In previous articles I have been concerned with various aspects of science; and I have now to endeavour to look at scientific activity as a whole, and to view it in its relation to other activities of man. I have been trying to avoid those pleasant sweeping generalizations which strike the imagination and which are so easy to write and to read about: such as that science is our only avenue to truth; or that science is abstract and tells us nothing about the concrete nature of things; or that knowledge of particular facts is the object of science, generalizations being merely a means thereto; or that generalizations are the object of science, investigation of particular facts being merely a means thereto; all of which can be defended by a rich array of arguments, none of which can finally stand confrontation with the actual nature of scientific activity as a whole. The situation seems to be much more complicated than any such generalizations would suggest.

The view which seems to have caught the popular imagination at the present time is the view that science is abstract, merely descriptive of events from the outside, and that therefore we must look elsewhere for an insight into the true nature of cosmic process. There are various reasons which can be plausibly given for the success of this view. In the nineteenth century science seemed to be getting closer and closer to the ultimate units of which things were made; the general lines of the ground plan of the universe seemed to be pretty patent; and it seemed as if only the details of the whole, with perhaps a few modifications in the account of the ground plan, remained to be made out. Again, the prospects for the human race, under the guidance of science and invention, seemed rosy. Soon we should all have more conveniences, better health, and a mastery over the secrets of nature. But things did not work out in this way, either in the realm of theory or in that of practice. The farther men penetrated into the depths of nature, the more puzzling her secrets became. The use of science and invention did not lead to happiness, but to the destruction both of man and of the country-side. The prospective benefactor turned out not to be so desirable a guide after all. And in consequence the opportunity was welcomed for putting him in his proper place. The fine arts, poetry, and religion began to breathe more freely, and to bestir themselves to tidy up.
the mess. Philosophy, which had long been objecting to the extravagant claims of science, now found its objections sustained even by scientists themselves.

But in truth this plausible account of the reasons for the popular currency of the view that science is merely descriptive does not represent the whole situation in proper perspective. The whole situation, it must be repeated, is much more complex. At the same time something like the above account represents the popular view of the situation. And we can put the popular view somewhat as follows: "If science is merely abstract and descriptive then it is our servant and we can go ahead and try to strengthen and deepen the spiritual life of mankind by taking a wider view. If science gives the ultimate nature of reality then it is our master, and spiritual life is in danger." Not that everybody holds this view. Everybody never does hold the popular view. But it is very widespread.

II

What I find objectionable in this view is the antithesis on which it rests. "Either science gives the ultimate nature of reality or it is merely abstract and descriptive." This antithesis seems to rest on a more fundamental antithesis between the method of analysis as a means of exploring nature and the method of intuition as a means of seeing Reality in its wholeness. The method of analysis rests on the assumption that any complex whole is built up of parts which are themselves either complex, and so built up of parts, or simple. Thus in the end there are certain ultimate simple constituents in the universe with their own basic properties. These basic properties they retain, however they are combined to form complex wholes, and the properties of the complex wholes depend on the properties of their simple constituents. The method of intuition denies that complex wholes can truly be regarded as built up of simple constituents, and insists rather that the nature of a whole dominates its constituents, imposing on any constituents a character which belongs to it only in its place in the whole: so that except in so far as you begin to grasp the character of the whole as such, you cannot hope to begin to understand the nature of its constituents. If, then, you begin by separating from the wider universe any apparent whole (such as physical nature abstracted from human activity) you are falsifying its nature; and your analysis of it into its constituent elements are merely a prolongation of your original falsification, which may perhaps be useful for certain practical purposes, but cannot possibly be true. The method of intuition then insists that truth is lacking to any view which does not reach up to the ultimate whole.
of Reality. The method of analysis insists that truth is to be found only when it is based on the ultimate elements of things.

Such wholesale contrasts seem to me to be too sharp. What if there should prove to be no separable ultimate elements of things, and no whole of Reality which imposes a character on all the partial wholes within it? And may there not be two main kinds of complex to be met with, one of which takes its character from its parts, one of which gives its character to its parts, and any number of intermediate grades of complex lying between these two main kinds? If there are, will it not be the business of science to note and study them, each in the way appropriate to it? The doctrine of emergent evolution, touched on in a previous article, suggests something like this. It suggests, e.g., that atoms can enter into atomic complexes which are not yet molecular, and whose properties depend on the properties of the constituent atoms; but that they can also enter into molecular complexes, whose properties are other than anything deducible from the properties of the constituent atoms; and so in general. Again, every complex is actually to be found in a wider setting. May it not be that as regards certain characteristics of a complex either some aspects or the whole of this setting can be neglected, while in regard to other characteristics some aspects of the setting must be taken into account? Our view of the principle of causality, and of the general nature of abstraction, involves this. If any of these possibilities should be actually met with, the sharp antithesis between the method of analysis and the method of intuition falls, and science cannot be described as following exclusively the method of analysis, or as false abstraction because it does not use the method of intuition. Its task will be that of studying its subject-matter, whatever it may be, by methods appropriate to that subject-matter. That such a description of the task of science tends to blur the sharp edges of the concept of science is true. But too sharply defined a concept may be misleading. Is science to be restricted to study based on quantitative measurement? Is a laboratory bench, with instruments of precision, to be regarded as essential to it? If a musician notes that certain effects are obtained in a piece of music by repetition, or inversion, or variation of certain musical phrases, or a painter notes the way in which certain rhythmic lines aid in knitting the various parts of a picture into a unity, is he using scientific method? Or is his study only to be described as scientific if he proceeds to generalize, and then to abstract, and by setting up laboratory apparatus to study the effects of various simplified musical or linear patterns? For myself, I should admit all these stages to the name of scientific, and agree that they are all valuable, indeed, indispensable, if used rightly and within proper limits; though I should demur to the suggestion that an investigator without
musical or pictorial sense could, with the aid of the laboratory, penetrate farther into aesthetic quality than the musician or painter could who was ignorant of the laboratory. Scientific study in such a field would involve both studies and both types of ability; and it would not be possible to say beforehand what the value of the abstract simplifications of the laboratory would be. What is true here is true elsewhere; analysis serves some purposes, but not all; in some cases the whole imposes its character on its parts, but not in all. Appropriate study of a whole is in general a mixture of both.

One might indeed question whether it is really in the end possible to describe any act of thought in terms of either intuition or analysis alone; for even where a complex is being dealt with which can be described in terms of its parts, an insight into the fact that this is so is necessary to complete the analysis; and where the complex gives its character to the parts this can only be decided by showing the insufficiency of analysis to describe the whole in terms of the parts. But leaving this aside, and allowing that the two activities can be distinguished, it seems clear that scientific study in general uses both.

III

If these considerations are admitted to be sound then it will follow that scientific study does help us to an insight into the nature of things, even though it is unable to point to any ultimate simple elements whose natures determine the whole cosmic process, and even though it does not carry us up to one single whole which determines the nature of all its parts. Certain other consequences will follow. Science will still endeavour to pursue its researches into the elements of things; for it will never be possible to say with finality what complexes are such as to impose their character on the nature of their parts, and what complexes can be explained by the natures of their parts; and it will always be important for the scientist to seek to describe complexes as arising out of their parts, even though he must keep in view the possibility that there are many complexes for which this cannot be done. He must, that is, make it a rule of method to seek always the determining constituents within a complex without asserting as true the principle that all complexes are determined by their constituents. Or in other words he must seek always to verify the principle, *Nihil est in toto quod non prius in partibus*—there is nothing in any whole which was not to be found already in its parts—which can be described as the principle of determinism, without affirming it as the principle which holds of all complexes. But all this will represent only one side or aspect of his investigations; these researches are a means to the fuller understanding of complexes; and where he finds complexes which he has
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not so far succeeded in deriving from their constituents he must at least provisionally endeavour to make out the way in which the organization of the constituents modifies the characteristics they have apart from this organization. A combination of openmindedness and of research directed toward the making out of detail will thus characterize the scientific activity. It is the fuller recognition of this on the part of scientists themselves that has led many of them to give up the claim of science to penetrate to the nature of things; but it does not seem either necessary or desirable for science to give up this claim in its entirety. It is not necessary to suppose that there are in the universe only two sharply contrasted kinds of complex, viz., those whose wholes determine the nature of their parts, and those which are determined by the natures of their parts. There is no reason why there should not be wholes which in certain respects are determined by the natures of their parts and in certain respects determine the nature of their parts. If we denominate the one kind of relation as that of determinism—given the parts the whole follows—and the other kind of relation—the whole imposes new characters on its parts—as creativity, then we can suggest that determinism and creativity are features to be found mingled in varying degrees in things. Science will have to do with both.

IV

It is at this point that we can introduce the conception of value into the discussion. We meet this conception most clearly in conscious activity. The process by which a conscious being sets out to produce a particular complex with a certain nature belonging to it as a whole can be described as a process of realization of value. To describe the process in this way implies that a conscious being is capable of acting as a whole, and is not merely determined in his actions by the natures of the parts of which he is composed. It implies that the complex he produces requires his activity for the particular groupings and juxtapositions of the materials he uses, though it does not imply that the complex he produces must itself necessarily be one whose nature as a whole determines the natures of its parts. For the effective conscious realization of value it is necessary that he should know how parts and wholes are related in the particular field of his activity. He can use both deterministic and creative materials (if the expression be permitted) for his purpose. But he must know the characteristics of his materials if his activity is to be in the highest degree effective. In other words, scientific knowledge, as we have described it, is essential for the effective realization of value.

It should be noted that for this purpose it is not necessary to have penetrated to any ultimate elements of things. It is not necessary
to have seen an ultimate Whole of Reality as determining the nature of all things within it. It is necessary, rather, to be able to make relative isolation of certain complex materials within the universe, and to be able to foresee what will result when these materials are brought together in certain ways. And if science can give this foresight it is giving at least the kind of knowledge needed for the realization of value. But it is just in so far as science does put us into touch with the natures of things (in this sense) that it is able to aid conscious purpose.

I do not wish to enter into the questions of what is meant by value, whether value is something independent of conscious appreciation, and so on. It is enough for the present purpose to note that conscious beings do recognize values, and do endeavour to realize them; that their activity depends on the kind of values they endeavour to realize, and on the intimacy of their knowledge of the materials through which they endeavour to realize their values. Again, a man’s values are not entirely determined by his scientific knowledge, though they may be to a large extent modified by it; for the perception that one kind of situation is easily realizable, while another kind is hardly or perhaps not at all realizable, does often tend to direct attention to the one situation and divert it from the other, even though in the absence of any such perception the latter situation might be regarded as the more valuable. It is in this way that scientific knowledge may become dangerous to the higher values; we grasp what is within our reach, and mechanize life instead of spiritualizing it. But blame should not be laid on science for this. It is we who are to blame for the lower use of what can become a higher instrument. Indeed to blame science is to darken insight. Those who would wish to turn away from science altogether, in the interest of spiritual life, seem to me to be guilty of some such blindness. I would suggest that it is only by the right use of scientific knowledge that in the last resort the highest spiritual values can be realized.

Knowledge is indeed itself a value, and the endeavour to make knowledge as wide and as detailed as possible is itself an endeavour to realize value. It requires long and continuous effort of self-discipline and of self-abnegation. The investigator must in the first place limit himself to a narrow field, must become a specialist in this field, if he is to succeed in his efforts; and this is no light matter. The desire for knowledge is in itself unlimited, and it is often only with great reluctance that the investigator can bring himself to renounce width for depth and precision. He must again impose on himself the strictest discipline, keeping watch lest his desire for conclusions outstrip his
insight. He must be ready to communicate what he has already discovered to other investigators in the same field, regardless of the fact that they may be enabled to make more imposing discoveries, win more applause. He must keep his imagination on the stretch, while at the same time holding it well in hand. His emotions he must bend to his purpose of gaining knowledge. And it will be found, I think, that in general this self-discipline is a moral discipline which affects his whole life. It is at any rate a discipline of a sort which is essential, however it be brought about, for the realization of any spiritual values of whatever kind. We should do well, when we are tempted to blame science for the mechanization of life, to study the scientist himself at work, and see the kind of life he lives in his pursuit of knowledge. It is the plucking of the fruit of the tree of knowledge, without the toil needed for the production of the fruit, that is responsible for the lowering of values.

The kind of knowledge I have described is itself a value, but it does not give rise to values distinct from itself, however much it may affect our attitude toward other values. Plato makes Socrates insist on this in the dialogue called the *Charmides*. The wisdom of which he is speaking is defined differently from the knowledge of which we have spoken, though in effect he is referring to the same thing. "Let us suppose," he says, "that wisdom is such as we are now defining, and that she has absolute sway over us; then each action will be done according to the arts or sciences, and no one professing to be a pilot when he is not, or any physician or general, or any one else pretending to know matters of which he is ignorant, will deceive or elude us; our health will be improved; our safety at sea, and also in battle, will be assured; our coats and shoes, and all other instruments and implements, will be well made, because the workmen will be good and true. Aye, and if you please, you may suppose that prophecy, which is the knowledge of the future, will be under the control of wisdom, and that she will deter deceivers and set up the true prophet in their place as the revealer of the future. Now I quite agree that mankind, thus provided, would live and act according to knowledge, for wisdom would watch and prevent ignorance from intruding on us. But we have not as yet discovered why, because we act according to knowledge, we act well and are happy, my dear Critias."

Critias admits that what is needed over and above this knowledge is the knowledge of good and evil; whereupon Socrates replies:

"Monster! you have been carrying me round in a circle, and all this time hiding from me the fact that the life according to knowledge is not that which makes men act rightly and be happy, nor all the sciences together, but one science only, that of good and evil. For, let me ask you, Critias, whether, if you take away this, medicine
will not equally give health, and shoemaking equally produce shoes, and the art of the weaver clothes?—whether the art of the pilot will not equally save our lives at sea, and the art of the general in war?"

"Quite so."

"And yet, my dear Critias, none of these things will be well or beneficially done, if the science of the good be wanting."

VI

Plato was himself anxious to insist that though knowledge of the sciences is not itself knowledge of good and evil, it is yet a stepping-stone, and indeed an essential stepping-stone, to that knowledge. Whether we follow him in this or not, it is a mistake to turn away altogether from science and seek our spiritual values in entire independence of it; and equally a mistake to regard science as itself the only or the dominating value. Both these mistakes are frequently made. But insight into æsthetic quality, for example, is not a matter of momentary vision, but involves a lifetime’s active search, just as much as does insight into truth:—

This is that Lady Beauty, in whose praise
Thy voice and hand shake still—long known to thee
By flying hair and fluttering hem—the beat
Following her daily of thy heart and feet,
How passionately and irretrievably,
In what fond flight, how many ways and days!

It cannot be separated from the effort to produce works of art, and again to enter as fully as possible into the significance of works of art produced by others. And it is folly here to despise the attempt to enter into the detail of a work of art, to see the way in which the parts contribute to the whole and are transfigured by their place in the whole. Whether you are so constituted as to be able to see this without any kind of conscious exploration—that is to say, by a kind of intuition—or whether you have to make conscious effort to see it, is not here to the purpose. However you do it, your grasp of the significance of the work of art, just as much as your ability to produce works of art, demands a grasp of technique. It demands, in short, knowledge of detail held in due subordination to grasp of the whole. This is none the less true, although there are in fact many seekers after æsthetic value who plod toilsomely on the pedestrian path of technique without vision. They do what they can; and their shortcomings do not warrant a neglect of technique. Nor is their contribution useless. They are the labourers who bring stones for the paving of roads.

The same is true of the attempt at realization of good. Even if

2 Rossetti, Sonnets for Pictures: Sibylla Palmifera.

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you retire into a cloister and seek your good by way of ecstatic vision, you will not succeed without a lifetime's active search. And even here you will find technique as important as elsewhere, and just as liable to get in the way of your vision. The detail you will here have to master is the detail of your own complex nature; "Know thyself" will become even more essential if you are seeking heaven by way of the cloister than if you are seeking it by way of activity in the world of men. By technique I mean knowledge of wholes in their detail, and knowledge of how to produce new wholes by modification of detail. It is science in its practical aspect. And I suggest that it is essential for the realization of value in any field whatever; essential and dangerous. It is the devil on whose shoulders you have to climb if you would gain the heights of heaven.

If you seek the realization of good in the world of man, the importance of detailed knowledge of human nature, and of how to move men, becomes more obvious still. The great moral reformers have possessed this knowledge in a high degree apparently without seeking for it. Men of lesser insight have to seek for it with toil. Just so in the world of pure science, the man of genius often sees into detail in flashes of insight which the less gifted have to verify by slow process. The slow process is, however, essential to the forward advance of mankind. And if all men are to be put in the way of living the good life it is essential that knowledge of human nature, as well as of physical nature, should be both deep and widespread. The task is one not merely of insight into ends, but of detailed knowledge of means, and of ability to bring about appropriate types of organization. I do not forget Carlyle's jibe at the English faith in the machinery of organization in the effort to realize spiritual ends; organization is in this field what technique is in the field of art, at once the devil and the essential helper.

VII

I hold, then, that science is itself a value which men do seek to realize, and that it is not itself merely instrumental to the realization of values other than itself; that while it does not furnish theoretically rounded off knowledge in the sense of either penetrating to the ultimate elements of things or of reaching up to the ultimate whole of things, it does nevertheless furnish knowledge adequate in its kind; that this kind of knowledge, while not in itself sufficient to lead to insight into values other than science, is yet necessary for full insight into other values and for their realization—necessary, however dangerous it may be. Science provides instruments which can be used blindly when the vision needed to guide them is lost: if we use its instruments we endanger our vision; but if because of this we turn aside from its instruments we endanger our vision still more.