landscape, or whether a man with good eyes is shut up in a dark room.

It is of this the poet speaks, when he says :—

"O Lady! we receive but what we give,
And in our life alone does Nature live;
Ours is her wedding-garment, ours her shroud!
And would we aught behold of higher worth,
Than that inanimate cold world allow'd
To the poor, loveless, ever-anxious crowd,—
Ah! from the soul itself must issue forth
A light, a glory, a fair luminous cloud
Enveloping the earth;
And from the soul itself must there be sent
A sweet and potent voice, of its own birth,
Of all sweet sounds the life and element!"

But let us hasten to our friend Philosophus, who is a man of quite a different mould. Once, when he was young, his tutor said to him, "Have the goodness, sir, to solve the following problem: 'A hemispherical bowl is filled with a heavy fluid, the density of which varies as the *n*th power of the depth below the surface; find the whole pressure and the resultant pressure on the semi-lune of the surface contained between two vertical planes passing through the centre of the bowl, and making with each other an angle 2β.'" But Philosophus thrust the paper violently aside, saying "I will have none of that," and in fact was extremely rude. You may be sure, therefore, that when he came to be a man he had a mind of his own, and carried out his own ideas. He told us lately that he had been studying the laws of energy. It is a mistake, he said, to suppose that these laws are difficult of comprehension; they are merely remote from our ordinary conceptions, and must be patiently pursued until you grasp them. He had studied them, he said, at all times and on all occasions—in the railway carriage, on the thoroughfare, in the study, on his bed, in the night watches; and now that he had come to perceive their exceeding grandeur, and beauty, and simplicity, they were a source of great and continual joy to him, and recompensed him more than a thousandfold for all the trouble he had taken. Philosophus lately told us certain truths which may, perhaps, be of service to the readers of NATURE. He said that, not far from London, there was a place where the spirits and understandings of men were annually ground to pieces in a huge machine made of the very best metal; ay, such is its temper, said he, that were it only made into good broadswords, it might enable us to cleave our way to the very heart of the universe. Again, he said: "No doubt the dulness of science is a cry of the blind; nevertheless, men of science are much to blame. It is their sense of beauty that leads them to Truth, whom they discover by means of the glorious garments which she wears. But she is immediately stripped of these, and dressed in an antiquated mediæval garb, worse than that of any charity-school girl, and equal to that of any Guy Faux: no wonder that in such guise her beauty is unperceived by those who cannot pierce the veil, and that as a consequence she is slightly esteemed."

There was another thing he told us—a thing of the highest importance. "The priests of Science," he said, "must consent to use the vernacular, before they will ever make a profound impression upon the heart of humanity; and when they have learned to do this, let them not fear the sneers of their deacons who will call their teaching sensational.

F. R. S.

THE ATOMIC CONTROVERSY

It is one of the most remarkable circumstances in the history of men, that they should in all times have sought the solution of human problems in the heavens rather than upon the earth. Sixty years ago a memorable instance of this truth occurred when Dalton borrowed from the stars an explanation of the fundamental phenomena of chemical combination. Carbon and oxygen unite in a certain proportion to form "carbonic acid;" and this proportion is found to be invariable, no matter from what source the compound may have been prepared. But carbon and oxygen form one other combination, namely, "carbonic oxide"—the gas whose delicate blue flame we often see in our fires. Carbonic oxide may be obtained from many sources; but, like carbonic acid, its composition is always exactly the same. These two bodies, then, illustrate the law of *Definite* Proportions. But Dalton went a step further. He found that, for the same weight of carbon, the amount of oxygen in "carbonic acid" was *double* that which exists in carbonic oxide. Several similar instances were found of two elements forming compounds in which, while the weight of the one remained constant, the other doubled, trebled, or quadrupled itself. Hence the law of *Multiple* Proportions. The question was—in fact, the question is—how to account for these laws. Dalton soon persuaded himself that matter was made up of very small particles or *minima naturæ,* not by any possibility to be reduced to a smaller magnitude. Matter could not be divisible without limit; there must be a barrier somewhere. No doubt, as a chemist, he would have rejected the famous couplet—

Big fleas have little fleas, upon their backs, to bite 'em;
And little fleas have smaller fleas, and so *ad infinitum.*

"Let the divisions be ever so minute," he said, "the number of particles must be finite; just as in a given space of the universe, the number of stars and planets cannot be infinite. We might as well attempt to introduce a new planet into the solar system, or to annihilate one already in existence, as to create or destroy a particle of hydrogen." All substances, then, are composed of atoms; and these attract each other, but at the same time keep their distance, just as is the case with the heavenly bodies. The atoms of one compound do not resemble those of another in weight, or size, or mutually gravitating power. But as they are indivisible, it is between them that we must conceive all chemical action to take place; and an atom of any particular kind must always have the same weight. The atom of carbon weighs 5; the atom of oxygen weighs 7. Carbonic oxide, containing one of each must therefore be invariably constituted of 5 carbon, and 7 oxygen: carbonic acid must in like manner contain 5 carbon, and 14 oxygen. Here, then, Dalton not only states that he has accounted for the two laws we have mentioned by making a single assumption; but he evidently intends his theory to be used as a criterion or control in all future analytical results, and already views it as the birth-place of chemical enterprise.

Such, and so great, was the atomic theory of Dalton; founded, certainly, on erroneous numbers, but containing in itself the germ of their correction; aspiring to the command in innumerable conquests; and setting itself for the rise or fall of the chemical spirit.

It is hardly necessary to make any detailed review of the history of the atomic theory. Berzelius made it a starting-point for researches which, on the whole, have been unsurpassed in their practical importance, and engrafted upon it his celebrated electrical doctrine. Davy and Faraday refused to admit it; Laurent and Gerhardt accepted it doubtfully, or in a much modified form. Henry declared that it did not rest on an inductive basis. There can be no doubt, however, that the atomic theory has been accepted by the majority of chemists, as may be seen on even a cursory inspection of the current literature of their science. Our present intention is to give such a summary of the atomic question as may be serviceable to those who take an interest in the discussion at the Chemical Society on Thursday last.

The modern supporters of the atomic theory agree with Dalton in the fundamental suppositions we have given above; but assert that they have a much stronger case. The phenomena of gaseous combination and specific heat have indeed changed the numerical aspect of the theory, but not its substance. The simplicity of all the results we have accumulated with respect to combining proportions is itself a great argument for the existence of atoms. They all, for example, have the same capacity for heat; they all, when in the gaseous state, have a volume which is an even multiple of that of one part by weight of hydrogen. But bodies in the free or uncombined state—such, in fact, as we *see* them—more commonly consist of many clusters of atoms (*molecules*) than of simple atoms. These molecules are determined by the fact that when in the gaseous state they all have the same volume. Again, select a series of chemical equations, in which water is formed, and eliminate between them so as to obtain the smallest proportion of water, taking part in the transformations they represent. It will be found that the number is 18; which necessarily involves the supposition that the oxygen (16) in water (18) is an indivisible quantity. To put this last point another way: hydrochloric acid, if treated with soda, no matter in what amount, only forms one compound (common salt). Now we know that the action in this case consists in the exchange of hydrogen for sodium. But if hydrogen were infinitely divisible, we ought to be able to effect an inexhaustible number of such exchanges, and produce an interminable variety of compounds of hydrogen, sodium, and chlorine; hydrochloric acid being the limit on the one side, and common salt (sodic chloride) terminating the other. No such phenomenon occurs; and, since matter must be infinitely or finitely divisible, and has been thus proved not to be the former, it must be the latter. Atoms, therefore, really exist; and chemical combination is inconsistent with any other supposition. Those who hold the contrary opinion are bound to produce an alternative theory, which shall explain the facts in some better way.

Now let us hear the plaintiff in reply.

The atomic theory has undoubtedly been of great service to science, since the laws of definite and multiple proportions would probably not have received the attention they deserve, but for being stated in terms of that theory. Yet we must discriminate between these laws, which are the simple expression of experimental facts, and the assumption of atoms, which preceded them historically, and therefore has no necessary connection with them. For it was the Greek atomic theory which Dalton revived. Nor has any substance yet been produced by the atomists, which we cannot find means to divide. If, moreover, we have no alternative but to admit the infinite divisibility of matter, even that is consistent with the simple ratios in which bodies combine; for two or more infinites may have a finite ratio. Therefore, the observed simplicity, if used as an argument, cuts both ways. Possibly we are mistaken in connecting the ideas of matter and division at all; at any rate, the connection has never been justified by the opposite side. Again, admitting the argument based on the formation of common salt, the atomic theory does not tell us why only one third of the hydrogen in tartaric acid can be exchanged for sodium; why, indeed, only a fraction of the hydrogen in most organic substances can be so exchanged. Yet, the explanation of the one fact, when discovered, will evidently include that of the other. On the whole, it appears that the atomic theory demands from us a belief in the existence of a limit to division. No such limit has been exhibited to our senses; and the facts themselves do not raise the idea of a limit, which Dalton really borrowed from philosophy. The apparent simplicity of chemical union we do not profess to explain, but to be waiting for any experimental interpretation that may arise. The atomists, in bringing forward their theory, are bound to establish it, and with them lies the *onus probandi*.

The above are a few broad outlines of the existing aspect of the atomic controversy, and may somewhat assist in forming an estimate of it. The general theoretical tone of the discussion last Thursday must have surprised most who were present. Our own position is necessarily an impartial one; but it will probably be agreed that between the contending parties there is a gulf, deeper and wider than at first appears, and perhaps unprovided with a bridge.

LECTURES TO LADIES.

WHAT is the meaning of the present stir about the "Higher Education of Women"? We have before us announcements of courses of lectures intended to be given during the coming winter to the ladies of Edinburgh, London, Glasgow, Manchester, and Bradford; and we believe that similar courses are to be delivered in several other towns. The organisations under whose auspices these lectures are to be delivered, seem all of them to have come into existence at nearly the same time. Edinburgh and Professor Masson, so far as we know, have the credit of having taken the lead in the movement; but this was only two winters ago, and none of the towns we have named were more than one year behind.

What is the cause of this sudden and wide-spread demand on the part of our countrywomen for access to a different and, presumably, a higher kind of intellectual culture than has hitherto been within their reach? Or rather, first of all, is the apparent demand a real one? Is it such as to indicate that a real step has been taken, or is likely soon to be taken, towards an improved method and a higher standard of female education in England? Or is it more reasonable to suppose that the interest now manifested in the subject will disappear in the same proportion as the novelty of it? For our own part,—after making what seems full allowance for the influence which the love