831 / by J.F. Daniell.

AN

TRODUCTORY LECTURE,

DELIVERED IN

KING'S COLLEGE, LONDON,

OCTOBER 11, 1831.

BY J. F. DANIELL, F.R.S.

Professor of Chemistry in King's College, London.

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INTRODUCTORY LECTURE.

Mr. Principal and Gentlemen,

In addressing you upon this interesting, this exciting occasion, I am sensible that something more is required of me than a mere elementary introduction to a course of Chemistry. I am conscious that it would ill become me to discourse before a general audience, amongst whom are so many of the patrons of science, of education, and of this noble institution, assembled together to encourage our undertaking and to animate our exertions,—it would ill become me, I feel, to enlarge, before such an assembly, upon the simple propositions which properly constitute the first objects of the student's attention. And yet it is with the most unaffected diffidence that I shall venture for a moment to deviate from the straight and obvious path of the ordinary duties which devolve upon me, from

the charge with which I have been so highly honoured. My task is rendered of peculiar difficulty from the circumstance of my following so closely upon those whose eloquence must be still fresh in the memory of my hearers: and not only is my choice of a subject thereby greatly narrowed, but the "Objects, Pleasures, and Advantages of Science," have lately* been so simply, so eloquently, and so convincingly displayed; and the inductive course proper to be pursued in "the Study of Natural Philosophy,"† so beautifully, so accurately, and with such a master's hand delineated, that it would be presumption in me, of no ordinary kind, to hope to interest you upon these exhausted topics. The eminent authors of the well-known discourses to which I allude, have added to the obligation which all must feel who are interested in the diffusion of knowledge, that they have not addressed their eloquent appeals solely to the affluent;—they have not merely written for the learned, and published the results of their researches in hot-pressed quartos or in the expensive records of Philosophical Societies; but have

* A Discourse of the Objects, Advantages, and Pleasures of Science, being a Preliminary Treatise to the Library of Useful Knowledge.

† A Discourse on the Study of Natural Philosophy, by J. F. W. Herschel, Esq. A. M.

devoted their talents to popular illustrations: and have placed it in the power of the poorest student, who thirsts for intellectual improvement, to drink of the fresh springs which they have opened to his view. To attempt to add to the incentives which they have offered to the study of the glorious frame of creation, and the general laws by which the material universe is ruled, would be to betray my own incapacity; and detract from the conviction which must arise, from the recollection of arguments so captivatingly enforced.

But it is remarkable, that, amidst all the love of science, and zeal for the promotion of knowledge, which have been thought preeminently to distinguish these days, and this country in particular;—at a time when, not only are our elder establishments for learning, most wisely, most discreetly, and most zealously accommodating their systems of instruction to the exigencies and pressure of an increasing activity of intellect, but new institutions are arising in every quarter of the land for affording elementary instruction in general, and for the promotion of various branches of natural knowledge in particular;—it is singular, I say, that at such a moment, a lamentation should be set up on account of the "Decline of Science in England." The alarum has been sounded from

no obscure quarter:* it has been propagated and reverberated with no common energy:—it has astonished most men; it appears to have confounded many. The proposition is general, that "Science has LONG been neglected and declining in England." The tomb has scarcely closed over the mortal remains of three of the greatest philosophers who ever conferred honour upon this, or any other, country,—the whole civilized world still mourns the premature loss of DAVY, WOLLASTON, and YOUNG,—and yet we are assured, that in the country which claims them with glory as her sons, science has long—yes, LONG—been neglected and declining. It is not, however, attempted to establish this startling assertion by evidence: the disease is supposed to be confessed, and the cautery is forthwith applied for its extirpation with no tender hand. With regard to chemistry, indeed, something like definite charges may be collected from this comprehensive indictment; and upon these I shall venture to make a few observations: which I am sure that you will the more patiently bear with, as, from so singular a controversy, something, I think, of profit may be derived to the rising generation; the object which all here present have most nearly at heart.

* Reflections on the Decline of Science in England, and on some of its Causes, by Charles Babbage, Esq.

One, whose varied acquirements no man can more sincerely admire than the humble individual who has now the honour of addressing you, and whose authority, upon all matters which he can afford the time duly to investigate, is most valuable—has asked, in a tone of despondency, "Who can tell us any thing of the sulpho-salts? who will explain to us the laws of isomorphism? Nay, who among us has even verified Thenard's experiments on the oxygenated acids? Oersted's and Berzelius's on the radicals of the earths? Balard's and Serrullas's on the combinations of brome? and a hundred other splendid trains of research in that fascinating science, Chemistry?" Now these questions, —which have never, possibly, been answered, for the simple reason that the answers to them are so easy and obvious that no one has hitherto thought it worth while to make of them a formal display or a boast,—have been brought forward as "specific and incontrovertible proofs" of the fact of the decline of chemical science in this country.* These doubts, which probably presented themselves to the mind of the inquirer in a mood too exquisitely sensitive to the painful and slow degrees by which all acquirements in

* Observations on the Decline of Science in England. Edinburgh Journal of Science, by D. Brewster, LL. D. No. IX. p. 1.

science are effected, and nervously impatient of the obstacles which the imperfection of our nature opposes to every species of intellectual advancement,—have been laid hold of, with a spirit very different from the spirit of that wisdom "whose ways are ways of pleasantness, and all whose paths are peace,"* as an excuse for a severity of criticism, which it would be difficult to justify, upon institutions and men, who, whatever of human imperfection may have attached to them, have done good service to the cause of science. They imply, however, a want of acquaintance with the common routine even of our principal schools of chemistry, which, if excusable in one whose days and nights are possibly dedicated to the all-absorbing pursuits of the highest branches of science, and who merely expresses his doubts as matters of speculation, is utterly without palliation in those who adopt them, without investigation, as the basis of vituperation not only severe but personal. Allow me to attempt a very short reply to questions of such fearful import to the science which claims our present attention, in the inverse order to that in which they have been proposed. The "hundred other splendid trains of research," indeed, which are asserted to have been neglected

* Prov. iii. 17.

along with those which are more particularly indicated, I must leave you to judge of from the success which may attend my efforts to answer what is specific in the charge.

We are asked, "Who among us has ever verified Balard's and Serrullas's experiments upon brome?" Most simple is the reply—In the courses of lectures given in the Royal Institution, and in the London University, of which I can speak from personal knowledge, bromine and its compounds are as regularly introduced and illustrated by experiments, as chlorine or iodine. It ought also to have been known to those who so unsparingly censure the ignorance of others, that the professor of chemistry in the University of Oxford has not only verified the experiments referred to, but has extended the discovery of the new elementary substance to the brine springs, and other mineral waters, of this country.*

The question is also asked, "Who among us has ever verified Oersted's and Berzelius's experiments on the radicals of the earths?" And can it really have been supposed for a moment, that the professors and directors of that laboratory, from which emanated the first glorious train of research which ended in the decomposition of

* Memoir on the Occurrence of Iodine and Bromine, in certain Mineral Waters of South Britain; by Charles Daubeny, M.D. &c. &c. Phil. Trans. 1830, p. 223.

the alkalies and earths, have become so inactive and inefficient as not to have the desire, or the ability, to verify experiments, which are the mere loads and veins of that mine which was opened under their own inspection? Has Davy indeed left no mantle behind him? no disciples worthy of their master? Well may we lament for these degenerate days!—if we do not rather grieve that such things should be assumed, without due inquiry, for purposes of detraction. I can, however, vouch for it, that at the Royal Institution these objectors might have witnessed the production of magnesium, aluminum, and silicon, with much less trouble than it cost them to transcribe these questions: and to the merest tyro of both the schools which I have named, I refer them for the manner in which the processes are explained.

Again, it is inquired, "Who has ever verified Thenard's experiments upon the oxygenated acids?" Now this question may not, probably, have been inappropriate at the time when it was first distrustfully proposed:—but, long before it was prominently arranged with others, and extracted from a position in which it is allowed it was "unlikely to meet with general attention,"* the distinguished author of the experiments

* Babbage's Preface.

had published to the world, that he had been mistaken in the conclusions which he had originally drawn from them. The appearance of oxygenated acids, he proved, had been conferred by the presence of a new compound of oxygen and hydrogen, in which the quantity of the former element was double the proportion in which it exists in water; and upon which he bestowed the name of deutoxide of hydrogen. And yet the chemists of this country are reproached with not having verified these abandoned conclusions! Does not this resemble the conduct of men, who wilfully close their eyes, and perversely exclaim, that all the world is enveloped in gross Egyptian darkness? The discovery of the deutoxide of hydrogen—the legitimate result of M. Thenard's laborious experiments—has been verified in the Royal Institution; and if the new compound be not ordinarily exhibited in lectures, as a class experiment, the expense, not the difficulty, of its preparation prevents the illustration.

"Who will explain to us the laws of isomorphism?" proceeds the objector. If by this a doubt is meant to be expressed, whether the phenomena of isomorphism, as developed by their discoverer, Professor Mitscherlich, are duly known and appreciated in this country, I again appeal to the classes of our schools: but if we are accused of ignorance of the general laws which

connect these facts together, it is an ignorance which we share with the natural philosophers of other countries; and greatly do I doubt whether much more of observation must not precede any useful attempt to theorize upon this interesting subject. Perhaps I may even be allowed to say that some hesitation is excusable in the adoption of such generalizations of the subject as it has been already attempted to extend to mineralogy, when we observe a class of *silicates* distinguished, in which the *silica* is wholly replaced by *alumina*. That England, moreover, is not at the present moment destitute of men who are competent to reason, if not precipitately, closely and powerfully upon this subject, has lately been evinced in a paper which adorns a late number of one of our scientific journals.*

But foremost stands the question, "Who can tell us any thing of the sulpho-salts?" To this, I trust, you will excuse me if I reply a little more at length. Highly distinguished as I have been, and far, I fear, above my merits, by my appointment to the chair of Chemistry in this College, it became my first duty to adopt such a plan of instruction, as, upon mature reflection, I might feel convinced would lead the student forward by an easy and safe

* On Isomorphism. By H. J. Brooke, Esq. F.R.S. &c. Phil. Magazine, Sept. 1831.

advance. I felt myself called upon to review with care, the different arrangements of the science which had been made by the most distinguished professors, for the purpose of adopting such as might most facilitate the progress, and assist the memory, of my pupils. In the course of this review, that which has most fixed my attention and called for most consideration is the new arrangement and the new nomenclature proposed by the distinguished Swedish chemist, Berzelius, of which the division of *sulpho-salts* forms an important part; and the result of my deliberation has been to reject a change, which, by unnecessarily increasing a class of compounds, already too extensive for convenience, must greatly add to the difficulties of a beginner. This new arrangement, and this new nomenclature, have not hitherto been adopted by British chemists; with one very recent exception: and I think that, notwithstanding the deservedly high reputation of the author, they have done wisely to suspend their judgment upon them. At the same time, the exception of so distinguished a chemist as Dr. Thomson,* although I differ from him in opinion, is amply sufficient to enforce my argument that it has been hastily and inconsiderately concluded that British chemists *could* not tell us any thing of

* Thomson's Chemistry of Inorganic Bodies.

the *sulpho-salts;* while the hesitation of the majority, I believe, proves any thing but that they do not understand the subject.

Berzelius* has imagined that, in the combinations of a certain set of the binary compounds of sulphur with another set of the same compounds, there exists a strong analogy to the binary compounds of oxygen, which are distinguished by the name of acids, in their union with the salifiable bases. He therefore classes sulphur with oxygen, under the appellation of *amphigeneous* bodies (or bodies which produce both series of acids and bases); he divides their binary compounds into oxi-acids and oxi-bases, and sulpho-acids and sulpho-bases. The combinations of the two former, together, he calls *oxi-salts,* and of the two latter, (hitherto known by the name of double sulphurets, or hydro-sulphurets,) he designates as *sulpho-salts.*

Now, without at all denying that some of the sulphurets may be electro-positive and electro-negative with regard to each other, and that they are consequently capable of chemical combination, I conceive that such compounds differ most materially from the general character of salts. There is no such thorough change of nature and properties, in the two combining bodies, as ensue from the neutralization of an acid by a

* Traité de Chimie, par J. J. Berzelius, i. 220.

base: neither, I believe, does Berzelius pretend that by electrical decomposition will the *sulpho-acid* be evolved at one pole of the voltaic battery, and the *sulpho-base* at the other. The union is precisely of the same nature as that of the double chlorides, or double salts of any other class—of which so many instances are known: and we might admit *chlorine* to the rank of an *amphigeneous* body,—and constitute a class of *chloro-acids,* and *chloro-bases,* and *chloro-salts,*—upon precisely the same analogy as that on which we are called upon to distinguish the sulpho-salts. Dr. Thomson, indeed, in adopting Berzelius's views upon this subject, has seen the necessity of this further extension of them; and actually arranges the double chlorides in this manner.* When to these we add, as it is also proposed to do, the analogous compounds of selenium and tellurium, under the titles of *seleno-acids* and *seleno-bases,* and *telluri-acids* and *telluri-bases,* it seems to me that utter confusion must result; and I cannot resist the temptation of quoting the words of the last-named distinguished writer against his own present opinions, who, in speaking of another, and not very dissimilar, class of compounds, has said, "The hydrates indeed have been considered by some modern chemists as likewise saline combinations.

* Thomson's Chemistry of Inorganic Substances.

But this name cannot be applied to them without extending the meaning of the terms *acid* and *base* so far as to render them really useless."* Far be it from me to undervalue the great additions which the indefatigable professor of Stockholm has made to our knowledge of the double sulphurets; but I have high authority for saying that, in science, "hardly any thing can counterbalance the evil of disturbing well-established names, which have once obtained a general circulation."†

In collecting together the "scattered" evidence of the fall of chemistry, the accuser has found one more specific charge from a different quarter. Some of our most eminent chemists, it appears, have successfully directed their attention to other branches of natural philosophy, and have preeminently advanced the science of electromagnetism: they are therefore arraigned for a misdirection of their talents; and are held responsible for not having decomposed nitrogen, and insulated the suspected fluorine. To this it is indeed difficult to return a serious answer. What, if we were to mete by the same narrow measure! What might not we say to the profound mathematician who quits the

* Thomson's System of Chemistry, Fifth Edition, vol. ii. p. 699.

† Herschel's Discourse, p. 139.

calculus for chemistry, not to perform the labour of a successful cultivator of the field, but to undertake the inglorious task of depreciating the exertions of others? But I refrain.

I trust that in taking this opportunity to reply to a statement, which very recently it has been alleged that "no person has ever dared to controvert, even in the minutest particular,"* I have said nothing in behalf of the science which I am called upon to teach, unworthy of the place from which I have the honour to address you;—I trust that I have said nothing inconsistent with that respect which is preeminently due to the high scientific characters of the individuals, the disheartening effect of whose despondency and crimination I have thought it not inconsistent with my duty to oppose. I presume not to interfere beyond the precincts of my own department; but I cannot but express my conviction that they greatly err, who, because the scientific men of this country have not replied to the severe animadversions which have been made upon the supposed "Decline of Science," imagine that they *dare* not take up the controversy. Such a silence will admit of a far different interpretation. The wisdom of such forbearance has indeed been amply justified; for the defence of British science, against British

* Brewster's Journal, No. IX. p. 2.

scientific men, has been undertaken, from unimpeachable motives, by the impartial hands of a foreign philosopher,* who has thus proved, to the eternal honour of her name, that true science is of no country. The competency of this generous champion, and his intimate acquaintance with the progress of European discovery, even his opponents must allow; and it is amply evidenced by the performance of his chivalric enterprise. It has been well said, that the best anticipation we can form of the judgment of posterity upon any of our works may be derived from the opinion of an enlightened contemporary foreigner; and I doubt not that the judgment of posterity upon the alleged "Decline of Science" in this country, and in this age, is thus prevented in the pages of the professor of Utrecht.

Gentlemen,—In the course of my argument against the supposition that in this country "we are fast dropping behind in Chemistry," I have incidentally—I trust it will not be thought presumptuously—become the apologist of two great chemical schools in this metropolis; but it would be contrary to every feeling of my heart to turn from their mention thus. A warm

* On the alleged Decline of Science in England, by a Foreigner. The author of this pamphlet, it is understood, is Dr. Moll, of Utrecht.

acknowledgment is due from me to the professors of those eminent establishments, for the ready alacrity with which they have proffered their assistance and counsel at the commencement of our new career. The illustrations of their lectures, the benefits of their experience, have all been communicated to me in the most generous manner. This is, indeed, in the spirit of true philosophy! We may almost envy them the opportunity, which they have so nobly embraced, of being the first to evince the sentiment, which animates our own breasts,—that there may be rivalry without hostility, and abundance of emulation without opposition.

Permit me now to address myself, more particularly, to the younger part of my audience, for whose benefit this splendid institution has been founded. To you, my young friends, the events which are passing around you, the discussions which are carried on in your presence, teem with exhortation and instruction. The scientific reputation of the present age will rest upon some of the illustrious dead, alas! and upon men still in the prime of life; who, doubt not, whatever may be insinuated to the contrary, will ably support and exalt it. Their names are recorded upon the page before me, but the rules of good taste forbid me to recite them; for many of them, I am proud to say,

grace this meeting with their presence. There is not one upon the list who would not press forward in the cause of science—

"Nil actum reputans dum quid superesset agendum."

But to you, the rising generation, is committed the charge of the future: into your hands it is quickly passing. Towards you the enlightened of the present age have acted a noble part indeed! The means of preparation and improvement are placed most liberally before you: but, should you neglect to use them,—should science really decline in your hands,—judge of the sentence which awaits you. Reprobation, which they who merit not may disregard and laugh at, will humble you to the dust; and generous foreigners will lament, when they can no more deny, the degeneracy of your native land.

Gentlemen,—Great facilities in the present day are offered to your labours; but be careful lest these become a snare unto you. Be careful that you be not seduced to skim the surface of natural philosophy, and content yourselves with a mere smattering of knowledge. To the student of chemistry, most particularly, do I address this caution. The illustrations of this fascinating science are of such a pleasing nature,—the experimental parts of its course

of instruction so striking,—that there is danger of their fixing the attention, to the exclusion of any consideration of the relations which subsist between the phenomena. A person might certainly find some amusement in watching the experiments of a laboratory, as he would gaze upon a display of fireworks; but small would be the instruction which would remain with him. You must discipline your minds to the accurate comparison of facts; you must accustom yourselves to weigh and measure results; you must fix your attention on numerical conclusions;—or vain will be your attendance in the lecture-room. Pleasure there doubtless is in the acquisition of natural knowledge—a pleasure far beyond the mere surprise of novelty;—but the penalty of the "sweat of the brow" is exacted no less for the enjoyment of the intellectual harvest, than for that of the fruits of the earth.

Many of you are, doubtless, about to prepare yourselves for the exercise of the medical profession: many, I trust, will be aspirants to its honours. Our colleges and halls have most wisely prescribed a course of study to those who are candidates for their licenses and diplomas: but be not satisfied with the *minimum* of knowledge; do not be content with such an attendance upon your courses of instruction as may barely entitle you to your certificates. The kind

of half-education which might thus be indolently acquired, will not shield you from the inquiring spirit of the times; which, be it for good or for evil, will sift your pretensions to the bottom. Mystery can no longer offer a shelter for ignorance; and, were you accessible to no higher motive, subsistence would be precarious, if you should not be prepared to meet the criticisms of an enlightened age.

Some of you, perchance, in following your education with that zeal and attention which can alone insure your advance, may become true votaries of science; and may, possibly, hereafter be induced to sacrifice, as many have done before you, prospects of worldly advantage, and the more certain roads to wealth, to aspirations after increasing knowledge. Should it be necessary for you, in the pursuit of this meritorious ambition, to connect, in some measure, objects of profit with the cultivation of science, fear not the reproach, that you "pursue not science with true dignity:" it may be made, in arrogance; but they to whose judgment alone you need defer, will do justice to your motives.

Many of you, I doubt not, will attend these lectures, as a necessary part, in these days, of a system of liberal education. You would consider it irrational and disgraceful to remain ignorant of the constitution of those commonest

forms of matter amongst which your lot is cast. The days are past in which a cultivated taste, a knowledge of languages, and a general acquaintance with history, will excuse a man for utter ignorance of the laws by which the frame of nature is sustained; and the time is arrived when the four elements of earth, air, fire, and water, must take their classic station as the "primordia rerum," by the side of the mythological deities of antiquity. The business of active life, to which you will be hereafter devoted, will not, depend upon it, suffer from such preliminary knowledge: on the contrary, in all the paths of honourable exertion and laudable ambition which open before you, a general acquaintance with the principles of natural philosophy and chemistry will not only be ornamental and pleasurable, but useful, profitable, and, if I may be allowed the term, *exchangeable.*

But, Gentlemen, to all of you I must address the homely admonition of attention, diligence, and punctuality; for, in proportion to these, will be the profit which you will derive from lectures. After all the exertions which he can make, the success of the Professor must depend upon the industry of the pupil. Be not satisfied with the acquirement of names; or fancy, that if you master terms, and retain

certain forms of expression, they will stand you in stead of a real understanding of principles. Do not be satisfied with your hour's attendance upon the lecturer, but consult books; and, should you be sensible that any obscurity impedes your progress, ask for those explanations which will be most anxiously, most cheerfully, afforded you. Above all, I would recommend you to submit yourselves to examination. Of all the auxiliaries to instruction, I know of none more powerful than this wholesome practice. It is beneficial both to the master and the pupil: to the former it affords the opportunity of discovering any weak points in his explanations, any deficiency in his illustrations; to the latter it gives the inestimable advantage of seeing the same subject placed in different lights, of hearing difficulties familiarly discussed, of securely *feeling* his own advances. Of some of you, the regulations of the College will probably require submission to this discipline: I trust that no false shame will prevent any of you from partaking of its advantages.

Do not omit, when it is possible, to confirm your knowledge by actual experiment, and to exercise yourselves in manipulation. To do this does not, as is too often supposed, require a collection of expensive apparatus and scarce

materials. Original investigations, indeed, in the present advanced state of the science, cannot be prosecuted with effect, without the aid of many of those delicate contrivances which we owe to the ingenuity of a long succession of the ablest philosophers. These you will have the opportunity of hearing explained, and of seeing applied to use; and you will handle and examine them. But all the general principles of the science may be tested by operations which are constantly going on around us, or which we may command at pleasure. In the way of apparatus, wine and beer-glasses, phials, oil-flasks, glass and tin tubes, old gun-barrels, tobacco-pipes, an argand and a spirit-lamp, with a common fire and bellows, offer almost inexhaustible resources to a person moderately endued with the faculty of contrivance; especially if he make himself master of the easy art of sealing, bending, and enlarging a glass tube, over a lamp. Such easy illustrations I shall lose no occasion of pointing out to you; and I would strongly impress it upon your minds, that to be able to substitute an apparatus or vessel at hand for one that is wanting, is no bad criterion of the chemist's art.

I do not consider that any advantage would, at present, arise from my entering at large upon the plan of my future course.

Any criticisms upon arrangement, or general view of a subject, of which I conceive that it is an essential part of my duty to suppose the beginner totally unacquainted, would be utterly without profit to him, and tedious, without doubt, to those who honour us as visitors upon this occasion. It is my purpose, as much as possible, to lead the student from the known to the unknown; from the simple to the complex; from common experience to experiment. In following this order, it is true that there are difficulties which are peculiar to the science of Chemistry. The elementary substances are very rarely indeed presented to us in their simple forms in nature: they are the educts in general of complex analyses. Hence it might be inferred, that the ascent from the known to the unknown is opposed to that from the simple to the complex. This is, in some measure, overcome by exhibiting and describing the elements, at first, without particular reference to the processes of their extraction. Not that this method itself is not liable to objection; neither is it my intention to adhere very strictly to it. Perhaps I shall more accurately describe my intention by stating, that I shall at all times sacrifice system, when I conceive that by so doing I may render the acquirement of knowledge more easy. I shall not, however, fail, as the pupil advances,

to impress his mind with all the advantages of arrangement.

Notwithstanding the judicious provision made by the Council for a separate and complete course of instruction in Natural Philosophy, I feel that my duty calls upon me to commence my lectures in Chemistry, with some account of the cognate sciences. The heads of the medical colleges have not yet rendered it incumbent upon their candidates to attend to these subjects as a separate course: and as some preliminary acquaintance with the nature of heat, light, and the electrical and magnetical forces, is absolutely necessary to the proper study of chemical affinity, I shall commence with these interesting subjects. As, however, it would be impossible for me to enter at any length upon so extensive a field of investigation,—and as the chemist's view of natural philosophy differs, in general, considerably from that of the accomplished mathematician,—they who wish to ground themselves, as all should do, in a knowledge of the sublimest phenomena of nature, will not fail to avail themselves of the excellent opportunity which will be here presented to them.

From these preliminary views I shall proceed to a description of the elementary substances, and of their primary combinations with each other. The laws of combination will be illustrated by

synthesis; and, without neglecting the advantages of such *crucial* instances as may present themselves, the character of this part of my course will be *synthetic*. I shall then direct the student's attention to the secondary compounds, and to that numerous and important class of bodies which are called *salts*. This, I conceive, will afford a fit opportunity for enlarging upon the processes of *analysis*, and the mode of detecting the several elements in combination, by tests and re-agents. Last in order, I shall endeavour to elucidate the chemical processes and products of organic nature;—a field of research of paramount interest and importance, but of corresponding complexity and difficulty. Here it is that so much is left to the future cultivator, and that the most accomplished chemist must feel that so much remains to be learned by comparison with the little that is known.

In unfolding the principles of a progressive science, great is my satisfaction in feeling assured that my own mind must be strengthened and improved. It cannot be, but that a large portion of the beams of that light which I hold up to others must radiate upon myself. In Chemistry, above all sciences, it is incumbent upon the professor to be a learner as well as his pupil:—and no light task is it, at the present day, to keep up with the rapid and gigantic

strides by which knowledge, in this direction, is advancing. The enlightened liberality of the Council of King's College has afforded ample, nay splendid, accommodation and means for prosecuting this essential labour. The only return, which it becomes me to promise, is that of a diligent application of them.

The first object of my ambition will be—the object of the Founders of the College—the steady advance of my pupils in sound and useful knowledge: and, should my exertions for this end be rewarded with success, I shall not care, though I may be doomed to share, with the professors of our English Universities, the reproach of a Scottish philosopher—that they are disadvantageously distinguished from "philosophers actively and constantly engaged in original research," because their names are not found in the lists of medallists and correspondents of foreign academies, in which his own so conspicuously appears.* I confess, gentlemen, that I am not of the number of those who so loudly lament that science, in this country, has no peerages—no orders of merit—no ribbons, red or blue—to offer to her votaries. Low, indeed, must be his estimate of her attractions, who can think that she need hold out such lures to worship at her shrine. Strong

* Brewster's Journal, No. IX. p. 3.

is the conviction in my mind, that such temptations never yet led a generous spirit one forward step in his inquiry after truth, or in unravelling the sequence of natural causes and effects. No man, indeed, *ought* to be insensible to the approbation of the wise and good; but, if you deserve it, doubt not that it will find you out without a badge to your persons.

Hear, now, a description of that delight which is worthy to tempt you onwards; hear, from the pen of one who has not sipped, but drunk deeply, of the fountain — of the inexhaustible source of pure and exciting contemplations which is opened to him who studies natural science, and contemplates, in the right spirit, the glorious fabric of creation.—" Accustomed to trace the operation of general causes, and the exemplification of general laws, in circumstances where the uninformed and uninquiring eye perceives neither novelty nor beauty, every object which falls in his way elucidates some principle, affords some instruction, and impresses him with a sense of harmony and order. Nor is it a mere passive pleasure which is thus communicated: a thousand questions are continually arising in his mind,—a thousand subjects of inquiry presenting themselves,—which keep his faculties in constant exercise, and his thoughts perpetually on

the wing; so that lassitude is excluded from his life, and *that craving* after artificial excitement and dissipation of mind, which leads so many into frivolous, unworthy and destructive pursuits, is altogether eradicated from his bosom."*

One observation more, and I will trespass no longer upon your indulgence. I have cautioned my younger hearers, and I cannot too often enforce it upon their attention, not to substitute names for things, not to mistake expressions for ideas. It becomes me, I feel, to guard them from this error in one of the most important points to which the attention of a rational creature can be directed. I have used, and I shall hereafter frequently employ, the expressions of Nature and the Laws of Nature: by these I mean the God of Nature, and the Laws by which his providence has seen it good to rule the material universe. I use not these words as terms in the convenient ambiguity of which doubt may seek for refuge, or indolent indifference concealment. But as, on one hand, reverence forbids that the sacred name should pass too carelessly from our lips, so, on the other, is the effort to exalt our minds to a proper contemplation of such a subject, too great for constant repetition. I regard such language, as the

* Herschel's Discourse, p. 15.

veil upon the face of the prophet,—destined to subdue the glory which we are not prepared at all times stedfastly to behold.

This explanation, which I feel to have been due to that candour which I hope ever to maintain towards you, warns me to conclude; lest I should appear presumptuously to intrude upon a department in which your guidance is intrusted to safer and far abler hands. From every branch of natural knowledge to which your attention will be successively directed, you will find that the whole universe abounds with evidence of design and contrivance of the most perfect order; and from the science of Chemistry, particularly, you will learn, that the inorganic creation is constituted by "measure and by weight." The all-important conclusions to be derived from this unexceptionable testimony, will be unfolded to you within these walls with the care which their preeminence requires; and I am satisfied that you will not neglect the opportunity which will be thus presented you, of perfecting yourselves in the noblest and most delightful exercise of the intellectual faculties which the study of natural philosophy can afford.

R. CLAY, PRINTER, BREAD-STREET-HILL, CHEAPSIDE.