CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

THE IDEAL AIM OF PHYSICAL SCIENCE

A SCRUTINY of the activities and of the utterances of the men who, through the centuries, have been the pioneers in scientific discovery does not lead to the conclusion that their aims were wholly, or even mainly, of what may be called the practical order. As we all know, their labours have resulted in a progressive transformation of industrial and social life in the modern age. But the true man of Science has been dominated by a deep-seated impulse to obtain a precise knowledge of, and in some sense to comprehend, natural phenomena. In fact his aim has been to obtain the satisfaction of what I may perhaps venture to describe as glorified curiosity. For him, the practical inventions to which I have alluded have been at most a by-product of his activities, subordinate to his striving after the attainment of a purely mental satisfaction. In fact, with some notable exceptions, men of Science have, in a large measure, relegated the exploitation for practical purposes of their discoveries to men of a different type of mind; to the inventors, whose labours were however absolutely dependent, for the possibility of success, upon the results of pure Science.

It is of the ideal aim of Physical Science, as distinct from the practical aim of controlling natural phenomena, and in particular of the different manners in which this ideal aim has been, and may be formulated, that I shall speak in this Lecture. I propose to illustrate the matter by means of refer-

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

ences to some of the most modern physical theories. As a simplification, necessary in a single Lecture, I shall avoid all reference to those phenomena in which the fact that some of the objects in the physical world are what we call living organisms is, or appears to be, relevant. I shall, in fact, restrict myself to that simpler part of Natural Science which we call Physical Science, but which includes Chemistry, which is essentially a department of Physics, and also Mathematics, which has its origin in the same source as Physics in general, and is, in its abstract form, the indispensable instrument for the formulation of all physical theories which have reached an advanced stage in their development. Physics and Chemistry, owing to methodological and historical reasons, were for a long period cultivated separately, but they have in our time, owing to the discoveries in the last few decades, in the domain of Radio-activity, been forced to recognize, at least in principle, their essential unity.

The form in which the ideal aim of Physical Science has been conceived has varied greatly at different epochs, and it has depended very largely upon the general philosophical outlook of particular periods and upon that of different groups of thinkers during one and the same period. In recent times, in which specialization of knowledge has been much more prominent than in earlier periods, many, perhaps most, men of Science have been but little subject to the direct influence of the movements of speculative Thought; and they have often conceived the aims of Science in accordance with the

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE
Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

uncritical views of what is called common sense. But the recent theory of relativity, promulgated by Einstein and his followers, subversive as it is of certain assumptions hitherto universally made both by Science and common sense, has forced upon the scientific world a reconsideration of fundamental matters, in such wise that a renewed discussion of the more precise formulation of the ideal aim of Physical Science can scarcely be avoided.

In making attempts to define the general aim of Physical Science as something which is, at least in some degree, capable of attainment, we are not bound to accept as satisfactory the notions of particular great men of Science, present or past, as to the fundamental character of such ideal aim. A man of Science may think he is engaged in doing one thing when in fact he is doing something that turns out, when closely scrutinized, to be quite different from what he imagined.

There is one source of frequent misunderstanding as to the aim of Science; that is an insufficient delineation of the frontier line between Physical Science and general Philosophy. Without such delineation the aims of Science may be so extended as to include some at least of the wider aims of Metaphysical Philosophy, the attainment of which requires something beyond those methods of procedure which are alone essential for the purposes of Physical Science.

Philosophy, in its eclectic review of the whole of human experience, has to take into account the methods and general results of scientific enquiry,

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

and has to use them for the purpose of making ontological and other inferences applicable to the universal domain with which Philosophy is concerned.

The making of such inferences from the results of Science, and a scrutiny of the validity of such inferences, is no part of the direct aims of Physical Science, but the mistake is frequently made of including in those aims what should really be regarded as belonging to the aims of Philosophical thought, so far as it uses the results of Science as material for its own purposes. No doubt, like all frontiers, the frontier between Physical Science and Philosophy is partly conventional, but the position of Physical Science is greatly strengthened if its aim is so formulated that it is shielded from those elements of doubt and uncertainty which may arise in connection with the wider philosophical inferences from the results of Science. The aim of Physical Science should accordingly be regarded as a modest one, compared with that of general Philosophy. There is no need to make Science responsible for the inferences which Philosophy may make from scientific results, and least of all for the underlying ontological, or other, assumptions upon which such inferences may be based. It is said that Science has to deal with physical phenomena, but that every phenomenon is an appearance of something to someone; and thus that the characteristics of phenomena may be used for making inferences as to the characteristics of that something which gives rise to the appearances. Thus a real ground, or an underlying substance, or things in themselves,

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE
Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

or νοούμενα are brought into relation with scientific results. Inferences of this species may be quite legitimate matters for general Philosophy, but there is, I think, an overwhelming advantage, for clarity of thinking, both on the philosophical and on the scientific side, if such inferences are completely extruded from the province of Physical Science, which may, with great advantage, confine its attention to dealing with the phenomena themselves, and can thus free itself from speculative accretions, the due discussion of which, important as it no doubt is in general Thought, requires methods and ideas which are not necessary for the primary purpose of classifying and systematizing the march of physical phenomena.

The notion that the main aim of Physical Science is to *explain* physical phenomena has, at least until recently, been a dominant conception of the function of Science. It is however necessary to enquire what precise meanings have been attached to the term "explanation." To explain, or make plain, a phenomenon, or a group of phenomena, has often been taken to denote the reduction of the relatively unfamiliar to a case of the relatively familiar. The making of mechanical models which imitate the elastic, or other, properties of matter is an example of the idea that phenomena can be explained by reducing them to an instance of what is so familiar that it is regarded as already plain; the assumption being made that the functioning of the model does not, at least provisionally, itself require elucidation.

Since the time of the Greeks the idea has been

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

extraordinarily persistent in the history of Physical Science that all physical interaction must be due to what takes place on the contact of bodies, or to their impingement on one another. The fact that, in order to produce physical changes in our environment, we place some portion of our bodies in contact with external things has made the notion of contact action so familiar to us that the reduction of physical phenomena of any class to a case of contact action affords, in the sense to which I am referring, an explanation of the phenomena in question. To this order of ideas the introduction into Physical Science of the various ethers and effluvia which have figured in the history of Physics is due; they were all introduced with a view to the mediation of contact action. When Newton's law of Gravitation was formulated, it was held by Newton and his contemporaries that, as action at a distance is inconceivable, the law itself afforded no explanation of gravitational phenomena; that, in fact, it was necessary, for a real explanation, to show that the formal law could be accounted for by action propagated through some medium by which the apparent, but unintelligible, action at a distance could be reduced to an intelligible contact action, or in accordance with Le Sage's theory, to a system of impacts.

The numerous unsuccessful attempts which were made to effect this reduction were inspired by this supposed need. The full recognition of the fact that action by contact or shock is in need of further elucidation; and that in fact a reduction to spatial

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

scale of phenomena to be explained is all that can be accomplished by the introduction of an ether, or intervening medium, is even at the present time, in some quarters at least, incomplete. It is only right to emphasize the fact that the employment of substantial ethers has been of immense value at various stages in the development of Physical Science, although it only leads to an explanation of phenomena in the very circumscribed sense of the term "explanation" of which I am now speaking; moreover there are in general insuperable difficulties connected with the constitution and physical properties of the ethers or media.

The most rigorous sense in which the term explanation is used is that in which the major and minor premisses of a syllogism explain the conclusion; that is of reduction to logical identity. The application of this conception of what is meant by "explanation" to the case of physical phenomena has taken a very different form in the modern period from that which was prevalent in medieval times; but traces of the latter conception have still appeared from time to time up to our own day. We come thus to the notion of explanation by means of *à priori* laws. The idea that the laws of physical phenomena can be obtained as *à priori* constructions of pure thought; that physical phenomena must of necessity proceed in accordance with certain principles regarded as *à priori* necessary, dominated thinkers for a long time. Implications of this kind have been persistent even since the doctrine in its pure form has no longer been

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

accepted. The doctrine in its fuller forms received its death blow after the Renaissance, when Bacon and others succeeded in establishing the view that empirical knowledge of physical facts and processes must be the ultimate and indispensable basis of the coordinative and constructive efforts of the human mind which lead to the edifice of scientific knowledge. That facts are the basis of all true Science has now been universally recognized, and has sometimes even been stated in such a manner as to depreciate unduly the importance of the other factors in the growth of Science, and to call for the warning expressed by Poincaré in the words "Science is built up of facts, as a house is built of stones; but an accumulation of facts is no more a Science than a heap of stones is a house." But the more ancient error of admitting scientific principles which have not been shown to rest upon the basis of actual physical experience dies hard. The principles of conservation of matter, of mass, and of energy, and the principle of least action, have all been based by various thinkers in modern times upon supposed necessities of thought. The notion of indestructibility, or conservation, as an *à priori* principle, has proved singularly unfortunate in relation to attempts to decide what it exactly is that is conserved during physical transformations. The principle of conservation of mass, of great value as a formulation of what holds good at least with sufficient approximation in a large class of physical processes, is now, in accordance with recently acquired knowledge, regarded as untenable in the

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

absolute sense in which it had been accepted. Indeed, in accordance with the theory of relativity, mass has been merged in energy, and both mass and energy have measures only of a relative kind. By Leibniz, the principle of the conservation of kinetic energy was made to rest upon the *à priori* principle of causation; and by J. R. Mayer, and by Colding, both pioneers of the general principle of conservation of energy, the truth of the principle was not made to rest upon experimental evidence such as that adduced by Joule, but rather upon *à priori* principles relating to the necessary indestructibility of the original endowments of matter.

Even Clerk Maxwell, whose fame as a true scientific discoverer will be at least as enduring as that of any man of Science of the nineteenth century, made an attempt to prove the principle of inertia on an *à priori* ground.

But the main form which the notion that the function of Physical Science is to obtain explanations of physical phenomena and processes has taken in recent times is embodied in the idea that Physical Science must proceed, by stripping off from our sense data what is regarded as accident or subjective appearance, and penetrating to an underlying objective reality to which the phenomena or appearances are regarded as due. Thus the aim of Physical Science, from this point of view, is to obtain a knowledge of objective reality, or at least of that part of reality of which the physical world is the manifestation. The complete acceptance of empirical observation as the basis of Physical

© in this web service Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-1-316-61984-1 — The Ideal Aim of Physical Science
E. W. Hobson
Excerpt
More Information

Science would appear to have strengthened the opinion of the majority of modern men of Science that they are engaged in an attempt, which has been in some considerable measure successful, to obtain a knowledge of the characteristics of ultimate reality.

By what tests we are to be assured, at any particular stage of the evolution of Physical Science, or of any department of it, that we have at any point actually reached bed-rock reality is not clear. If the test is taken to consist of the reduction of physical sequences to a chain of causes and effects in which the relation of cause with effect becomes completely transparent, and appears as a relation not only of observed invariable sequence in point of fact, but as one in which any kind of necessity is to be discerned, it may, I believe, be safely asserted that in no single instance has this test been satisfied. The words of David Hume in criticism of the view that we are able to discover either efficient causation or logical necessity in the sequences of natural phenomena themselves have a weight of evidence in their favour which has, if possible, been rendered more cogent, and of application in a deepened sense, by the wonderful developments of Physical Science which have taken place since he wrote the following words: "When we look about us towards external objects, and consider the operations of causes, we are never able, in a single instance, to discover any power or necessary connection; any quality, which binds the effect to the cause, and renders the one an infallible consequence

© in this web service Cambridge University Press www.cambridge.org