

Now, this religious situation, namely, that as an inquirer becomes more competent to generalize and criticize he becomes, also, farther removed from the phenomena with which he is to deal—this is in itself one sufficiently unfavorable to sound scientific conclusions, but beyond the difficulty itself is the all but fatal facility which it makes for the assumption that these receding phenomena are unreal in proportion to their inaccessibility. The psychological investigator of religion perhaps feels the religious response and the religious craving no longer. These things for him have lapsed into that limbo of his memory where linger the shades of many adolescent ideals—plans for lofty service, schemes for human betterment, dreams of personal achievements, etc.—programmes which he has discovered can not be realized in this heedless, refractory world; and he easily assumes that his religious experience—possibly a meager and quite conventional one—is of the same stuff throughout as these youthful cloud castles. The ideational part of that long-past experience seems easily explainable as the projection, under the suggestive conditions of some ecclesiastical environment, of the mind's craving for continued betterment, and that form of the craving for betterment being no longer felt by the philosophic inquirer, its real character and significance are not appreciated. Naturally it is but an easy step further to conclude that the religious experience of other men, indeed of all men, however larger in *amount* it may possibly be, is none other in significance and validity than that now vanished phase of the inquirer's own inner life. Now, evidently in such situations assumption, like charity, easily covers a multitude of (logical) sins, leading to conclusions which to the inquirer himself may wear the garb of science, but which have no just claim to its authority.

Wherefore, I conclude that those thinkers who have denied that science can speak the decisive word in theology, and have maintained that when science has done its best, religion will still remain the field of individual intuition and personal life venture, have reasoned well.

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## REVIEWS AND ABSTRACTS OF LITERATURE

*The Mechanistic Conception of Life: Biological Essays.* JACQUES LOEB.  
Chicago: University of Chicago Press. 1912. Pp. 227.

The title of this volume is somewhat misleading to the philosophical reader. It leads him to anticipate that he will here find a mechanistic interpretation of life. What he finds, though, is not an interpretation at all, but a collection of studies exhibiting certain mechanisms of life. Now, it is surely one thing to demonstrate, let us say, the chemical processes in-

volved in a tropism; and it is a very different thing to prove (or even claim) that tropisms are *nothing but* chemical processes. The latter enterprise might result in a mechanistic hypothesis of life; but of this there is scarcely a vestige in Loeb's book. What the author gives us is a valuable collection of experimental studies in biological chemistry. They are such work as even a vitalist like Driesch might have performed.

What is it, then, that warrants the title, "The Mechanistic Conception of Life"? Simply this: Loeb supposes that his recorded facts point unwaveringly toward such a metaphysic, and he often repeats this assurance at the close of his most striking empirical observations. So frequently does the reader come upon such utterances that he may be deceived into thinking that he is reading an interpretation of life logically similar (though contrary in doctrine) to Driesch's "Science and Philosophy of the Organism" or Bergson's "Creative Evolution." Whatever else critics may say of these two monumental philosophical undertakings, they must admit that these do not merely point to a view of life; they actually develop, more or less minutely and coherently, that view together with its wider implications. But it is precisely this which Loeb does not attempt, much less accomplish.

To be persuaded that such a criticism is fair, the reader has only to consult the opening essay, whose title is the title of the book. "It is the object of this paper," so runs the first remark, "to discuss . . . whether our present knowledge gives us any hope that ultimately life, *i. e.*, the sum of all life phenomena, can be unequivocally explained in physico-chemical terms." Were we to take each word of this passage in earnest, we might expect the author to reach the conclusion that there is hope of reaching a complete physico-chemical explanation. But evidently we must not construe so rigorously. For after a review of the now pretty familiar facts about artificial activation of ova, the determination of sex, and the mathematical relations in heredity, he finishes thus: "The solution of the riddle of heredity has succeeded to the extent that all further development will take place purely in cytological and physico-chemical terms" (p. 23). And, concerning psychical life, he adds: "Our wishes and hopes, disappointments and sufferings, have their source in instincts which are comparable to the light instinct of the heliotropic animals. The need of and the struggle for food, the sexual instinct with its poetry and its chain of consequences, the maternal instincts with the felicity and the suffering caused by them, the instinct of workmanship, and some other instincts are the roots from which our inner life develops. For some of these instincts the chemical basis is at least sufficiently indicated to arouse the hope that their analysis, from the mechanistic point of view, is only a question of time" (p. 30). And the essay ends with this remark: "Not only is the mechanistic conception of life compatible with ethics; it seems the only conception of life which can lead to an understanding of the source of ethics."

In Loeb's facts, however, the reviewer is unable to discern the least evidence for the above assertions and hopes. That the organism is composed of chemicals and varies with their processes, is a fact that no longer

calls for proof. But that every relation into which chemicals can enter and to which the organism can react is a mechanical relation, is not merely an unproved presupposition; it is one which can be defended only by foisting upon the term, "Mechanics," a connotation which it has never enjoyed and which is quite repugnant to the mechanistic philosopher and scientist. As the physicist understands it, mechanics is the science of the action of *forces* on material bodies. Technically it is divided into two branches: statics, which considers forces in equilibrium; and dynamics, which has to do with forces non-equilibrated and hence generating motion. Now, if words are to be useful in serious discourse, they must preserve an identity of meaning. Mechanism must signify mechanism. What the man of physics lets it stand for, that must it also represent in biological discussions. But clearly Loeb's usage of the term can not be identified with the familiar one. Many passages from his pages might be cited to prove this; but I shall adduce only a single exceptionally obvious one.

In the essay on "The Significance of Tropisms for Psychology," Loeb says that, while heliotropic phenomena are determined by the relative rates of chemical reactions occurring simultaneously in symmetrical surface elements of an animal, "there is a second class of phenomena which is determined by a sudden change in the rate of chemical reactions in the same surface elements" (p. 54). This second class Loeb distinguishes from tropisms,—and quite properly, too. He designates it with the expression, "differential sensibility." Such sensibility is used by Jennings and others as evidence against the tropism hypothesis of life; but Loeb deems this improper. "If we wish to trace all animal reactions back to physico-chemical laws," he argues, "we must take into consideration besides the tropisms not only the facts of the differential sensibility, but also all other facts which exert an influence upon the reactions" (p. 55). "Ideas can also act, much as acids do for the heliotropism of certain animals, to increase the sensitivity to certain stimuli, and thus can lead to tropism-like movements or actions directed toward a goal" (*ib.*). Now, all this is an amazing,—yes, even a bewildering concession to non-mechanistic hypotheses. In one respect it surrenders the case, while in another it begs the question. It does the former in that it admits the difference between tropisms and reactions to intensity changes; for assuredly an animal which responds to the increase or decrease of stimuli *in successive moments* is responding to something that can not be described in genuine mechanical terms, such as mass, velocity, momentum, force, or the like. It is, of course, responding to acceleration and retardation of some sort; but these are derivatives, ratios of functional increments to variable increments,—in short, peculiar *relations* between forces and space, and time. But what does this imply, if not that an organism with differential sensibility *is stimulated by time*? Or, more precisely stated, is it not responding to a stimulus containing as a constitutive part a duration? What is acceleration if not a *change* of velocity per instant? And what is change if not at least a time-character? As Spaulding has clearly shown,<sup>1</sup> an acceleration is not a punctiform entity; *i. e.*, it does not exist at

<sup>1</sup>"The New Realism," pp. 209-212.

one position in either space or time, but is rather a one-one correlation of the terms of a *series* of velocities with the instants of time. Now by all odds the most significant feature of it is that it is a relational complex extended in time. This fact makes obviously impossible the reduction of it to a quantum of force. It is not a force at all, it is a relation of force to time. And herein appears the difficulty of the would-be mechanistic philosopher. If Loeb grants the existence of a differential sensibility, he must grant also that organisms are affected by other things than mechanical forces. He must admit that the behavior of an animal at a given moment can not be deduced from the pattern of physico-chemical forces in and around it at the previous instant. For a reaction to a change is not a reaction to anything *in* the previous instant; it is a reaction to a relation *between* some character of that instant and a character of the succeeding instant. But if a temporal series of relations can stimulate an organism, into what depths of despondency must the mechanistic philosopher fall? How can he ever again hope, with La Place, to deduce the entire state of the material universe at any desired instant, if only its condition at some one other instant is fully made known to him? The momentary state of affairs is not the sole determinant of the next. The world is full of fore-and-aft connections. These are not "spiritual" nor "vitalistic" nor even psychical, so far as I see; they are merely temporal. But neither are they mechanical in the generally accepted and historical meaning of the adjective.<sup>2</sup>

Emphasis has been here placed upon this difficulty in Loeb's presentation because, in the reviewer's opinion, it is at once the most insidious, the most general, and the least noticed of all mechanistic misinterpretations. It seems to be the original sin and orthodox error of the scientific mind to suppose that whatever involves, in any manner whatsoever, mechanical factors or is in any regular way related to them is itself mechanical. When, in the last passage cited, Loeb says that the mechanistic biologist must take into consideration all facts which exert an influence upon reactions, he believes that he is not damaging his arguments for out-and-out mechanism; and he can believe this consistently only if he falls into the error I have indicated. He must suppose that, if one starts with chemical processes and observes only what influences them, one can

<sup>2</sup> This is not saying that accelerations and retardations are not reckoned with in mechanics. They certainly are. And they are not misconstrued in mechanical computations. But what I insist upon is that they are not admitted as *extra* forces (energies) over and above those moving bodies which figure in their differential ratios. For instance, the displacement of the body *A* by the body *B* which impinges upon *A* is a function of *B*'s momentum at the instant of contact, regardless of the derivation of the momentum. That is to say, *B* may have been moving with uniform velocity, or with some acceleration or some retardation; but this makes no difference in *A*'s displacement. Here we have, I believe, an exact and demonstrable clue to the fundamental difference between organic and inorganic behavior. "Mere matter" (the nickname for the mechanical order of events) varies with instantaneous energetic conditions, while "life" (another nickname) varies not only with such, but also with serial and other time relations between those conditions.

not pass beyond mechanism. Logically, this is identical in form with the idealist's error of supposing that whatever is related to the cognizing process is mental. Quite apart from the gratuitousness of the assumption, the latter begs the whole question. If all that is related to mechanism is mechanical, of course life is only the elder brother of the automobile. And all biological discoveries are not proofs but merely illustrations of mechanism. Our metaphysics is settled in advance of research.

How far Loeb's discoveries herein recorded fall short of being proofs of his mechanistic philosophy of life may be seen in the four most important essays,<sup>3</sup> which deal with the problems of artificial fertilization of ova and the rôle of salts in the preservation of life. Lack of space forbids my reporting more than one instance from those fascinating pages. Loeb has successfully produced artificial parthenogenesis in a number of lower marine animals, sometimes by agitation of the eggs, sometimes by pressure, and sometimes by brief immersion in chemical solutions (cytolytics). What happens in all these experiments? Loeb finds that an outside membrane of the egg is broken, chafed, dissolved, or precipitated; and that probably this "facilitates the diffusion of oxygen or of HO ions (bases) or other substances necessary for the development into the egg" (p. 151). In other words, the formative stimulation is not formative stimulation at all, but only a destruction of peripheral cellular matter whose removal enables a protein substance of that layer to absorb water and swell and pass on to the egg some food or stimulus which sets up the constructive ovarian activities. To interpret this situation as evidence of the mechanical character of life is quite as illogical as to argue that the actors on a theater stage are made of asbestos because they can not begin performing until the asbestos curtain between them and the audience is raised.

There is a round dozen of other flaws in these pages which catch the philosophical reader's eye. Two of these ought to be at least mentioned here. In every inference from observed fact to mechanistic hypothesis, Loeb seems to presuppose that inflexible regularity of behavior under definite *physical* conditions of the environment and of the organism indicates the exclusively mechanical nature of the organic reaction. We have already pointed out the error of identifying physical with mechanical; there now remains the other aspect of this presupposition, namely, the implicit doctrine that inflexible regularity of reaction must be mechanical. Expose the larvæ of *Balanus perforatus* to sunlight, and they move toward it. Place them in the light of a quartz mercury lamp, very rich in ultraviolet rays, and soon the larvæ move away from the rays. These tests are alleged to indicate that the responses are exclusively mechanical. Now, they can not be this merely because the stimulus is physical; for if that fact were proof of mechanical reaction, then there is no problem at all. All life, by virtue of its adjusting itself to a physical setting, declares itself to be purely a machine, according to such an argument. We must assume, then, that Loeb founds his presupposition on the other aspect of the proposition, namely, upon the variation of reaction with stimulus.

<sup>3</sup> Nos. 6 to 9, inclusive.

What now is the logic of this assumption? It reduces to the following primitive form:

$$\begin{aligned} A &= f(B), \\ B &= M; \\ \therefore A &= M. \end{aligned}$$

That is to say, the larval movements are functions of ether wave lengths in the stimulus. The ether waves are mechanical. Hence the larval movements are, too. Comment on such logical procedure should be superfluous.

The other error to be noted is one which plays no part in the specific arguments of Loeb. I cite it only because it is wide-spread and easy. Throughout this book statements are made like the following: "Heredity . . . is perhaps the most rationalistic part of biology" (p. 23). "Tropisms . . . pave the way for a rationalistic conception of the psychological reactions of animals" (p. 60). "It is already possible to reduce . . . the tropisms to simple rationalistic relations" (p. 61). I think it only equitable to assume that the author does not mean "rationalistic" here in either its standard connotation or its accepted philosophical meaning. He does not champion the rationalism which is historically opposed to empiricism. And it would be unfair to charge him with using the term in its theological sense, namely, as opposed to supernaturalism; for such a meaning makes nonsense of his assertions. And finally he can scarcely be accused of Kantian rationalism nor yet of Platonic rationalism; for he scorns all such theories as mere word play. I infer, therefore, that in the above context "rationalistic" means only "rational," viz., deductively established. If it is permissible to place this construction upon the word, the error latent in its usage appears. Loeb is ever presupposing that a theory of life can be rational only if it is mechanistic. Nowhere does he say this unequivocally; but the creed cries shrilly from between the lines. Such grotesque metaphysical leaps are all too common, and sprightliest jumpers are to be found among the natural scientists who, like Loeb, ridicule philosophy and her inquirers. They are the best justification for philosophy's earnest continuance and for the encouragement of stiff logical analysis.

To halt here with comment would convey a false impression as to the reviewer's verdict on the volume. Loeb's theory is lame, halt, and blind,—a simple tropism (as he himself would have to describe it). But the experimental data and results which he reports can not be recommended too highly to the philosophical reader. Although some of them are now out-of-date, they furnish a vivid picture of a field of research which will some day upset many of our cherished misconceptions and teach us to see the world with new eyes.

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