# PHILOSOPHY
# AND THE CONCEPTS OF
# MODERN SCIENCE

*By*

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DEDICATED TO MY TEACHER

JOSEPH A. LEIGHTON

# INTRODUCTION

THAT the present age is one of critical examination in which scientific concepts, traditional institutions, and social practises are being weighed in the balance is an observation so trite that only purveyors of platitudes are guilty of calling attention to the fact. Nevertheless the reorganization in ideas and practises we are now undergoing is so fundamental that many tangled metaphors are invoked to describe this upheaval. One of the most curious manifestations of the sometimes paradoxical situation of modern culture is found in the fact that while science, in the course of the last several centuries, has progressively extended man's control over nature, it has at the same time been undermining its position as a theoretical discipline. Thus we find that after verifying Francis Bacon's dictum that knowledge is power, modern science is coming to see that power is not necessarily knowledge. As an example of this imbalance of theory and practise we need only point out that while science has increased its ability to predict and determine the future, there is as yet no adequate theory of "natural law" explaining and justifying these practical results. The status of induction, causality, probability, etc., is a scandal in the philosophy of science which is no whit abated by the advent of Heisenberg's famous "principle of indeterminacy."

Undoubtedly many thinkers, noting the fact that the crises in our economic-political systems parallel the need for theoretical reorientations in scientific structures, would regard this coincidence as purely accidental. But it is also possible to regard this necessity for readjustments in social relations and the theoretical foundations of science as two phases of the same unitary phenomenon. This, in fact, is the view of the situation taken by the *cultural interpretation* of history, a view which is reminiscent of the older organismic theory of society. In any case the fact remains that science today is being forced to criticize itself, its procedure and fundamental assumptions, to an extent never before even vaguely anticipated.

So thoroughgoing is this reconstruction that it reaches down into an examination of the logical tools we employ in all our thinking. In other words, one of the formulations now proposed as a necessary part of the new scientific methodology is that we develop a new logic to take the place of the older Aristotelian logic, which the human race has been employing for over two thousand years. Thus it is proposed that we adopt a non-Aristotelian logic, discarding the most fundamental laws of thought which have hitherto provided the regulatory principles according to which thinking has progressed. I have set forth my own reaction to this non-Aristotelian logic in Chapter III. My own view, which at the same time sets forth an alternative to the present popular movement of *Logical Positivism,* is expounded in Chapter V.

It is clear that in order to provide the new intellectual synthesis which the modern world must find, if it is not to disintegrate from lack of unifying principles and thus go down to destruction, it will be necessary for scientists to frame some unifying scheme which will be capable of integration with human culture and with human personality. The theoretical results of science must be humanized and the practical achievements of applied science must be socialized. But while we cry for interpreters, for scientific seers, who can lead us through the mazes of modern learning, our scientists for the most part remain philosophically inarticulate. In view of this situation in science those of us who regard it as the obligation of philosophy to attempt to coördinate the results of science may well ask ourselves, what is to be done?

In the following chapters I have set forth my own impressions of the nature and implications of the intellectual revolution which is in progress. The present view embodies several ideas which are current in present day thinking, namely, the method of phenomenology, the organic theory of nature, the theory of emergence, and the doctrine of humanism. These doctrines, which are somewhat distinct movements, I have tried to combine into one system. Let me indicate briefly the rôle which each of these ideas plays in the development of the present thesis. First let us glance at phenomenology.

As a possible method of integrating the vast and unwieldy masses of facts of the sciences into meaningful wholes the adoption of a phenomenological viewpoint is recommended. By phenomenology is meant a study of that which *exhibits* or *displays* itself: it is the *descriptive* point of view obtained by viewing a thing *as a whole.* Much of the trouble, it seems to me, comes from an overemphasis upon microscopic details. Thus it comes about that we can no longer see the forest for the trees. It is therefore proposed that we occasionally ascend in intellectual balloons and view the forest and ignore the trees! I do not know what term a Freudian would invoke to describe this "flight" from "reality," but it is interesting to note that scientists sometimes turn to this viewpoint. Those who have followed the recent developments in *gestalt* psychology have seen this method appear in psychology. An illustration of the phenomenological method may be found in the study of botany. We may view a flower as a phenomenal pattern, which is the attitude of *appreciation.* Or like the biochemist, who studies the intimate and complex mechanisms, we may analyze the petals of flowers into their intricate molecular structure. But we must never forget that the flower, in spite of its detailed complexity, possesses a *phenomenal simplicity* which is responsible for its *beauty* to us. Lest the reader fear that after all this is only poetry, let me recall that physics and chemistry, in employing the second law of thermodynamics, are also resorting to the phenomenal point of view. And this brings us to our own interpretation of the organic theory of nature as embodied in the doctrine of emergent evolution.

Several years ago, as pointed out in Chapter VII, the writer indicated that modern science is coming to recognize two types of "laws" in nature. This duality of natural law is stated in terms of a contrast between *dynamical* laws and *statistical* laws. The first type, *dynamical* laws, are *causal* laws, giving rigid determinism and predictability, and the second type, *statistical* laws, yield mere probability and introduce indeterminism into the calculations. A dynamical or causal law eliminates contingency, and implies ability to visualize the mechanisms in operation. But in statistical laws, concerned with the calculation of mean values, the individual elements of the statistical ensemble are not studied. Let us set down the contrasts between these two types of laws:

| *Dynamical Laws* | *Statistical Laws* |
|---|---|
| 1. *Illustrated by the principle of least action (including the first law of energetics).* | 1. *Illustrated by the second law of energetics (or thermodynamics).* |
| 2. *Causal (or necessary).* | 2. *Probable (or contingent).* |
| 3. *Microscopic processes are visualized.* | 3. *Macroscopic states (or averaged results).* |
| 4. *Real mechanisms.* | 4. *Phenomenal viewpoint.* |
| 5. *Reversible processes.* | 5. *Irreversible processes.* |

Here we see that the atomic processes of microscopic mechanisms are reversible (sometimes periodically) and subject to necessary causal laws, whereas the macroscopic states represent the mean value of a large number of individual processes of a statistical aggregate. It is sometimes supposed that since the mechanical processes are reversible, the second law of thermodynamics, expressing as it does the irreversible character of familiar natural processes, is necessarily a non-mechanical law. It must be noted, however, that the second law of thermodynamics does not contradict a dynamical law (such as the first law of energetics, more familiarly known as the principle of the conservation of energy), but is supplementary to it. The second law of thermodynamics (or energetics), which gives an *arrow* to time, as Eddington says, does not disturb the foundation of classical kinetic theory. Statistical mechanics, in fact, rests upon the conceptions of the mechanical-kinetic (microscopic) theory, *i.e.*, mass particles in motion. The real difference lies in point of view. The dualism between reversible and irreversible is associated with the dualism of the atomistic and the phenomenal points of view, as Max Planck observes in his book, *Survey of Physics* (p. 103).

The writer has on several occasions independently argued the thesis that it is the second law of thermodynamics which underlies the production of macroscopic or phenomenal states. It is interesting to note that Professor A. S. Eddington, in his work, *The Nature of the Physical World,* favors a dualism which parallels our own distinctions between *dynamical laws* and *statistical laws.* These are termed *primary* and *secondary* laws by Eddington (*op. cit.*, p. 75). According to Eddington, a primary law holds for the behavior of individuals and is indifferent to the time direction; whereas secondary laws hold for aggregates rather than individuals, express probable rather than necessary results, and therefore introduce "chance" into our picture of nature. Eddington states that it is the second law of thermodynamics, illustrating a secondary law, which gives to time the arrow which indicates direction or is responsible for irreversibility. This idea is entirely in harmony with the writer's supposition that the unidirectionality (irreversibility) of experienced time is a manifestation of the irreversibility of the biochemical reaction in the human brain, as these reactions proceed in accordance with the second law of thermodynamics. Some experimental verification for this view is provided by Professor Hudson Hoagland, in a paper to which he refers as he comments upon the present writer's view (cf. *Philosophy of Science,* Vol. I, 1934, 351).

While Professor Eddington accepts the second law of thermodynamics as an illustration of a secondary law, he does not explicitly regard it as the basis for the production of what, in the present view, is termed a macroscopic or phenomenal pattern. And yet our own interpretation here is quite in harmony with his view. Eddington tells us (*op. cit.,* pp. xiv-xv) that the external world has become a shadow world, and that the drama of familiar life, from the point of view of present day physics, is a shadowgraph performance. And now we ask, why should we not identify this "shadow world" with the phenomenological world of statistical ensembles which thereby *exhibit* themselves? Why shouldn't the second law of thermodynamics be generalized to provide the physical basis of macroscopic patterns, whether of molecular or of human societies? Eddington almost comes upon this view when he tells us (p. 105) that *entropy* is to be placed alongside *beauty* and *melody,* because they all three appear as features of *arrangement*. Thus nature produces what the writer has called *new simplicities,* or *second order simplicities,* out of *first order* or *simple simplicities*. This difference (except for the ultimate constituents of matter), is relative, *i.e.,* what is a simple simplicity from one point of view is a complex simplicity from another, just as a cell is an elementary unit in an organism (a unitary mode of behavior), but is also a complex aggregate of the large number of molecules of which it is constituted. Part of the present thesis is that the *gestalt* properties of the phenomenal macroscopic state are *field* properties.

In Part II of this work the idea that the second law of energetics is an expression of the tendency of statistical ensembles to come to some common basis of functional pattern is employed in a human social context. That is to say, just as consciousness is a macroscopic emergent from the activities of microscopic entities (neurone frequencies), so social patterns are phenomenological emergents from the social entities of statistical ensembles. This is our social philosophy of energetics. As indicated in the references, the attempt to employ the laws of energetics in a social *milieu* is not unprecedented, for Henry Adams, W. Ostwald, Edwin E. Slosson, and probably others, have made investigations along these lines. The advocates of "technocracy" have popularized the "energetic interpretation of history," but I find little that is new in their views.

And now how does humanism fit into this picture?

Of course there are various conceptions of the meaning of humanism. The implications of the term for ethics are pointed out in Chapter XV. In the field of the philosophy of science humanism is interpreted as a doctrine which stands midway between materialism and supernaturalism. Humanism as here understood holds that these are extreme views, and asserts that the truth lies in a compromise position which includes the best elements of both. Humanism is thus associated with the theory of emergent evolution. Humanism as a theory of nature becomes peculiarly interested in the drama of cosmic evolution at that point wherein man appears on the stage. Man today, in the rôle of the scientist, appears largely as a "student" of this wider world of nature from which the human race emerged. But man's eventual rôle may be quite different, in that he may become the "teacher" in that very cosmic classroom where first he learned to "obey" the laws of nature. Man cannot remain content to be a passive onlooker. His very growth in knowledge and in wisdom will undoubtedly make a difference to the future direction of nature's course. Humanism adopts the position that the final fate of our cosmos cannot be calculated without taking into account the rôle which humanity is to play in the subsequent acts of this as yet incomplete, and perhaps forever unending, drama. And so the naturalist and the humanist join in with the ancient voice of hope and triumph: It doth not yet appear what man shall be!

And now a few words concerning those persons who have influenced me most in the development of my own thoughts. Of course my former teachers have had much to do with the shaping of my views. Here I refer especially to Professors J. A. Leighton, A. P. Weiss, A. R. Chandler, A. E. Avey, B. H. Bode, and H. H. Goddard. From my present colleagues, Professors M. R. Gabbert and Richard Hope, I have received stimulus and helpful criticism. In addition to these influences, and over a period of years, I have been the recipient of counsel and suggestions from others who have been interested in my mental evolution. Among those who, at one time or an-

other, have passed judgment on my work are Doctors Christine Ladd-Franklin, Marvin Farber, G. P. Conger, D. L. Evans, Harry Helson, Hudson Hoagland, N. Rashevsky, Edwin E. Slosson, Smith Ely Jelliffe, G. E. Coghill, W. M. Malisoff, Herbert Feigl, Charles Hartshorne, A. J. Lotka, Archibald Henderson, M. Lukiesh, and Count Alfred Korzybski. I wish to thank these persons for their comments and criticisms, destructive as well as constructive, even though I have not always benefited from their suggestions to the extent that they intended. Finally I wish to thank my wife for her unfailing patience and encouragement during the period of the writing of this book.

Chapter IX of the book is a revised version of an article on "The Biological Origins of Religion," which first appeared in the *Psychoanalytic Review,* January, 1932 (Vol. 19). I am indebted to the Editor of this review for permission to use that article here. Part of the last chapter is taken from a paper on "The Social Objectives of Humanism," which was first read before the First Humanist Assembly in New York City on October 11, 1934. These meetings were organized by Dr. Charles Francis Potter. Professor John Dewey was kind enough to take part in this symposium. My own paper was published in the *New Humanist,* December, 1934, and is here reproduced by permission of the journal. Aside from an occasional quotation, the remainder of the material of this volume has not previously appeared in print in this country.

O. L. R.

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# PART I

## PHILOSOPHY AND THE PHYSICAL SCIENCES

# CHAPTER I

## IDEALISM AND SCIENTIFIC REALITY

### I. Science and Human Progress

Ages, like human beings, have their fashions. Like the men that live in them, periods of history have their individual modes of expression. And so we moderns, not to be outdone, must also have our cultural eccentricities. And who can deny that we have? Is it not obvious that one of the peculiar idiosyncrasies of the modern era is the belief in progress? Even the Great War and the Depression have not permanently damaged our optimistic faith in the future.

There are other intellectual modes which characterize the present age, but let us pause for a moment and examine more closely this confidence we have that history is not purposeless. Progress, as we all know, implies direction in time. The idea carries with it the implication that the past was a preparation for the present, which in turn can be succeeded by an even more perfect future. Accordingly, under the influence of this idea, we have come to regard the course of history from the Ape-man (or the Dawn-man) to the modern period as the record of the increasing realization of civilization. In our charitable moments our enlightened futurists of culture will grant that the Middle Ages constituted but an intermission in the drama of cultural progress, a detour on the somewhat winding but ever ascending highway to the