

THE PHENOMENON OF LIFE

Toward a
Philosophical Biology

Hans Jonas

With a foreword by Lawrence Vogel

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SECOND ESSAY

Philosophical Aspects of Darwinism

I

The mechanistic model of nature which the seventeenth century brought forth concerned itself at first with existing structures, be it solar system or animal organisms, without committing the thinker on the question of their genesis. Each structure as found was conceived as a functioning mechanism whose analysis into elementary components of matter and motion was to explain its actual functioning by a uniform standard: how it had come to be in a past history of nature was no part as yet of the scientific agenda, if sometimes the subject for summary speculation. This temporary avoidance of a question fraught with theological dangers protected the infancy of modern science. For a century or so its founders were spared the problem of origins by their theistic beliefs. Even when the infant had grown in strength, eighteenth-century deism still supplied the tenuous theological setting for the new scientific cosmology. Against the idea of the Cosmos as a living self-created whole to which pantheists clung, deism accepted the idea of a vast machine which, once set up, follows its course automatically. But it had to be set up in the first place: the continual creator became the constructor (the "clockmaker") active but once; and the place of the unmoved mover who draws the world into his eternal present was taken by the initial mover who had imparted a fixed momentum in the past. By a curious irony of fate, the Biblical concept of an extramundane Creator, and of creation as a circum-

scribed act in the beginning, had helped to prepare the ground for this jejune picture. "*Was wär ein Gott, der nur von aussen stiesse?*" protested Goethe. However, the idea of the ready-made mechanism was for the scientific mind itself a temporary expedient only. The first things in explanation must inevitably also become the first things in time, and the present configuration must become the latest member of a time-series connecting it with those first things. If these are the utterly primitive ones of matter and motion unplanned, and the series leading to the present condition can be constructed from their premises alone, creation becomes supererogatory.

Questions of origin have been inherent in any comprehensive inquiry into the nature of things since the beginnings of human speculation, and mechanistic philosophy is no exception. Its principles initiated of themselves two trains of investigation with regard to every physical entity, of which the second was taken up as soon as the maturation of the first allowed science to emerge from the shelter of deism. The first, as we said, was the analysis of given physical systems, that is, the explanation of their observed functioning in terms of the general principles of mechanics; the second was the reconstruction of the possible generation of such systems from antecedent states and ultimately from some primordial state of matter which, by the operation of the same general principles of mechanics and without the intervention of an intelligent design, would in due course transform itself into the stable system under consideration as simply a necessary stage in its causal history. The two sides are exemplified on the one hand by Newton's theory of the solar system as an existing mechanism, on the other, by the Kant-Laplace nebular hypothesis of the origination of this system.¹ The point in modern physics is that the answer to both these questions must employ the same principles, that is to say, that origin and resulting existence do not differ except in the sense of antecedent and subsequent states of an identical substratum: the producing reality is of the same order as the product, being merely differently located in the infinite time-series of cause and

1. Both sides were already articulated in Hobbes' genetic derivation and functional analysis of the "body politic": the same primitive dynamic, fear of violent death, determines the unordered "state of nature," the transition from this to the commonwealth, and the mechanics of the latter.

effect. This implies that any given entity can be treated at the same time as a product and as itself productive of the future state which will result from it.² The only qualitative difference admitted between origins in general and their late consequences (if the former are to be more self-explaining than the latter and thus suitable as a relative starting-point for explanation) is that the origins must, in the absence of an intelligent design at the beginning of things, represent a simpler state of matter such as can plausibly be assumed on random conditions. With this sole difference, earliest origins and latest results are of the same nature. And since it is nothing but disequilibrium that provides the dynamics of change, any state of organization attained is a measure of equilibrium resulting from the instability of an earlier distribution. Thus the place of transcending, constructive creation is taken by the total series in its infinite continuation itself. The metaphysical secret of this new approach lies in the radically temporal conception of being, or in its identification with action and process. The central position which motion assumes in the ontological scheme, in replacement of any *ens realissimum* envisaged in former speculation, denotes this shift.

In this new meaning of "origins" we observe a complete reversal of the older conception concerning the superiority of the originating principle over its effects. It had mostly been assumed that there must be not only more power but also more perfection in the cause than in the effect. The originating agency must possess more reality than the things originated by it. It must also be superior in formal essence, to account for the degree of form that the derivative things

2. The view is illustrated by Laplace's hypothetical "divine Calculator," to whose analysis the present state of the universe, instead of representing a lasting machine once constructed, is but a passing configuration of matter in the continual shift of configurations which compose the world's existence in limitless time. *All these configurations are equivalent* as temporal sections through a constant quantity of matter and motion. Thus any choice of a point for the beginning is as arbitrary as that of one for an ending, and indeed as the choice of the existing state for representing the design of the creator. Each instant of time is alike qualified to provide in its data of bodies, positions, and forces the basis from which to construct backward and forward the states at each and any other instant of time. To the limitless analytical intellect, one instant contains the whole history of the world in past and future. The world is conceived as the *history of matter* rather than as a particular order of matter.

may enjoy. At the very least the cause must possess of these things "as much as," "not less than," the things springing from it.³ Obviously this pattern is completely reversed in the kind of genetic deduction which modern theory inaugurated. If the most elementary situations can of themselves give rise to all diversification and order, and if the latter are explained by the dynamics of the former, then, paradoxically speaking, the antecedent cause is here inferior to the effect, in terms of structural articulation though not in terms of quantity, which is constant. Thus genetically as well as functionally, the primitive is called upon to account for the more articulated, the unstable for the stable, disorder for order, becoming for being.

II

Of all provinces of reality the living kingdom longest defied the application of this idea of origins, and it was only in the nineteenth century that the theory of *evolution* succeeded in subjugating it in this respect to the general scheme. What were the particular difficulties? To Descartes, animal bodies were machines constructed to function as they do, and though there is neither intelligence nor purposiveness in their functioning itself, this being automatic, their construction *toward* such functioning seemed to call for precisely those qualities. If then the constructive task assumedly devolves upon matter itself, the very success of the scientific analysis of organisms—unlike that of the majestically crude cosmic structure—stands in the way of making the assumption good in *their* case. For the more admirably they revealed themselves to be constructed, the less possible it seemed to conceive of the genesis of such patterns other than by design, and at

3. It was characteristic of the classical attitude to understand the lower, i.e., more elementary, in the light of its being a "less" of the higher, to that extent as lacking in reality, and as subservient to the higher realization. As the first principle of explanation was taken from the highest kind of being, which is also ontologically "first," explanation was typically from the top of the scale downward, the lower orders being derived from the higher by way of privation. The realm of passion, for example, is characterized by the absence of reason, but in order to exist it must still participate in the principle of being, though it does so to a lesser degree than does reason. Plotinus furnishes the extreme example of this direction of explanation from higher to lower, where the bottom of the scale is the last to be accounted for.

that by a design as far superior to the design of human ingenuity as the natural machines proved superior in construction to man-made ones. If design or teleological direction were ruled out, the odds against a mere chance production would seem no less overwhelming than those against the famous monkeys' randomly hammering out world literature on their typewriters in the aeons at their disposal. The comparison holds so long as the fixity of species, and consequently separate origination of each, is assumed.

The problem is complicated by the fact that in the case of these mechanical structures, i.e., organisms, unlike the more enduring cosmic ones, we constantly witness their coming-to-be in the individual instances. If anywhere, then here genesis does belong to the complete picture of the entity itself; but the genesis in question points distinctly away from the mechanistic pattern. For in the ever-repeated origination of highly organized individuals from an infinitesimal germ, the working-out of a prearranged *plan* of growth and development seems obvious. Thus the very idea of "development" which the facts of *reproduction* suggested stood in the way of applying to the living kingdom the same categories of genesis that were applied on mechanistic principles to reality at large. Indeed, the term "evolution" denoted originally just this phenomenon of individual genesis, and by no means the genesis of species. On the contrary, "evolution" in its literal sense presupposes the existence of the species, because it is precisely this which, in the persons of the parent individuals, provides the prearranged plan to be "evolved" in every given case of generation. What evolves is not the model itself but its re-embodiment in each generation from germ to maturity: what evolves was involved in the germ, its potency there derived from its act in the progenitor. In terms of cause-effect relation, then, the parent accounts not only for its offspring's existence but also for its offspring's *form* by its own possession of this selfsame form. This is a pattern very different from the mechanistic chain of cause and effect and strongly suggests the operation of a *causa formalis* in addition to a *causa efficiens*, or the existence of substantial forms, which were otherwise banned from the whole system of natural explanation. In short, the very concept of *développement* was opposed to that of mechanics and still implied some version or other of classical ontology.

When, therefore, the question of origin was at last extended to

those permanently self-repeating plans of growth themselves, a venture of prime ontological importance was initiated, whose success on the terms of natural science was bound to complete the anti-Platonic movement of the modern mind. On the premise of the noneternity of our earth, which followed from the scientific cosmology, first representatives in the chains of generation were still called for (as they were in the doctrine of creation), but they no longer would have to be representatives of the existing patterns, if these are regarded as the temporal outcome rather than as the timeless determinants of the life-process. The probability-problem indicated by the example of the monkeys would then be split up into two divisions, that of the spontaneous generation of the first forms and that of the descent from them of the present ones, and this splitting-up held the secret of success in that it overcame the monstrous improbability embodied in that example.

"Evolution" in the modern sense made it possible to credit unaided matter more plausibly with the production of the living kingdom, and thus to advance the materialistic monism of science by a decisive step. It did so by *abandoning* the original meaning of the term "evolution," derived from the growth process of individual organisms: the idea of preformation and unfolding was abandoned and replaced by the quasi-mechanical picture of an unplanned, undirected, yet progressive sequence whose beginnings, unlike the germ, adumbrate nothing of the outcome or of the successive steps. If the living forms are descended from one another and have not each arisen independently, the stumbling block of spontaneous generation is pushed back to the very first instance of life as such, where its magnitude and therefore its theoretical inconvenience are reduced in proportion to the minimum of organization assumed in these first beginnings. Immeasurably consequential as was the first step, the transition from inorganic to organic, it can hypothetically be made small enough not to overstrain the probabilities of chance combination. All further variegation is then left to the dynamics of this initial something, and for the whole doctrine to be a scientific one it is essential that the dynamics invoked do not contain any element of teleology, of preformative disposition or aspiration toward the higher forms to come, but that they "evolve" those higher forms without their being in any sense "involved" in the initial stage. Everything therefore depends on

a conception of these dynamics which both is causally satisfactory and does not burden the primitive with any mysterious content anticipatory of the more advanced: the operative causality, while accounting for the emergence of the advanced in succession from the primitive, must let the latter be as unambiguously primitive as it is. Then, while each throw of the dice is still blind, the probability-situation is yet decisively changed: the first and simplest form of life once given, all further shaking of the dice occurs in confined dice-boxes with selected dice and defined ways for them to be cast, so that the game of chance is vastly narrowed down. Also each "throw" is bound by the sum of the previous ones, adding to their result and not starting over again. In other words, life, once existing, progressively sets its own conditions for the mechanical play of variations; and the probabilities do look better than for the monkeys, who at each moment start anew, their action undetermined by their past performance.

Thus *heredity*, which at first seemed the strongest argument for the doctrine of immutable species, becomes an instrument for their very derivation by way of change: transmitted in reproduction, the effects of mutation can accumulate within one strain, superadded one upon the other, and the small steps of chance are allowed to grow into vast and complex patterns. In addition to this cumulative functioning of mutation through heredity, the working of *natural selection* on its results seems to fill admirably the place of a directing principle vacated by teleology. Indeed it was the Darwinian theory of evolution, with its combination of chance variation and natural selection, which completed the extrusion of teleology from nature. Having become redundant even in the story of life, purpose retired wholly into subjectivity.

Like every major theory, the contemporary theory of evolution and genetics is an intricate combination of fact, hypothesis, and deduction. In the category of established fact belongs evolution as such: that species do change, have emerged in series of changes from ancestral forms, and in their entirety form a branching family system of common descent in which the simple precedes the complex, and transitions are gradual. Also an ascertained fact is the occurrence of mutations; but not their nature or cause. Natural selection is a logical deduction from the two premises of competition and of differences in

the competitors, which themselves are facts. The chance-character of mutations is a hypothesis: the inducement of some of them by external forces, such as radiation, is a fact of laboratory experience, but the claim that these are representative for all of them and for their underlying dynamics is a mere trial with Occam's razor; and the sufficiency of this kind of variability for the emergence of the major plans of organization is, so far, more a metaphysical contention (or, more soberly, a methodological postulate) than a scientific hypothesis—if "hypothesis" implies the construction of at least a mentally workable model. All these aspects raise philosophical issues, some of which we shall indicate.

III

The mere factual discovery of evolution had a profound significance for the very concept of life, quite apart from the special issue of the descent of man. In Descartes' conception of animal nature, the point of departure is some definite mechanical structure—a given type of organism—and the life of the animal in question is the function of that structure, the performance of the machine. Here structure unilaterally determines function and explains it; its analysis therefore answers all the questions which can reasonably be asked with respect to a living thing. Evolutionism, however, regards this given type of structure, the condition for a specific performance of life, as itself a product of life, the outcome and temporary stopping-place of a continuous dynamism which itself must be termed "life." Thus life appears in its very means, that is, in its structural equipment for living, as its own achievement, or at least result, instead of being simply endowed with its means and faculties. This is one of the most far-reaching discoveries ever made with regard to the nature of life. Among other things, it completes the liquidation of immutable essences, and thus signifies the final victory of nominalism over realism, which had had its last bulwark in the idea of natural species. This is a major philosophical event in that it powerfully confirms the anti-Platonism of the modern mind. If we add to this the absence of any teleological directedness, the evolutionary process presents itself as a sheer adventure with an entirely unforeseeable course. This specifically modern idea of the unplanned, open-ended adventurousness of

life, the corollary to the absence of immutable essence, is again a major philosophical consequence of the scientific doctrine of evolution.

As on the physical scene at large, so in the history of life *conditions* take the place of essence as the originating principle. In the shape of "environment," condition becomes so much a necessary correlative to the concept of organism that it enters into the very derivation of its being. The constitutive function of environment is common to Lamarckism and Darwinism. Organism is seen as primarily determined by the conditions of its existence, and life is understood in terms of the organism-environment situation rather than in terms of the exercise of an autonomous nature.

Organism and environment together form a system, and this henceforth determines the basic concept of life. Living, then, is the behavior induced by this bipolar system in one of its poles; and the typical patterns of living, the relative stability and specificness of behavior in any given species, represent the equilibrium achieved between the two factors that make up the situation. But so does organic structure itself: this too, not only its current behavior, represents an equilibrium relative to the long-term generic situation, being the outcome of the previous working of that situation on the substratum of life. In other words, the nonfixity of species, added to the principle of environment, divests the subject of life to an unprecedented degree of original and inherent determinations. In the unplanned transactions of the biological situation, and with the formative role of environment whose effects accumulate over the generations, life's own created and immutable essence contracts toward a minimum, while the import of the total situation, with its demands and selective criteria, increases toward a maximum. The minimum left to the original essence of life is just self-preservation, which is analogous to the inertial laws ruling the conduct of a particle. The maximum transferred to the situation is the sum total of all those influences eliciting from mere self-preservation (by way of incidentally adaptive variability) that wealth of superstructure and super-induced behavior by which life as it were, entirely innocent of any foreshadowing disposition toward them, surprises itself—and its Creator if there is one. Mind was not foreseen in the amoeba, nor was the vertebrate structure, science no more than the opposable thumb:

one and the other were elicited in due—but unforeseeable—course in the enormous span of the changing vital situation. The variability is essentially instability, which itself testifies to the absence of a pre-determined substantial form.

This reduction of the formal essence of life to the vanishing-point of a mere vital momentum without specific original content, and correspondingly the throwing open of the indefinite horizon of situation for the evoking of possibilities which were not pre-existing potentialities, have a familiar ring to those conversant with contemporary philosophies of Man. Indeed nineteenth-century evolutionism, which completed the Copernican revolution in ontology, is an apocryphal ancestor (along with the more official ones) of present-day existentialism. The latter's encounter with "nothingness" springs from the denial of "essence" which blocked the recourse to an ideal "nature" of man, once offered in his classical definition by reason (*homo animal rationale*), or in the Biblical one by creation in the image of God. The "image," in the absence of creation, had vanished with the original; and reason had been reduced to a means among means, to be judged by the efficiency of its instrumental role⁴ in the survival issue: as a merely formal skill—the extension of animal cunning—it does not set but serve aims, is not itself standard but measured by standards outside its jurisdiction. If there is a "life of reason" for man (as distinct from the mere use of reason), it can be chosen only nonrationally, as all ends must be chosen nonrationally (if they can be chosen at all). Thus reason has no jurisdiction even over the choice of itself as more than a means.⁵ But use of reason, as a means, is compatible with any end, no matter how irrational. This is the nihilistic implication in man's losing a "being" transcending the flux of becoming. Nietzsche's nihilism and his attempt to overcome it are demonstrably connected with the impact of Darwinism. The will to power seemed the only alternative left if the original essence of man had evaporated in the transitoriness and whimsicality of the evolutionary process. This is to say, not that Darwinism is *the* pro-

4. But to have an instrumental role, reason—i.e., mind—must have causative force, and this, as it challenges the self-sufficiency of materialism, also raises the whole issue of determinism connected with it: see Appendix to Fifth Essay.

5. Cf. Eighth Essay, especially sect. III.

genitor of existentialism, but that it conforms and contributes to all the other mental factors out of whose total setting existentialism logically grew. We mentioned the major role which evolutionism with the liquidation of immutable species played in the anti-Platonic trend of modern science: existentialism is the most radical conclusion drawn so far from the unreservedly accepted victory of nominalism over realism.

IV

In relating evolutionism to the Copernican revolution, we have especially in mind the fact that it extends to the realm of *life* that combination of natural necessity with radical contingency which the Newtonian-Laplacean cosmology resulting from that revolution had universally proclaimed. The combination of necessity and contingency seems paradoxical. The first obvious aspect of the universe in the modern scientific scheme was indeed the strict rule of causal law, in the function and consequently also in the genesis of things, and this seems rather to exclude any kind of contingency from nature. It certainly does exclude contingency in the sense of accidents outside the law. In another sense, however, the modern causal scheme is the very principle of an overall contingency of existence as such, insofar as the necessity here operating is external for any given entity within its pluralistic setting and does not proceed as an autonomous law of becoming from its intrinsic nature. Nor does it proceed from a transcendent plan, in the comprehensive design of which the particular things and their destinies are integrated. Rather is the necessity that of the sum total itself in the interaction of its parts, each of which contributes its quantity and is itself determined by the distribution of quantities around it. Though everything in this interaction is governed by causal law, the resulting formations are metaphysically contingent: none fulfills a particular end of reality, there being no intrinsic preference in reality for this rather than another outcome of the arithmetic of interrelated quantities. External necessity of the summative type is therefore the corollary to the most radical contingency of every particular existence. Some initial conditions being different, the solar system would not exist or would be otherwise than it is, and the completeness of nature as an equilibrium-system would

be none the worse for it. "Necessity plus contingency" can be most simply expressed here by saying that there is the complete concurrence of *causes* but no *reason* for the system as it happens to exist.

The same logic applies to life under the categories of evolutionism. The combination of necessity and contingency appears in all the features which we have discussed.

1. One such feature was the reversal of the older belief in the superior status of origins. Since perfection is not a standard intrinsic in nature itself, the so-called "higher" structure may well emerge from more primitive ones *accidentally*, i.e., by the agency of entirely primitive forces. If higher levels happen to emerge in the dynamics of the primitive, their quality as levels is wholly contingent, though their factuality is necessary. The importance of this idea of descent for the self-understanding of life is obvious.

2. Another feature was the reversal of the traditional relation assumed between pre-existing structure and function, and here too we meet the character of contingency. Organic structure, though in each given case the condition for specific function, is itself the function of a vital dynamic in the sequence of generations which is concerned not at all with the achievement of a particular structure but with the business of living and the continuance of life as such. (We shall presently see that "concerned" is a metaphorical expression only.) Species, a relatively stable, temporarily self-perpetuating structure, is an incidental result of life's history with no terminal status in creation and no indication where it may lead next. The flux of dynamism replaces essence and qualifies what appears as such with a radical contingency.

3. In the emphasis on environment we have a third feature pointing up the rule of "necessity and contingency." When we said before that in the evolutionary conception the patterns of organic structure appear as themselves products of life, the meaning was not that the emergent form is considered an autonomous achievement of the living substance which would unfold in this series of emergence its original potentialities. The explanatory accent lies rather, in accordance with the physical ontology we have been discussing, on the external conditions as the chief agency in evolution. Only when the term "life" comprises the interplay of organism and environment is it correct to say that "life produces species." Even the saying that the

emergent forms are "adaptations" to conditions, credits, by Darwinian standards, too much to the bearer of life if adaptation suggests a performance on its part. The adaptations rather represent a dynamic equilibrium, working itself out between the conditions of the environment and the haphazard possibilities offered by organic instability. Thus we observe the same shift from substance and its intrinsic properties to the function of a plural system of relations which characterizes the physical world-concept in general and leads to the combination of necessity and contingency here discussed.⁶

Regarding the distribution of causality between organism and environment as the factors of the evolutionary situation, we have to make a final observation. According to Darwinism the distribution is: chance-variation (or mutation) on the part of the organism, natural selection on the part of the environment. The first of these rests ultimately on the fact that nothing in nature is completely stable; the second, on the fact that life is continually put to the test under the alternative of being and not-being inherent in it. What, then, is the respective share of either of these two causes? Theoretically, the mechanics of selection, in which no purpose intervenes, is to take the place of teleology in that it decides on the merits of the random material offered it, and it does so by criteria which, mechanical as

6. It may be pertinent to point out the bearing of all this on the classical idea of "perfection." As long as in the Aristotelian or even Cartesian sense there was such a thing as the definitive pattern of a given species, it was possible to speak of a more or less perfect realization of an essence in the lives of individuals. One could argue that an individual is in a greater or lesser degree what it is destined to be, viz., a representative of its species. "Perfection" here means the completeness with which the pattern of the tree or dog or of man comes to actualization in the individual development of a specimen of the species. Again, for the comparison of species with one another and for their ordering in a scale one could postulate certain standards of perfection. But the picture is changed when it is admitted that species is only relatively stable, and that this stability represents only the temporary equilibrium among the forces which generally determine the structure as successful. In this view, each given structure represents a trying-out in the drama of adaptation and is on principle open to unforeseeable revisions which, if pushed far enough, may result in something which can no longer be regarded as the more perfect realization of an original pattern, but must be termed a new species.

they are, favor "progress" in certain directions. It is to be noted, however, that they "favor" by elimination. This is essentially a negative substitute for teleology: it accounts for the disappearance only and not for the emergence of forms—it suppresses and does not create. Thus it replaces teleology as a directing principle only on condition that it is offered the suitable material to select from. This means that the positive role, the emergence of forms, falls wholly to the random play of aberrations from pattern, which as aberrations are by themselves indifferently "freaks," and on which the distinction between deformity and improvement is superimposed by entirely extraneous criteria. Strained through their sieve, the fortuitous is held to turn constructive—and with no "cunning of reason" there results the paradox of advance through mischance, of ascent by accident. It has still to be shown that the infinitely complex and wonderfully adjusted organic "machines" and their ascending series can really be accounted for on these terms.

It is not for us to decide on questions of fact, but we can make explicit what the hypothesis implies. Plasticity is here instability, and we are left with the riddle of the latter's feigning creativity. For if the gene system is the transmittor of heredity, stability—the condition of faithful transmission—is its essential virtue. A mutation, then, is a disturbance of this stability, resulting in failure to transmit faithfully. Presumably the disturbance is due to some external influence (e.g., radiation) which has managed to break through the stabilizing barriers of the system, and whose action, from the point of view of the system itself, is nothing but a mechanical mishap. Since it is a mishap to the steering-system of a future organism, it will result in something which from the point of view of the original pattern can only be termed a deformity. However "useful" it happens to be, as a deviation from the norm it is "pathological." As similar mishaps continue to befall the same gene system in succeeding generations, an accumulation of such deformities under the premium system of selection may result in a thoroughly novel and enriched pattern: but the "enrichment" would still be an excrescence on the original simplicity, a slipping of the discipline of form multiplied over and over again under the licensing of selection; and thus the high organization of any animal or of man would appear a gigantic monstrosity into which the original amoeba has grown through a long history of disease. Tenden-

tious as it sounds, this must be the picture so long as mutation is conceived as nothing more than a freak accident whose deleterious or beneficial quality (and deleterious is overwhelmingly the rule) is decided only *post hoc* in the lottery of natural selection, i.e., by the external *fiat* of environment (except where intrinsic viability is affected by the change). On this model, which reflects the present conceptual state of genetics, any "higher" form is indeed nothing but a sport, by itself indistinguishable from degeneration, of a "lower" form, but a sport which has turned out to have a differential survival-value. This extreme consequence of Darwinism squarely poses the question whether a mechanistic biology can do justice to the phenomena of life.

Let us sharpen the question by the following consideration. In the combination of Darwinism with modern geneticism which constitutes the rational core of present theory, a *new dualism* of model-conception supersedes any previous one in the interpretation of life. It is not, as might appear at first glance, the dualism of organism and environment—this pair rather forms one interactive system—but the dualism *germ: soma*, in which the soma (the actual organism) is itself part of the "environment," namely, the immediate environment for the germ plasm and the mediator of the effects on the latter's existence of the wider environment. These effects, however, as far as conducted through the *life history* of the soma, are merely in the either-or terms of admission or nonadmission of the germ to reproduction (i.e., to its continuation *qua* germ) and in no way include any reflex of the organism's experience and achievements in its lifelong dealings with the environment. The nontransmission of acquired characters precludes the latter possibility. Thus there arises within the materialist realm itself a strange parody of the Cartesian model of two noncommunicating substances. Weismann's theory of the continuity of the germ plasm is the clearest expression of this new biological dualism. There is on the one hand the blind automatism of a germ history enacted in the subterranean darkness which no light from the upper world penetrates; and on the other hand the upper world of the soma meeting the world in terms of life, pursuing its destiny, fighting its battles, taking the impress of its victories and defeats—and all this being of no other consequence for the hidden charge than that of its being either continued or eliminated. The vicissitudes of the *germ's*

history, as expressed in mutations, are entirely separate from the vicissitudes of the soma's history, uninfluenced by the whole drama of life enacted in the light, though determining the latter through the next embodiment. On these terms, the short-lived macroscopic individual appears as something like a repetitious offshoot of the enduring germ plasm, sent up in succession to provide its nourishing and protecting "environment": all complexity of the temporary carriers (with its attendant enjoyment and suffering) is the ever more expensive elaboration of this their subservient function. Thus the Platonic-Aristotelian immortality of the species is here replaced by the immortality of the germ plasm as a continuous existence in itself; and in a reversal of the classical formula, one would have to say that the developed is for the sake of the undeveloped, the tree for the sake of the seed.

V

In one respect, the triumph which materialism achieved in Darwinism contains the germ of its own overcoming. The metaphysical importance of Darwinism lay in the comparative success of its attempt—imposed by the scientific commitment as such—to credit the automatism of material nature with the generation of the branching and ascending life forms. But by thus dispensing with the dualistic necessity for a creative principle different from the created, the resulting monism also drew upon deserted matter the full weight of a burden from which dualism had kept it free: that of having to account for the origin of *mind*, in addition to the physical organizations themselves. For the mental attributes are among the "sports" thrown up in the mechanics of organic mutation, and this genetic doctrine implies a more fundamental view of the relation of mind and body. Of this relation the early philosophers of modern science (though with important exceptions such as Hobbes and Gassendi) had taken a conveniently dualistic view, and only after science had reaped to the full the advantages of this view did it exchange it for a materialistic monism in the doctrine of universal evolution.

Let us recall what made science fasten upon a certain form of dualism as the ontological setting most suitable for its purpose, entrench itself in its portion of the patrimony, and finally discard the

other half as redundant. Again we make reference to Descartes. The scientific advantage of dualism was, at its briefest, that the new mathematical ideal of natural knowledge was best served by, and indeed required, the clear-cut division between two realms which left science to deal with a pure *res extensa*, untainted with the nonmathematical characters of being. That reality *in toto* was not of this one desirable kind had been realized by Galileo, whose doctrine of the mere subjectivity of the "secondary qualities" (the expression is Locke's) initiated the extrusion of the undesirable features from physical reality. But subjects themselves are objective entities within reality, and the extrusion of features remained incomplete so long as their dumping-ground itself was a part of the world to be described by natural science. Now Cartesian dualism seemed the perfect answer to this difficulty. Here was one substance whose one essential attribute is extension, whose knowledge therefore is essentially in the mode of measurement and mathematical description; and another substance entirely separate and independent, whose one essential attribute is awareness (*cogitatio*), and the appropriate mode of whose knowledge and description was indeed much less clearly stated, but also of much less concern:⁷ what mattered was its *isolation* from the other. The isolation of the *res cogitans* was the most effective way of securing the complete ontological detachment of external reality from what was not extended and measurable. Thus, besides constituting this reality as a self-contained field for the universal application of mathematical analysis, the division provided the metaphysical justification for the all-out mechanical materialism of modern science.⁸ It must be

7. In histories of philosophy Descartes figures mainly as the discoverer of the *ego cogito*, i.e., the founder of the philosophy of consciousness which terminated in idealism. When we take into account, however, his preoccupation with the metaphysical and methodological foundation of a science of nature, we may suspect that the isolation of the *res cogitans* was made perhaps more for the sake of the *res extensa* than for its own.

8. The fact that both idealism and materialism could issue from Cartesianism is significant for the two positions themselves. It signifies (as the First Essay has shown) that they both are by their nature, not only in time, postdualistic positions—in fact, disintegration products of the final stage of dualism, and with the shadow of their origin always beside them. Ancient, predualistic materialism is an imperfect parallel to modern materialism: it has the innocence before the fall, as it originated before

stressed that this justification lay in assigning the excluded, nonextended and therefore nonmechanical, characters a separate and fully acknowledged domain of their own, not in denying them reality; in other words, it lay in dualism, not in monism, and it automatically lapsed with the subsequent abandonment of the spiritual complement: alone with itself, materialism became an absurdity.

Yet this abandonment was inevitable because of the well-known theoretical difficulties inherent in Cartesian dualism. Its forte from the point of view of corporeal science, the mutual causal unrelatedness of the two orders of being, was also its mortal weakness (of which "occasionalism" was the clear confession). In consequence, Cartesian dualism broke up into two alternatives; and, while Berkeleyan idealism and Leibnizian monadology boldly tried the side of the *res cogitans*, natural science had no option in its choice of "matter." Much as science would like to have its choice understood in terms of method only and to be spared a *confessio fidei*, there are those among its own proper objects that force it to face the issue of materialism on the ontological level. These objects are living organisms, the mysterious meeting-place of Descartes' two substances, though he himself acknowledged such a "meeting" in only one case.

Here we must mention the most extreme aspect of Descartes' mechanistic theory of the animal body, an aspect he could afford precisely under the protection of his dualism. The animal automata, though entirely determined by the rules of matter, are yet so constructed that their functioning suggests to the human onlooker an inwardness analogous to his own *without their possessing any such inwardness*. All signs of pleasure and pain in animals are deceptive appearance, i.e., taken for such signs only by an unjustified inference from the habitual connection that in our case obtains between them and certain feelings. We impute the latter when we observe the former, but the imputation is gratuitous. Animals, in other words, are nothing but bodies.⁹ The gain of this *tour de force* lay in its confining

the discovery of the distinct concept of mind, which was the feat of dualism, had left its indelible mark on the ontological landscape.

9. Cf. Descartes, *Discourse on Method*, Part V; also *Treatise on Man*, and numerous passages in his *Letters*. From the last, e.g.: "We are so accustomed to persuade ourselves that the brute beasts feel as we do [a habit of thought engendered by "the resemblance existing between most

the locus of inwardness in nature to the solitary case of man. Puzzling as it was there, it was an exception to an otherwise universal rule and left the rest of living nature free for purely mechanical analysis. Having rid "body" in general of any relation to mind, and the science of body of any obligation to deal with the phenomena of mind, Descartes and the Cartesians could feel safe in treating the organism as just another instance of the *res extensa*.

Thus, at the cost of just one unmanageable metaphysical problem, the expurgation of the world of matter from the admixtures of mind was made defensible, since the claims of mind or inwardness were still honored by their allocation to a separate substance, with its independent set of phenomena under their own laws, even if its domain had to be contracted to the sphere of *human* consciousness: resolute dualism in one instance provided the good conscience for materialism in all other instances, and the unsolved enigma of man protected the nonenigmatic, if metaphysically meaningless, nature of the entire extrahuman biological realm. (See Appendix to this Essay.)

Now it is easy to see that the very *success* of the monistic venture, which this compromise with dualism had started on its course, even-

of the actions of the beasts and our own": *Letter to?* of March 1638] that it is difficult for us to rid ourselves of this opinion. But if we were as accustomed to seeing automata which imitate perfectly all those of our actions which they can imitate, and to taking them for automata only, we should have no doubt at all that the irrational animals are automata too" (*Letter to Mersenne* of July 13, 1640.) Already in a previous letter, of June 11, 1640, Descartes had declared to the puzzled Father: "I do not explain the feeling of pain without recourse to the soul . . . but I do so explain all the external motions which in us accompany that feeling: these alone are found in the beasts, and not pain properly speaking." The brazenness of the last assertion has something disarming. One cannot help wondering whether Descartes himself believed in the decree of his reasoning outside the charmed circle of theory, e.g., when actually dealing with animals. But the doctrine certainly stayed with him to the end—witness *Passions of the Soul*, Part I, art. 50 (published in 1650, three months before his death; see also the detailed statement in the *Letter to the Marquis of Newcastle* of November 1646.) The material is beautifully marshalled in Leonora Cohen Rosenfield, *From Beast-Machine to Man-Machine: Animal Soul in French Letters from Descartes to LaMettrie* (New York: Oxford University Press, 1941.)

tually withdrew from it the saving grace which the latter for a time could extend to it. For that success was achieved through the theory of evolution, and evolution precisely abolished the special position of man which had warranted the Cartesian treatment of all the remainder. The *continuity* of descent now established between man and the animal world made it impossible any longer to regard his mind, and mental phenomena as such, as the abrupt ingression of an ontologically foreign principle at just this point of the total flow. With the last citadel of dualism there also fell the isolation of man, and his own evidence became available again for the interpretation of that to which he belongs. For if it was no longer possible to regard his mind as discontinuous with prehuman biological history, then by the same token no excuse was left for denying mind, in proportionate degrees, to the closer or remoter ancestral forms, and hence to any level of animality: common-sense evidence was reinstated through the sophistication of theory—against its own spirit, to be sure.

Thus evolutionism undid Descartes' work more effectively than any metaphysical critique had managed to do. In the hue and cry over the indignity done to man's metaphysical status in the doctrine of his animal descent, it was overlooked that by the same token some dignity had been restored to the realm of life as a whole. If man was the relative of animals, then animals were the relatives of man and in degrees bearers of that inwardness of which man, the most advanced of their kin, is conscious in himself. Thus after the contraction brought about by Christian transcendentalism and Cartesian dualism, the province of "soul," with feeling, striving, suffering, enjoyment, extended again, by the principle of continuous gradation, from man over the kingdom of life. What both Spinoza¹⁰ and Leibniz had enunciated as an ontological postulate, the principle of qualitative continuity, allowing for infinite gradations in obscurity and clarity of "perception," has through evolutionism become a logical complement to the scientific genealogy of life.¹¹ The highest could have been reached from the lowest only through all intermediary stages, whether

10. See my article "Spinoza and the Theory of Organism," *Journal of the History of Philosophy* 3/1 (1965), 43-57.

11. Even the Aristotelian biological hierarchy of "souls" is in a way restored under the form of genealogical sequence: the evolutionary "later" largely coincides with the Aristotelian "higher."

these were merely transitional or left in being as permanent representatives. Where, then, throughout the enormous extent of this series can we draw with reason a line with the "nothing" of inwardness on its far side and the incipient "one" of it on the near side? Where else than at the beginning of life can the beginning of inwardness be placed? But if inwardness is coextensive with life, a purely mechanistic account of life, i.e., one in outward terms alone, cannot be sufficient. The subjective phenomena defy quantification and accordingly cannot even have outward "equivalents" substituted for them. Appetition, for instance, as actuating behavior, cannot be replaced by physical momentum, the drive for self-preservation by inertia, and measured in terms of amounts of these. The fear of death is an absolute which can be more or less acutely felt (according to the general level of feeling), but is in these different cases not present in greater or smaller amounts of a measurable quantity, even if the powers to act which it commands are measurably greater or smaller.

So it happened that in the hour of the final triumph of materialism, the very instrument of it, "evolution," implicitly transcended the terms of materialism and posed the ontological question anew—when it just seemed settled. And Darwinism, more than any other doctrine responsible for the now dominant evolutionary vision of all reality, turns out to have been a thoroughly dialectical event. This becomes increasingly visible as its teachings are philosophically assimilated. Whatever their success so far, all contemporary revisions of traditional ontology indeed start, almost axiomatically, from the conception of being as *becoming*, and in the phenomenon of cosmic evolution look for the key to a possible stand beyond the old alternatives.

APPENDIX (p. 56)

The Meaning of Cartesianism for the Theory of Life

Cartesian dualism landed speculation on the nature of life in an impasse: intelligible as, on principles of mechanics, the correlation of structure and function became within the *res extensa*, that of structure-plus-function with feeling or experience (modes of the *res cogitans*) was lost in the bifurcation, and thereby the fact of life itself became unintelligible at the same time that the explanation of its bodily performance

seemed to be assured. The impasse became manifest in Occasionalism: its *tour de force* of an extraneous, divine "synchronization" of the outer and the inner world (the latter denied to animals) not only suffered from its extreme artificiality, the common failing of such *ad hoc* constructions, but even at so high a cost failed to accomplish its theoretical purpose by its own terms. For the animal machine, like any machine, raises beyond the question of the "how" that of the "what for" of its functioning—of the purpose for which it had thus been constructed by its maker.¹ Its performance, however devoid of immanent teleology, must serve an end, and that end must be someone's end. This end may (directly) be itself, as indeed Descartes had implied when declaring self-preservation to be the *effect* of the functioning of the organic automaton. In that case the existence as such of the machine would be its end—either terminally, or in turn to benefit something else. In the former case, the machine would have to be more than a machine, for a mere machine cannot enjoy its existence. But since, by the rigorous conception of the *res extensa*, it cannot be more than a machine, its function and-or existence must serve something other than itself. Automata in Descartes' time were mainly for entertainment (rather than work). But the *raison d'être* of the living kingdom could not well be seen in God's indulging his mechanical abilities or in the amusement of celestial spectators—especially since mere complexity of arrangement does not create new quality and thus add something to the unrelieved sameness of the simple substratum that might enrich the spectrum of being. For quality, beyond the primitive determinations of the extended *per se*, is the subjective creature of sensation, the confused representation of quantity in a mind; and thus organisms cannot harbor it because as mere machines they lack mentality, and pure spirits cannot because they lack sensuality, or the privilege of confusion and thereby of illusion with its possible enjoyment. And as to their intellectual enjoyment, even that, deprived of the thrill of discovery by the same token, would pale in the contemplation of what to sufficiently large intellects is nothing but the ever-repeated exemplification of the same few, elementary (and ultimately trivial) truths.

There remained, then, the time-honored—Stoic as well as Christian—idea that plants and animals are for the benefit of Man. Indeed, since the existence of a living world is the necessary condition for the existence of any of its members, the self-justifying nature of at least one such member

1. The concept of "machine," adopted for its strict confinement to efficient cause, is still a finalistic concept, even though the final cause is no longer internal to the entity, as a mode of its own operation, but external to it as antecedent design.

(=species) would justify the existence of the whole. In Stoicism, Man provided this end by his possession of reason, which makes him the culmination of a terrestrial scale of being that is also self-justifying throughout all its grades (the end as the best of many that are good in degrees); in Christianity, by his possession of an immortal soul, which makes him the sole *imago Dei* in creation (the end as the sole issue at stake); and Cartesian dualism radicalized this latter position by making man even the sole possessor of inwardness or "soul" of *any* kind, thus the only one of whom "end" can meaningfully be predicated as he alone can entertain ends. All other life then, the product of physical necessity, can be considered his means.

However, this traditional idea, in its anthropocentric vanity never a good one even where it made sense, no longer did make sense in the new dualistic and occasionalist setting. For man, the supposed beneficiary of living creation, i.e., of all the other organic mechanisms, was now himself an inexplicable, extraneous combination of mind and body—a combination with no intelligible relevance of the body for the existence and inner life of the mind (as also, of course, vice versa). Therefore, even if it was shown that the existence of the organic world was necessary for the existence of human bodies, as indeed it is, it could not be shown that the existence of this very body was necessary for the existence of "man" considered as the thinking ego.² Furthermore, the very distinction of man's body within the animal kingdom, viz., to be at least partially an organ of mind—that distinction for the sake of which Descartes had been willing to brave the contortions of the pineal gland doctrine—was also nullified by the occasionalist fiction, in which the human body became no less completely an automaton than all other organisms. Thus, the existence of the entire living kingdom became utterly unintelligible as to purpose and meaning as well as to origin and procreative cause. A vast scheme of delusory "as ifs" superseded all question of real issue in the working of things.³

2. Berkeley, in due course, drew the conclusion from this theoretical redundancy: bodies are nothing but mental representations ("perceptions").

3. It is worth to note the profound change which the concept of "soul" underwent: from a principle of life and thus of action it became a principle of pure subjectivity—a dimension rather than a principle—and as such essentially powerless. This must be borne in mind when considering the two connected Cartesian ideas that "life" is a fact of physics alone, and that "soul" is a fact of man alone: according to the first, life is a particular corporeal *behavior* following from a particular corporeal struc-

All this amounts to saying that the main fault, even absurdity, of the doctrine lay in denying organic reality its principal and most obvious characteristic, namely, that it exhibits in each individual instance a striving of its own for existence and fulfillment, or the fact of life's willing itself. In other words, the banishment of the old concept of appetite from the conceptual scheme of the new physics, joined to the rationalistic spiritualism of the new theory of consciousness, deprived the realm of life of its status in the scheme of things. It is a measure of the compelling motives behind this conception, farfetched as it was, that it could hold its ground against the irrepressible voice of our psychophysical experience, every one of whose acts eloquently contradicts the dualistic division. Cartesian dualism created the riddle of how an act of will can move a limb, since the limb as part of the extended world can only be moved by another body's imparting its antecedent motion to it.⁴ Yet after learning

ture which distinguishes a class of objects in nature, viz., the natural automata; according to the second, "soul," equated with consciousness of any kind, be it feeling, desiring, perceiving, thought (*anima=mens=cogitatio*), as such not required for physical function of any kind *and thus not for life*, is absent in animals and present in man, but is neither in his case a principle of "life," which remains a purely structural-behavioral phenomenon in all cases. Cf. Descartes' letter of May, 1641, to Regius (Adam-Tannery III, 370 ff.), where he explicitly rejects the traditional idea of *species* of souls—vegetative, sensitive, rational—arguing that the first two, the powers to grow and to move, which man shares with the brutes, "are *toto genere* different from mind" and "nothing else than a certain disposition of the parts of his body."

4. The counterexperiential principle which became axiomatic for theory was most succinctly stated by Spinoza: "The body cannot determine the mind to thought, neither can the mind determine the body to motion nor rest, nor to anything else, if there be anything else" (Ethics III, prop. 2). With Spinoza this was, ostensibly, a proposition subject to demonstration (duly supplied) from first truths. But in reality it was postulative, and the "first truths" were conceived with a view to it—more particularly, with a view to the second half of the proposition which alone seriously mattered. The real argument should have read thus: If there were interaction of body and mind, there could be no science of nature; but there must be a science of nature: ergo, there cannot be interaction of body and mind.—The positive complement to the negative rule shows where its real application lies: "A body in motion or at rest must be determined to motion or rest by another body, which was also determined to motion or rest by another, and so on *ad infinitum*" (*ibid.*, lemma 3 after prop. 13). At least in this application to the *corporeal* realm, the ontological rigor of the rule admits no exception; and we may add that

from theory that it cannot be, we still go on feeling that we do move our arms "at will." Theory, while invalidating this primary certainty, had yet to explain it. The "violence" of metaphysical speculation after Descartes, which dared common sense more than any previous one and needed accordingly greater ingenuity to carry it off, is in part explained by the enormity of what it had to cope with.⁵ The "psychophysical problem"—the cost for the scientific revolution—loomed behind all its exertions. Never had the rift between reason and immediate knowledge been so great.

Besides the riddle of our practical experience, there was the riddle of degrees of organization which the animal kingdom so manifestly displays, but which no longer could be related to degrees of self-rewarding awareness. The new doctrine denied the means for connecting the perfection of a physical organization with the *quality* of the life supported by it: all it provided for was the connection between organization and observable behavior, i.e., organic function. The wealth of gradation in the animal world from the most primitive (i.e., simple) to the most subtle (i.e., complex) structure could not be overlooked, but had to remain meaning-

none of the leading thinkers of the period down to, and including, Kant ever challenged the validity of it. The motives for thus ruling out of court the most insistent evidence of common experience—that fear or love or deliberation can determine action and thus be causes of bodily motion—have been discussed in the Essay: whatever their theoretical merit, they commanded overwhelming consensus and still express the creed of the scientist.

5. Indeed, there is little "ingenuity" or inventiveness in former speculation, and perhaps it should have no place in philosophy. It makes its appearance only where theory has to uphold prior commitments, as e.g. in the case of certain problems posed to the Schoolmen by the competing authorities of revelation and reason (or, Scripture and Aristotle), which *had* to be reconciled. But the doctrine of God, creation, and salvation, though outside experience, surely does not contradict experience. Cartesianism was the first to create a situation in which theory self-confidently *clashes* with experience: this situation, as it demanded of theory a new kind of ingenuity to effect a "reconciliation," also allowed it a new, despotic ruthlessness in dictating the terms of it (a combination characteristic of the thought of Spinoza and Leibniz): theory could indulge in a radicalism unknown to it before. That this ruthlessness went by the name of "rationalism" is a historical circumstance which veils the imperiously willful element in the situation. Philosophy has reason to distrust the masterful manner in theorizing, and for more than the Humean or Kantian reasons: the question is whether the intellect conforms or prescribes to reality.

less. Since no other kind of soul than the rational was recognized, all the mechanical perfection displayed in animal organisms amounted just to a gigantic hoax, as no higher type of experient life corresponded to greater excellence of mechanical performance. Thus the very perfection in terms of external construction and function mocks all justification in terms of lives.

Obviously, with regard to both riddles, theory could not rest with the verdict of sheer unrelatedness, nor with its desperate reprieve by the continuous miracle of divine coordination: Spinoza's and Leibniz' grand attempts to improve upon the Cartesian position offered ingenious solutions to both aspects of the psychophysical problem. Yet they were solutions to the problem *as set* by Descartes, sharing the motives and the broad terms of his bifurcation (to which indeed all thinkers till after Kant remained committed). Their very ingenuity, as remarked before—a typically inventive ingenuity called forth in response to a difficulty never faced before and itself an invention of theory—makes us admire the thinkers but suspect their problem. Our admiration is in part that for a feat accomplished with the performer's hands tied behind his back.