THE CATEGORIES OF SCIENTIFIC METHOD.

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THE study of philosophy has entered on a period in its development, which is not yet closed. After Hegel's death there set in a reaction against the abstract point of view from which it was sought to construct a "naturphilosophie." Later on there came, if not reaction against, at least indifference to, those classifications of the sciences—really of an *a priori* character—which Comte and Mr. Spencer inaugurated. If thought is no longer to be treated as of less account than things, no more are things to be treated as of less account than thought. We threw over materialism for subjective idealism. We threw over subjective idealism for an idealism which was objective in so far as it refused to treat the individual mind as the centre of existence. We now-a-days go a step further, and declare that no amount of analysis of the real world into intelligible relations will satisfy us that we can, *a priori*, construct it or even learn its nature. We have not ceased, those of us who have come to this point of view, to be idealists. We only maintain that idealism and realism, mind and experience, are alike, abstractions which cannot be divorced.

But it has not been merely the idealist, commonly so-called, who has sought to construct nature from without. Men of science have forgotten the very lesson which they have preached. They have sought to make the facts fit a mechanical standpoint, as much as the post-Kantians sought to make theirs fit into a "naturphilosophie." This has been, perhaps, more markedly the case in physiology and biology than in any other department. The controversies about vitalism, and the lengths to which the cell theories of Schwann and Schleiden were carried, illustrate the deep hold which the assumption that all that is can be expressed in terms of mechanical categories, had taken of men's minds. If there are no relations in nature but those of mechanism, if position in space and time distinguishes what is real from what is not, vitality must be either a mere form of energy subject to the laws of conservation and degradation or a special force rendering these laws incapable of universal application. This opinion was not merely that of people who had not mastered the critical philosophy and were still at the dogmatic point of view. It was the opinion of disciples of Kant, such as was Schleiden. In the *Critique of Judgment* Kant had deduced from the principles of his system that such categories as those of organisation and beauty were

simply regulative conceptions of merely subjective validity and did not belong to the real. The real for him was what was schematised in space and time through the twelve categories of the Critique of Pure Reason. What was not real in this sense belonged to the region of mere subjectivity. The result was a great impulse towards materialism, which manifested itself in the scientific teaching which came later. There rose in the minds of men of science a metaphysical presupposition that what could not be mechanically expressed was not. Spiritualism, being, from this standpoint, impossible as a clumsy piece of mechanism out of harmony with the rest of nature, got to be regarded with suspicion. In the end men set themselves to seek for a materialistic interpretation of all the phenomena of life.

The disastrous effect of this tendency becomes apparent when we consider what scientific procedure really is. A man does not, nowadays, say "*Hypotheses non fingo*." On the contrary the method of induction—as Whewell and Jevons have taught us—is to form an hypothesis and then see whether the facts fit into it. The preliminary conception thus comes to exercise much influence on the facts, or at least in our view of them. Nature only discloses herself to a mind well stored with presuppositions, and the extent to which she discloses herself depends largely on the presuppositions.

The danger of using these presuppositions uncritically shows itself in every direction. Conceive space as discrete only—as made up of a number of smaller spaces, and you make the higher Calculus and the theory of Limits untrue and practically possible only as an approximation. Conceive the relation of cause and effect as the only real relation of sequence, and you are plunged into difficulties about the relation of motive to volition and are drawn into fatalism. Conceive the relation of whole to parts as one which must be apparent in space and time if it is to be admitted as real, and you get a whole which is a mere aggregate of the parts, and can exercise no determining influence upon them. In not one of these instances is the presupposition indicated adequate to the facts or an induction from them. The very essence of the relation of motive to volition is that the antecedent does not pass over into the consequent as does a cause—the sum of the conditions of the effect, into the effect. If I strike a match and merely convert potential into kinetic energy, the latter is but a transformation of its antecedent. But the motives which induce a volition do not pass over into what follows on them in experience in a similar fashion. The psychical process cannot be adequately described by the category of cause. Again there is no apparent justification in the facts for the attempt to ignore the characteristic of a living organism, its power of self-conservation and

of determining its parts and the material which it absorbs. And yet we are constantly told by distinguished men of science that the aim of physiology ought to be to proceed from the mechanical point of view, an assertion which is certainly not the result of observation or experience.

The moral of this is that a criticism of categories or conceptions is essential to a right understanding or investigation of the facts of nature. If we proceed dogmatically—if, for example, we assume that organic nature can and ought to be brought under the categories of mechanism, we are not only proceeding dogmatically upon an assumed metaphysical basis, but we are in danger for the reason already pointed out, of misapprehending the facts. One great lesson which the Hegelian theory of knowledge has taught us is the necessity for such a criticism. We may accept or reject Hegel's general system and his explanation of the relationship of the categories to one another, but we are left with the warning which he gave us against any dogmatic assumption, such as Kant made, of a distinction between regulative and other judgments. He has made us conscious of traps and pitfalls which exist where we least expect them in the investigation of the facts of nature, and he has warned us against a most insidious form of bad metaphysics into which those who are most anxious to keep clear of everything of the sort are constantly stumbling.

I cannot help thinking that the logic of the future must assume a somewhat new shape. One of its chief functions must surely be to determine what categories are appropriate to the different Sciences, and to distinguish these categories. Is, for example, the relation of a stimulus to the muscular movement which follows on it to be regarded as an example of the relation of cause and effect, and if so, upon what grounds? For the burden lies on those who assert the affirmative to shew why. The proposition, too, carries with it important consequences. It assumes that the change which takes place can be explained as a conversion of potential into kinetic energy, that the consequent can be resolved into the sum of its conditions, a proposition which readily leads to further inferences, and induces views of the facts which may prove altogether abstract or misleading. Again, what are the laws which determine the quantity of oxygen which the blood requires, or which the organism uses in sustaining itself? By what justification do we assume that these laws are those of the sphere of mechanism? To assert the contrary would by no means be to assert an exception to the law of the conservation of energy. It would merely be to assert that we are here at a different point of view to which the categories of mechanism are not adequate; in the sphere of what Kant saw to be

different conceptions altogether, irreducible to the ordinary categories; the sphere which he assumes to be unreal, and of regulative validity only. May it not be, to take another example, that such controversies as those about the freedom of the will and the existence of God are mainly due to a dogmatic misapplication of categories. Certainly, the dilemmas which arise regarding them do arise from the application of certain categories, the applicability of which no one before Kant had paused to investigate.

Of course the business of determining the categories appropriate to each department cannot be done *a priori*. It is the attempt to make the determination on an *a priori* basis which has led to much of the discredit into which philosophy has fallen in regard to Science. The work must be done inductively, as the result of full knowledge of the materials which are comprised in each department. The difficulty, as things at present stand, is that knowledge of the nature and extent of the danger of falling into metaphysics is confined to metaphysicians, who are, in their turn, devoid of adequate scientific knowledge. For a mere general acquaintance with Science is not enough for this work. The only men who can do it are those to whom scientific investigation and its methods are concrete realities, the business of their daily lives, and who experience the danger, at every turn, of putting their own reading into what they profess simply to observe. The scientific layman who reads a book on the general aspects of physiology, or even physics, feels this at every turn, and feels himself at the same time powerless to check the results which those who speak from first-hand knowledge tell him they have got. We may be certain, in our own minds, that a mechanical view of cell structures is inadequate to the realities of nature, but we are not in a position to tell those who we think ought to know better where their professions of passive receptivity in observation have failed them. It is, to my mind, unquestionably easier for the man of science usefully to study philosophy than for the philosopher to make anything like an adequate study of science. The theory of a criticism of categories does not rest on any dogmatic basis. It simply asserts doubts and dangers and asks people not to make assumptions which are not and cannot be verified.

I should be sorry to suggest that the work of students of formal logic was at an end. What I do mean is, that there is an immense amount of work to be taken in hand which can only be done by masters of departments of observation and experiment, who have made themselves familiar with the doubts which Kant and Hegel and their modern disciples have cast upon, not the facts, but certain generalisations and influences which are made in a light and airy fashion from the facts. Anyone who will take the trouble to read

such books as Du Bois Reymond's popular lectures, Prof. Tyndall's *Belfast Address*, and Profs. Tait and Balfour Stewart's *Unseen Universe*, or even Mr. Herbert Spencer's *Principles*, will recognise what I mean. What philosophy can do is to display the danger signal, and impress on the devotees of observation and experiment the necessity of a preliminary criticism of these categories. This done, the logic of the various sciences can, it appears to me, be worked out only by the men of science themselves. One has a something more than uneasy sensation about the second-hand science that one finds in even the best text books of the present day.

Why do physiologists throw over Vitalism? Some of the greatest physiologists, men like Johannes Müller, have been Vitalists, and there is evidence in some of the introductory chapters of modern text books on the subject that there are distinguished modern physiologists who adopt the mechanical standpoint, if at all, only with misgivings. But there can be little choice, while there is no choice of categories. Were it once recognised that a man who refuses to treat, as an illusion, the conception of a whole which determines and conserves itself into parts, or of an end which the organism is striving to realise, is not necessarily acting irrationally in seeking to throw overboard generalisations about energy, which are well established in other spheres, but do not necessarily apply to that in which he is working, we should be on safer ground in approaching nature inductively. The same thing is seen of the controversies about the foundations of the higher mathematics, the methods of empirical psychology and a multitude of other topics about which few people are free from presuppositions. It seems to me that an immense mass of work remains to be done in this connection, and that the metaphysician is unfortunately not in a position to do it.

"The teleological judgment," says Kant, in the *Critique of Judgment*, "is at all events problematically applied with justification to the investigation of the facts of nature, but only in order to bring an investigation of these facts within the principles of observation and experiment, by analogy to a causation by ends, and without the delusion that we can thereby explain it. It belongs to the reflective and not to the constitutive judgment. The conception of combinations and forms in nature existing for ends is at all events a principle for bringing phenomena under rules, where the laws of a merely mechanical causality do not suffice." Kant in this passage shows how clearly he realised the inadequacy of the twelve constitute categories to the comprehension of nature. But he relegates those other teleological categories which he sees to be necessary to the region of subjectivity. One of the main services which Fichte, and still more

Hegel, rendered to philosophy was in pointing out the impossibility of ascribing more reality to the one kind of category than the other. We may analyse a landscape as we please into irregular combinations of form and colour, but it will continue to involve as an important part of its significance, those categories of the beautiful through which alone a sunset, for example, is important. We may trace life down to its lowest forms, but so long as we are dealing with life and organisation we are dealing with what is intelligible through concepts which do not belong to the sphere of mechanism, and there is no justification in an observation of the facts for the confusion of one with the other. Hegel gave us a theory of the categories, much of which may well remain long after his absolute system has ceased to be read. We may decline to accept his deduction in the systematic form into which he throws their relations. But he has done permanent work of a kind which cannot be questioned, in his examination of the differences which distinguish these categories from one another. We may refuse to use any more the result we thus obtain for the construction of an *a priori* "naturphilosophie." But this should not blind us to the fact that we do in the various sciences regard nature from abstract points of view which employ one of certain fundamental conceptions, and which do not profess to exhaust the whole. It was wrong to do as Kant did in arbitrarily taking certain of these conceptions and regarding the standpoint to which they belonged as the only one which was truly concerned with reality. But Kant saw the necessity of a wider view of things, and allowed subjective validity to the rest of the ideas which we find in nature. For him these ideas were even necessary to the modern man of science who preaches the mechanical method of regarding nature as the only true one, these other conceptions have not even subjective validity. Truly it is time that philosophy took in hand the business of correcting this new dogmatism. Some of the younger biologists are already becoming alive to the mischievous effect it has on the possibility of faithful observation of nature. From them a logic of science which should contain a criticism of its categories and at least reveal the danger of uncritical procedure would surely meet with a response.