hem internally nor the intellectual intentions they develop. These inten-ons come from far away, and these concepts are few in number; this is hy theoretical themes survive the apparent destruction that polemics and efutations pride themselves in having wrought.[100]

Now, it would be absurd to conclude from this that there is no difference etween science and mythology, between measurement and reverie. But nversely, to want radically to devalorize old intuitions on the pretext of heir theoretical obsolescence renders one—imperceptibly but inevitably—nable to grasp how such a stupid humanity could one fine day have woken p intelligent. We cannot chase away miracles as easily as might be thought, nd in trying to suppress them in the order of things, we sometimes reinte-grate them into thought—where they are no less shocking and useless. One would thus do poorly to conclude from our study that we find more theoret-cal value in the myth of Venus or in the narrative of Genesis than in cell theory. We have simply wanted to show that the obstacles and limits of this theory did not escape many scientists and philosophers at the time of its birth, even some of those who most profoundly contributed to its elabora-tion. Therefore, the current need for a suppler and more comprehensive theory will only surprise those incapable of seeking in the history of science a sense of theoretical possibilities different from what the teaching of the latest scientific results has made familiar—a sense without which there can be neither scientific critique nor a future for science.

PART THREE

Philosophy

> Biological knowledge is continued creative activity, by which the idea of the organism comes increasingly within reach of our experience. It is a sort of ideation equivalent to Goethe's *Schau*, a procedure that springs continuously from empirical facts and never fails to be grounded in and substantiated by them.
>
> —KURT GOLDSTEIN, *The Organism*

THREE

Aspects of Vitalism

It is quite difficult for the philosopher to try his hand at biological philosophy without running the risk of compromising the biologists he uses or cites. A biology utilized by a philosopher—is this not already a philosophical biology, and therefore a fanciful one? Yet would it nevertheless be possible, without rendering biology suspect, to ask of it an occasion, if not permission, to rethink or rectify fundamental philosophical concepts, such as that of life? Can one reproach the philosopher who has taken up the study of biology for choosing, among the teachings he has received, the one that has best enlarged and organized his thought?

For this task, we should not expect much from a biology fascinated by the prestige of the physico-chemical sciences, a biology reduced or reducing itself to the role of a satellite of these sciences. A reduced biology has as its corollary the effacement of the biological object as such—in other words, the devaluation of its specificity. Now, a biology autonomous with regard to both its subject and its manner of apprehending this subject—which is

t to say a biology that ignores or disdains the sciences of matter—always ks, to a certain degree, the qualification if not the accusation of vitalism. his term has served as the label for so many extravagances that, at a moent when the practice of science has imposed a style of research and, so speak, a code and a deontology of scientific life, vitalism carries a pejorae value even for those biologists least inclined to align their object with at of physicists and chemists. There are few biologists who, classified as talists by their critics, willingly accept this label. In France, at least, it is ot exactly a compliment to invoke the names and fame of Paracelsus or Jan aptist van Helmont.

It is nonetheless a fact that, in general and as a consequence of the signication it acquired in the eighteenth century, the term *vitalism* is appropriate for any biology careful to maintain its independence from the nexationist ambitions of the sciences of matter. It is here as important to onsider the history of biology as it is to consider the current state of its ndings and problems. A philosophy that asks science for clarifications of oncepts cannot remain uninterested in the construction of this very science. In this way, a certain orientation of biological thought, whatever the mited historical resonance of the name given to it, will be seen to have a ignificance greater than just that of a stage in biology's development.

At stake is not a defense of vitalism from a scientific point of view; such debate is of real concern only to biologists. Our concern is with understanding vitalism from a philosophical point of view. It may be that vitalism appears to today's biologists, as to yesterday's, to be an illusion of thought. But far from forbidding or foreclosing philosophical reflection, this denunciation of its illusory character calls for such reflection, for even today the necessity of refuting vitalism signifies one of two things. Either it is an implicit confession that the illusion in question is not of the same order as geocentrism or phlogiston theory—that is, it has a vitality of its own—in which case, one must philosophically account for the vitality of this illusion. Or it is a confession that the illusion's tenacity has obliged its critics to reforge their arguments and weapons—that is, to recognize in the corresponding theoretical or experimental gain a benefit whose importance cannot be without relation to the occasion from which it proceeds, since it always turns toward and against that occasion. It is thus that a Marxist biologist says of Bergsonism, classifying it as a philosophical species of the genus vitalism, that:

> From Bergsonian finalism there follows a dialectic of life which in its overall aspect has some analogy to Marxist dialectics, in the sense that both create new facts and beings. . . . In biology, of interest would be Bergsonism's critique of mechanism—had it not been carried out, much earlier, by Marx and Engels. As for Bergsonism's constructive argument, it is worthless; Bergsonism is, in hollow form, the mould of dialectical materialism.[1]

Thus, the first aspect of vitalism that philosophical reflection is led to examine is, for us, the vitality of vitalism.

A series of names attests to this vitality, from Hippocrates and Aristotle to Hans Driesch, Constantin von Monakow, and Kurt Goldstein, by way of Jan Baptist van Helmont, Paul-Joseph Barthez, Johann Friedrich Blumenbach, Xavier Bichat, Jean Baptiste Lamarck, Johannes Müller, and Karl Ernst von Baer, without excluding Claude Bernard.

One may notice that biological theory reveals itself to be a thinking that throughout its history has been divided and oscillating. Mechanism and Vitalism confront one another on the problem of structures and functions; Discontinuity and Continuity on the problem of the succession of forms; Preformation and Epigenesis on the problem of the development of a being; Atomicity and Totality on the problem of individuality.

This permanent oscillation, this pendular return to positions that thought seemed to have definitively left behind, can be interpreted in different ways. In a sense, one can ask if there is really any theoretical progress aside from the discovery of new experimental facts—whose certitude as reality does not at all compensate for the incertitude of their signification. In another sense, one can consider this apparent theoretical oscillation to be the expression of an undiscovered dialectic and understand the return to the same position as occurring by the optical error thanks to which we always perceive different points on a line as one and the same when projected on a perpendicular plane. And, transposing the dialectical process of thought onto the real, one can maintain that it is life, the object of study itself, that is the dialectical essence, whose structure thought must espouse. The oppositions of Mechanism and Vitalism, Preformation and Epigenesis are thus transcended by life itself as it extends into a theory of life.

To understand the vitality of vitalism is to engage in the search for the meaning of the relationship between life and science in general, life and the science of life more specifically.

As defined by Paul-Joseph Barthez, a physician of the Montpellier School in the eighteenth century, vitalism explicitly claims to belong to the Hippocratic tradition; this filiation is undoubtedly more important than the Aristotelian filiation, for if vitalism often borrows terms from Aristotelianism, it always holds on to the spirit of Hippocratism:

> I call the *vital principle* of man the cause that produces all the phenomena of life in the human body. The name for this cause is rather unimportant and can be chosen at will. If I prefer the name *vital principle*, that is because it presents an idea less limited than the name *impetum faciens* (*to enormōn*) that Hippocrates gave it, or other names by which one has designated the cause of the functions of life.[2]

It is not without interest to consider vitalism to be the biology of physicians skeptical of the constraining power of remedies. In pathology, the Hippocratic theory of the *natura medicatrix* accords greater importance to the organism's reaction and defense than to the morbid cause. The art of prognosis prevails over that of diagnosis, on which it depends. It is as important to predict the course of a disease as it is to determine its cause. Therapeutics consists as much in prudence as in audacity, for the first among doctors is nature. Thus, vitalism and naturalism are indissociable. Medical vitalism is the expression of a distrust, shall we say an instinctive one, of the power of technique over life. There is an analogy here with the Aristotelian opposition between natural and violent movement. Vitalism is the expression of the confidence the living being has in life, of the self-identity of life within the living human being conscious of living.

We can thus suggest that vitalism translates a permanent exigency of life in the living, the self-identity of life immanent to the living. This explains one of the characteristics that mechanist biologists and rationalist philosophers criticize in vitalism: its nebulousness, its vagueness. If vitalism is above all an exigency, it is normal that it would have some trouble formulating itself in terms of determinations. This will emerge more clearly in a comparison with mechanism.

If vitalism translates a permanent exigency of life within the living, mechanism translates a permanent attitude of the living human toward life. Man is here a living being separated from life by science and attempting to rejoin life through science. If vitalism, being an exigency, is vague and unformulated, mechanism, being a method, is strict and imperious.

Mechanism, as is well known, comes from *mēchanē*, whose meaning, "engine," contains two senses: that of ruse and stratagem, on the one hand, and that of machine, on the other.[3] One could ask whether the two meanings do not amount to just one. Is not man's invention and utilization of machines, and technical activity in general, what Hegel called the ruse of reason?[4] The ruse of reason consists in reason's accomplishing its ends through the intermediary of objects acting upon one another in conformity with their nature. Essentially, a machine is a mediation or, as mechanists say, a relay. A mechanism does not create anything—and therein lies its merit (*inars*)—but it can be constructed only through art, and it is a ruse. Thus mechanism, as a scientific method and as a philosophy, is the implicit postulate of all usage of machines. Human ruse can only succeed if nature does not have the same ruse. Art can only make nature submit to it if nature is not itself an art. The wooden horse cannot be brought into Troy unless one is named Ulysses and is faced with enemies who are forces of nature rather than astute engineers. To the Cartesian theory of the animal-machine, one has always opposed the ruses used by animals to evade traps.[5] Leibniz, adopting in the foreword to his *New Essays on Human Understanding* the Cartesian thesis that animals are capable only of empirical consecutions (today we would say conditioned reflexes), gives as proof of it the facility with which man entraps animals.[6] Reciprocally, the hypothesis of the deceiver God or evil genius formulated by Descartes in the *Meditations* ends up turning man into an animal surrounded by traps. It is impossible for man to attribute to God the very ruse that man uses to deal with animals without in the process nullifying man as a living being, reducing him to inertia.[7] But is one not then justified in concluding that the theory of the living machine is a human ruse that, if taken literally, would nullify the living? If the animal is nothing more than a machine, and the same holds for the whole of nature, why is so much human effort expended in order to reduce them to that?

That vitalism may be an exigency rather than a method and a morality rather than a theory was perceived by Emanuel Rádl, who spoke, it seems, with full knowledge of the facts.[8]

Man, he says, can consider nature in two ways. Either he *feels himself* a child of nature and experiences a sentiment of belonging and subordination to it; he sees himself in nature and nature in himself. Or else, he *holds himself* in front of nature as before a foreign, indefinable object. A scientist who experiences a filial sentiment, a sentiment of sympathy toward nature, does

not consider natural phenomena to be strange and foreign—he finds life, soul, and meaning in them, completely naturally. Such a man is fundamentally a vitalist. Plato, Aristotle, Galen, all the men of the Middle Ages, and a large number of the men of the Renaissance were, in this sense, vitalists. They considered the universe to be an organism, that is to say, a harmonious system regulated according to both laws and ends. They conceived of themselves as an organized part of the universe, a sort of cell in the universe-organism, and all cells were unified by an internal sympathy such that the destiny of the organ-part seemed naturally to have to do with the movements of the heavens.

If this interpretation (in which the psychoanalysis of knowledge undoubtedly finds material) merits being retained, this is because it coincides with Walther Riese's commentaries on Constantin von Monakow's biological theories: "In von Monakow's neurobiology, man is a child of nature who never abandons his mother's bosom."[9] It is certain that, for vitalists, the fundamental biological phenomenon—with the images it evokes and the problems it raises resonating, to a degree, with the meaning of other biological phenomena—is the phenomenon of generation. A vitalist, we would suggest, is a man who is led to meditate on the problems of life more by the contemplation of an egg than by the handling of a winch or an iron bellows.

This vitalist confidence in the spontaneity of life, this reluctance (and even, for some, horror) to consider life as springing forth from a nature broken down into mechanisms—a nature paradoxically reduced to nothing more than a collection of engines analogous to those created by human will in order to struggle against nature as against an obstacle—is embodied by a man like Jan Baptist van Helmont. Van Helmont is one of the three vitalist doctors whom the history of philosophy cannot ignore: Thomas Willis, because of Berkeley (*Siris*); van Helmont, because of Leibniz (*Monadology*); Johann Friedrich Blumenbach, because of Kant (*Critique of Judgment*).

Rádl presents van Helmont as a mystic, rebelling in Louvain against the science and pedagogy of the Jesuits (whose pupils included Descartes), returning deliberately to Aristotle and Hippocrates, and bypassing Descartes, Harvey, Bacon, and Galileo, whom he scorns or ignores. Van Helmont believes in the power of the world, in astrology, in witches, in the devil. He takes experimental science and mechanism to be the work of both the Jesuits and the devil. He refuses mechanism because it is a hypothesis—that is to say, a ruse of intelligence with respect to the real. The Truth, according to

him, is reality; it exists. And thought is nothing but a reflection. The Truth pierces man like lightning. Where knowledge is concerned, van Helmont is an integral realist.

Van Helmont is far from accepting the unity of natural forces, as Descartes did. Every being has its force, a specific force. Nature is an infinity of hierarchized forces and forms. This hierarchy includes seeds, ferments, the Archei, and the Ideas. The living body is organized by a hierarchy of Archei. This term (*archeus*), taken from Paracelsus, designates a directing and organizing force, which resembles the leader of an army more than a worker. This is a return to the Aristotelian idea of the body submitting to the soul like a soldier to a leader, like a slave to a master.[10] Let us note once again, in this regard, that the hostility of vitalism to mechanism is aimed as much and perhaps more against its technological form as its theoretical form.

Because no authentic vitality is sterile, the second aspect of vitalism that interests us is its fecundity.

Among its critics, vitalism generally has the reputation of being chimerical. And this term is, in the case in point, all the harsher now that biologists know how to fabricate *chimeras* by joining cells obtained by the division of eggs from different species. Hans Spemann fabricated the first animal chimeras by transplanting tissues from young triton embryos of different species onto each other. This fabrication of chimeras has been a precise argument against vitalism. Since it is possible to form a living being of equivocal species, what is the vital principle or the entelechy that rules and guides the cooperation between the two species of cells? Do questions of precedence or jurisdiction arise between the two specific entelechies? It is incontestable that Hans Spemann's experiments and his theory of the "organizer" have led to the interpretation of germinal localizations in a way at first apparently favorable to the mechanist viewpoint.[11] The dynamic of the development of the embryo is controlled by a localized zone—for example, the immediate environment of the primitive mouth in the case of the newt. Now, to start with, the organizer can stimulate and direct the development of an embryo of a different species onto which it has been grafted; moreover, for it to do so, it is not necessary that it be alive. The destruction of the organizer by heat does not nullify its power of organization—and, in the end, it is possible to compare the organizer's action to the actions of chemical substances of the sterol family prepared in vitro (the work of John Turberville Needham). Yet one fact nevertheless remains—and here the momentarily triumphant mechanist interpretation is faced with a new

obstacle: though the action of the organizer is not specific, its effect is. A frog organizer, grafted onto a triton, induces the formation of the nervous axis of a triton. Different causes obtain the same effect; different effects depend on the same cause. The organizer, reduced to a chemical structure, may well be considered a cause, if one wishes, but a cause without necessary causality. The causality belongs to the system constituted by the organizer plus the tissue onto which it is implanted. The causality is that of a whole on itself, not of one part on another. Thus we have here a specific case in which the chimerical interpretation is reborn out of its ashes.

It is nonetheless only too true that the theoretical notions elicited by the vitalist exigency, in the face of obstacles encountered by mechanist theoretical notions, are verbal notions. To speak of the *vital principle*, like Barthez; of the *vital force*, like Bichat; of *entelechy*, like Driesch; or of the *hormé*, like von Monakow, is to beg the question.[12] On this point even the philosophers most sympathetic to the spirit of vitalism agree—we need only cite Antoine-Augustin Cournot (*Matérialisme, vitalisme, rationalisme*), Claude Bernard (*Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux*), and Raymond Ruyer (*Éléments de psychobiologie*).

Vitalism's fecundity appears at first glance to be all the more contestable in that—as it naïvely shows by so often borrowing from Greek the names for the rather obscure entities it considers itself obliged to invoke—it always presents itself as a return to antiquity. The vitalism of the Renaissance is a return to Plato against an overly rationalized Aristotle. The vitalism of Jan Baptist van Helmont, Georg Ernst Stahl, and Paul-Joseph Barthez is, as has been said, a return, beyond Descartes, to the Aristotle of *De anima*. The facts in Hans Driesch's case are common knowledge. But what is the meaning of this return to antiquity? Is it a revalorization of concepts that are chronologically older and consequently more worn out, or a nostalgia for intuitions ontologically more original and closer to their object? Archaeology is just as much a return to sources as it is a love of the old. We come closer to grasping the biological and human sense of tools and machines, for example, when we have before us a flint stone or an adze instead of an electrical time switch or a camera. And, moreover, when it comes to theories one must be certain of their origins and the direction of their development in order to interpret a return as a step backward and an abandonment as a reaction or as treason. Was Aristotle's vitalism not already a reaction against Democritus's mechanism, as Plato's finalism in the *Phaedo* was a

reaction against Anaxagoras's mechanism? It is certain, in any case, that the vitalist's eye seeks a certain naïve vision of things, a pretechnological and prelogical vision, a vision of life anterior to tools and language, that is, to instruments created by man to extend and consolidate life. It is in this sense that Théophile de Bordeu (1722–76), the first great theoretician of the Montpellier School, called van Helmont "one of those enthusiasts needed in each century in order to keep the scholastics breathless."[13]

It is up to the facts and up to history to judge the fecundity of vitalism. One must be careful not to credit vitalism with achievements made by investigators associated with vitalism *after* the discovery of these facts and not *before*—facts from which their vitalist conceptions followed but to which they did not lead. Hans Driesch was led to vitalism and to the doctrine of entelechy, for example, by his discoveries of the totipotence of the first blastomeres of the sea-urchin egg fertilized during the process of division. Yet he had initially conducted this research (1891–95) with the intention of confirming the work of Wilhelm Roux on the frog egg and the doctrine of *Entwicklungsmechanik* ("developmental mechanics").[14]

That said, a history of biology systematic enough not to privilege any bias or point of view would perhaps teach us that the fecundity of vitalism as such is far from null—and in particular that this fecundity is a function of historical and national circumstances, whose significance is somewhat difficult to estimate and fits poorly either the rigid theoretical frameworks of race, milieu, and historical moment or the more flexible theories of historical materialism.[15]

The adherence of Caspar Friedrich Wolff (1733–94) to vitalist conceptions did not prevent him from truly founding modern embryology, thanks to his capable and precise microscope observations, introducing history and dynamics into the explanation of the successive moments in the egg's development. It was another vitalist, Karl Ernst von Baer, who, after discovering mammal eggs in 1827, in 1828 formulated his germ-layer theory—the result of remarkable observations on the production of the first embryonic formations. At that time, to be a vitalist was not necessarily to slow down the progress of scientific research.

The history of the development of cell theory includes among its precursors and founders as many vitalists as mechanists.[16] Were vitalists in Germany (Lorenz Oken and Johannes Müller), mechanists in France (Charles Brisseau-Mirbel, Henri Dutrochet)? The facts are much more complex. To

take just one example, Theodor Schwann, who is rightly considered to have established the general laws of cell formation (1838), could also be seen as having been sympathetic to certain antimechanist conceptions because of his belief in the existence of a formative blastomere in which cells appear secondarily; if a formative blastomere exists, then the living being is not simply a mosaic or coalition of cells. Inversely, Rudolf Virchow, dogmatic defender of the explicative omnivalence of the concept of the cell, hostile to the theory of the formative blastomere, author of the aphorism *Omnis cellula e cellula* ("each stell stems from another cell"), generally passes for a stalwart mechanist. But in the opinion of John Scott Haldane, the opposite is true.[17] Schwann, an orthodox Catholic, professor at the Catholic University of Louvain, was a strict mechanist: he believed that cells appear in the primal substance by precipitation; the affirmation that each cell originates in a preexisting cell seems in comparison like a declaration of vitalism.

There is another domain, although this is generally little known, in which vitalist biologists can claim discoveries as authentic as unexpected: neurology. Reflex theory—we do not speak here of the experimental or clinical description of automatic movements—probably owes its formation more to vitalists than to mechanists, from the seventeenth century (Thomas Willis) to the beginning of the nineteenth century (Eduard Friedrich Wilhelm Pflüger). Georg Prochaska—to cite him alone—is part of this tradition of biologists who were led to the notion of reflex by their vitalist theories of the *sensorium commune* and the medullary soul. The later mechanization of reflex theory cannot belie its origins.[18]

Yet history would also show that, even though the vitalist biologist in his youth may have participated in the advancement of science through confirmed experimental work, in later years he often ends up engaging in philosophical speculation and supplementing pure biology with philosophical biology. All in all, he is free to do as he likes—but one is justified in reproaching him for seeking to profit from his capacity as biologist on philosophical terrain. The vitalist biologist who turns philosopher of biology thinks he brings a certain capital with him to philosophy, but in reality he brings to it only a land-income [*rentes*], which continually decreases in the market of scientific values—for the simple reason that research, in which he no longer participates, continues to move forward. Such is the case with Driesch's abandonment of scientific research for philosophical speculation

and even teaching. What we have here is an unpremeditated abuse of confidence. The prestige of scientific work stems above all from its internal dynamism. The former scientist sees himself deprived of this prestige in the eyes of active scientists. He believes he will preserve it among the philosophers. This must not be so. Philosophy, being an autonomous enterprise of reflection, does not honor any prestige at all, not even that of the scientist, or—even more rightly—that of the ex-scientist.

Is it possible to acknowledge these facts without looking for their cause in the vitalist exigency? Doesn't the vitalist confidence in life translate into a tendency toward negligence, laziness, lack of ardor for biological research? Isn't there among the postulates of vitalism an internal reason for its intellectual sterility, as its adversaries suspect and vigorously affirm?

Is vitalism nothing more than the transposition of the limits of mechanism and the physico-chemical explication of life into dogmatic interdicts? To use Bachelard's expression, are we in the presence of a false conception of the notion of epistemological frontier?[19] Is vitalism anything other than a refusal to grant mechanism the time it needs to complete its project? Jean Rostand links it to precisely this refusal: "At present, mechanism has an extremely solid position, and one hardly sees how one can respond to it when, strong in its daily successes, it asks only for time to complete its work, *to completely explain life without life*."[20]

As Bachelard remarks: "Any absolute frontier proposed to science is the mark of a badly stated problem. . . . It is to be feared that scientific thought does not retain traces of philosophical limitations. . . . Oppressive frontiers are illusory frontiers."[21] These considerations—quite accurate in themselves and perfectly adapted to our problem—are in fact valid for vitalism insofar as we can equate it with a doctrine that seeks to explain a division within experience, as with a biologist like Bichat. For Bichat, the acts of life oppose their instability and irregularity to the invariability of physical laws—like a "reef on which all the calculations of physicist-doctors of the previous century have been stranded." He adds:

> Physics and chemistry are conjoined because the same laws preside over their phenomena. But an immense interval separates them from the science of organized bodies, because an enormous difference exists between their laws and those of life. To say that physiology is the physics of animals is to give an extremely inexact idea of it; I would as much like to say that astronomy is the physiology of the stars.[22]

In short, the classical vitalist accepts the insertion of the living organism nto a physical milieu to whose laws it constitutes an exception. Therein es, in our opinion, the philosophically inexcusable fault. There cannot be n empire within an empire without there being no longer any empire, either as container nor as contents. There can be only one philosophy of mpire, that which refuses any division: imperialism. The imperialism of hysicists or chemists is thus perfectly logical, pushing to its limit the expan- ion of logic or the logic of expansion. One cannot defend the originality of ne biological phenomenon, and consequently the originality of biology, by emarcating within the physico-chemical territory—that is, within the mi- eu of inertia, of externally determined movements—enclaves of indetermi- ation, zones of dissidence, or foyers of heresy. If one is to assert the riginality of the biological, this must be in terms of the originality of one ealm over the whole of experience, and not over islets of experience. In the nd, classical vitalism sins, paradoxically, only in its excessive modesty, in s reluctance to universalize its conception of experience.

Once one recognizes the originality of life, one must "*comprehend*" mat- er within life, and the science of matter—which is science itself—within ne activity of the living. Physics and chemistry, in seeking to reduce the pecificity of the living, did no more than remain faithful to their underlying ntention, which is to determine the laws between objects, valid without any eference to an absolute, central point of reference. Today, this determina- on has led them to recognize the immanence of measuring to the mea- ured, and to see the content of observation protocols as relative to the very ct of observation. The milieu in which one looks for the emergence of life nly acquires its meaning as milieu in virtue of the operation of the human ving being who takes measurements of it, measurements that bear an es- ential relation to the technical apparatuses and procedures by which they re made. After three centuries of experimental and mathematical physics, *ilieu*, which in physics first signified *environment*, has come to signify *cen- r*—in both physics and biology.[23] It has come to signify what it signified t its very origin. Physics is a science of fields, of milieus. But it has been iscovered that, in order for there to be an environment, there must be a enter. It is the position of a living being, its relation to the experience it ves in as a totality, that gives the milieu meaning as conditions of existence. Only a living being, *infra*-human, can coordinate a milieu. To explain the enter by the environment would thus seem to be a paradox.

This interpretation does not take anything away from a physics as determinist as it wants to be and can be—it does not take away from physics any of its objects. But it includes the physical interpretation within another, which is vaster and more comprehensive, since the meaning of physics is justified within it and the activity of the physicist fully secured.

Still, from an authentically biological point of view, a general theory of the milieu of man as technician and scientist [*l'homme technicien et savant*]—one like Jakob von Uexküll's theory for the animal and Kurt Goldstein's for the sick—remains to be elaborated.[24]

Thus understood, a biological point of view on the totality of experience appears perfectly honest, both as regards man the scientist [*l'homme savant*]—specifically, the physician—and as regards living man [*l'homme vivant*]. This very character of honesty is contested by the mechanist and materialist adversaries of a biology that is jealous of its methodical and doctrinal autonomy. This, then, is the third aspect of vitalism that we propose to examine.

Vitalism is held by its critics to be scientifically retrograde—and we have shown how, for us, this regress should be understood. It is also held to be politically reactionary or counter-revolutionary.

Classical vitalism (that of the seventeenth and eighteenth centuries) exposes itself to this accusation by maintaining a relation to animism (Georg Ernst Stahl), which is the theory according to which the life of the animal body depends on the existence and activity of a soul endowed with all the attributes of intelligence—"This vital, active, and vivifying principle of man, endowed with the faculty of reasoning, I mean, the reasoning soul such as it is"[25]—and acting on the body as one substance on another, from which it is ontologically distinct. Here, life is to the living body what the Cartesian soul is to the human body, which it does not animate but whose movements it governs voluntarily; the Cartesian soul would not cease to be all that it is if a body were not alive. Vitalism contaminated with animism thus encounters the same criticisms, at once philosophical and political, as dualist spiritualism. The reasons for seeing spiritualism as a reactionary philosophy become reasons for holding vitalist biology to be a reactionary biology.

Today, above all, the utilization of vitalist biology by Nazi ideology, the mystification that consisted in using theories of *Ganzheit* ("wholeness") to advocate against individualist, atomist, and mechanist liberalism and in favor of totalitarian forces and social forms, and the rather easy conversion of vitalist biologists to Nazism have served to confirm the accusation formulated by positivist philosophers like Philipp Frank, as well as by the Marxists.[26]

Driesch's thought represents a typical case of the transplantation of the biological concept of organic totality onto political terrain. After 1933, the entelechy came to be seen as the *Führer* of the organism.[27] What was responsible for the pseudo-scientific justification of the *Führerprinzip*—vitalism or Driesch's character? And was it Darwinism or Paul Bourget's character—in his response to Charles Maurras's *Enquête sur la Monarchie* (*Investigations on Monarchy*)—that was responsible for the exploitation of the concept of natural selection in the political arena?[28] Is this a matter of biology or of parasitism of biology? Could we not think, rather, that politics simply borrows from biology what it has already lent to it? Aristotle's notion of a soul that is to the body what the political or domestic leader is to the city or the family, and van Helmont's notion of the *archeus* as an army general are prefigurations of Driesch's theories. In Aristotle, the structure and functions of the organism are expounded by analogies with a tool intelligently manipulated and with a human society unified by command.[29] In the exploitation of antimechanist biological concepts by Nazi sociologists, what is at stake is the problem of the relation between organism and society. No biologist can, qua biologist, give this question a response whose authority would be guaranteed by biological facts alone. It is as absurd to seek in biology a justification for a politics and economics of exploitation of man by man as it would be to deny the truth of functional hierarchies in the living organism and the integration of functions of relation at ascending levels (Sherrington) simply because one is a partisan, for reasons of social justice, of a classless society.

Moreover, vitalist biology was not all the Nazis annexed and oriented toward their self-serving conclusions. They took genetics—to justify racist eugenics, techniques of sterilization and artificial insemination—just as they did Darwinism, to justify their imperialism and their politics of *Lebensraum*. One can no more honestly reproach a biology concerned with its autonomy

for having been utilized by Nazism than one can reproach arithmetic and the calculation of compound interests for having been utilized by capitalist bankers or actuaries. The self-interested conversion of certain biologists to Nazism proves nothing against the quality of either the experimental facts themselves or the suppositions accepted to account for these facts—suppositions to which these biologists, prior to their conversion, had believed they owed their scientific support. One is not obliged to locate within biology, as a logically inevitable consequence, the attitude that certain biologists adopted out of a lack of character and philosophical resoluteness.

If we look for vitalism's meaning in its origins, and for its purity at its sources, we will not be tempted to reproach Hippocrates or the Renaissance humanists for the dishonesty of their vitalism.

It must nevertheless be acknowledged that it is neither without interest nor entirely false to think of the offensive—or defensive—returns of vitalism as tied to bourgeois society's crises of confidence in the efficacy of capitalist institutions. Still, this interpretation of the phenomenon may appear too weak, in the epistemological sense, rather than too strong. It may appear too weak inasmuch as it presents a phenomenon of biological crisis within the human species—a phenomenon that is a matter of a technological philosophy and not only a political philosophy—as a phenomenon of political and social crisis. The rebirths of vitalism translate, perhaps in discontinuous fashion, life's permanent distrust of the mechanization of life. In them we find life seeking to put mechanism back into its place within life.

Ultimately, the dialectical interpretation of biological phenomena defended by Marxist philosophers is justified, but it is justified by what within life rebels against its mechanization.[30] If dialectics in biology is justifiable, it is because what gave rise to vitalism—in the form of an exigency rather than a doctrine—and explains its vitality is found in life: this is life's proper spontaneity, what Claude Bernard expressed by saying that life is creation.[31]

It is, nevertheless, easier to denounce mechanism and scientism in biology in words than it is to give up in fact their postulates and the attitudes they compel. If Marxist biologists are attentive to the invention and irreducibility life displays, they should praise vitalism for its objectivity toward certain characteristics of life. As an English biologist, John Burdon Sanderson Haldane, the son of John Scott Haldane, writes in his book *The Marxist Philosophy and the Sciences*,[32] a theory such as Samuel Butler's, which posits,

within a Lamarckian point of view, consciousness as the principle of life,[33] contains a priori nothing that dialectical materialism could not eventually accommodate. But we have read nothing of the sort here in France.[34]

On the other hand, Jean Wahl, in his *Tableau de la philosophie française*,[35] has fortunately brought to light the considerable role of vitalism in the work of those eighteenth-century philosophers ordinarily thought of as materialists. Diderot is here shown to us as a philosopher with a sense of the unity of life, situated "on the path that leads from Leibniz to Bergson"; his doctrine is characterized as a "vitalist materialism," and as a "return to the Renaissance."[36]

In the end, to do justice to vitalism is simply to give life back to it.

FOUR

Machine and Organism

The mechanical theory of the organism, after having long been accepted as dogma in biology, is today considered by biologists adhering to dialectical materialism to be a narrow and insufficient point of view. Dealing with this theory from a philosophical point of view could therefore seem to confirm the widespread notion that philosophy does not have its own domain, that it is but speculation's poor relation, obliged to dress in clothes worn out and abandoned by scientists. We would like to try to show that the subject is much more vast and complex, and that it is philosophically more important than its reduction to a matter of doctrine and method in biology presupposes.

We might even say that the science that would appropriate this problem is itself still a problem, for, though there are good works on technology, the very notion and methods of an "organology" remain vague. Thus, paradoxically, far from coming in belatedly to occupy an abandoned viewpoint, philosophy points science toward a position to take. Indeed, the problem of the

relations between machine and organism has generally been studied only in one direction: almost always, the attempt has been to explain the structure and function of the organism on the basis of the structure and function of an already-constructed machine. Only rarely has anyone sought to understand the very construction of the machine on the basis of the structure and function of the organism.

Philosophers and mechanist biologists have taken the machine to be a given—or, when they have studied its construction, they have explained it by invoking human calculation. They have appealed to the engineer—that is, for them, to the scientist. Deceived by the ambiguity of the term mechanical, they have seen machines as nothing but theorems solidified and displayed *in concreto* by a totally secondary operation of construction—the simple application of a knowledge conscious of its import and certain of its effects. However, we believe that it is not possible to address the biological problem of the organism-machine by separating it from a technological problem that it presumes resolved—that of the relationship between technique and science. This problem is usually explained by way of the logical and chronological anteriority of knowledge vis-à-vis its applications. But we will try to show that one cannot understand the phenomenon of the construction of machines by recourse to authentically biological notions without engaging at the same time the problem of the originality of the technical phenomenon in relation to the scientific phenomenon.

We will thus examine successively: the meaning of the comparison of the organism to a machine; the relationship between mechanism and finalism; the reversal of the traditional relationship between machine and organism; and the philosophical consequences of this reversal.

With the exception of vertebrates, living beings and their forms rarely display to the scrupulous observer devices [*dispositifs*] that could evoke the idea of a mechanism, in the sense given to this term by scientists. In *La pensée technique* (*Technical Thought*), for example, Julien Pacotte observes that the articulations of the limbs and the movements of the eyeball correspond, in the living organism, to what mathematicians call a mechanism.[1] We may define a machine as an artificial construct, a work of man, whose essential function depends on mechanisms. A mechanism is a configuration of solids in motion such that the motion does not abolish the configuration. The

mechanism is thus an assemblage of deformable parts, with periodic restoration of the relations between them. The assemblage consists in a system of connections with a determined degree of freedom: for example, a pendulum and a cam valve each have one degree of freedom; a threaded screw has two. The material realization of these degrees of freedom consists in guides—that is, in limitations on the movements of solids in contact. In any machine, movement is thus a function of the assemblage, and mechanism is a function of configuration. The fundamental principles of a general theory of mechanisms thus understood can be found, for example, in Franz Reuleaux's well-known work on kinematics.[2]

The movements produced (but not created) by machines are geometrical, measurable displacements. The mechanism regulates and transforms a movement whose impulse is transmitted to it. A mechanism is not a motor. One of the simplest examples of such transformation of movements consists in gathering an initial translateral movement into rotational form via the intermediary of technical devices such as a wheel crank or an eccentric crank. Naturally, mechanisms can be combined, by superposition or by addition. One can construct mechanisms that modify the configuration of the original mechanism and render the machine alternately capable of several mechanisms. This is the case in modifications effected by release or engagement actions—for example, the freewheel on a bicycle.[3]

We have already stated that what is the rule in human industry is the exception in the structure of the organism and in nature, and we must add to this that, in the history of techniques, of human inventions, configurations by assemblage were not the earliest. The oldest known tools are made of one piece. The construction of axes or arrows by assembling a flint and a shaft, or the construction of nets or fabrics, was not primitive. Their appearance is generally dated to the end of the Quaternary.

This brief reminder of the elementary concepts of kinematics is useful in allowing us to pose in all its paradoxical significance the following problem: How do we explain the fact that a model for understanding the structure and functions of the organism has been sought in machines and in mechanisms, as defined above? It seems possible to answer that this is because the representation of the living being by a mechanical model does not involve only mechanisms of the kinematic type. A machine, as defined above, is not self-sufficient, since it must receive from elsewhere the movement it

transforms. Therefore, one can only represent a machine in movement by associating it with a source of energy.[4]

For a very long time, kinematic mechanisms were set in motion by human or animal muscular effort. At that stage, it was obviously tautological to explain the movement of a living being by likening it to the movement of a machine dependent, for its own movement, on the muscular effort of a living thing. Thus, the mechanical explanation of the functions of life historically presupposes—as has often been shown—the construction of automatons, whose name signifies at once the miraculous character and the apparent self-sufficiency of a mechanism transforming an energy that is not—at least not immediately—the effect of a human or animal muscular effort.

This comes across in a well-known text:

> Examine with some attention the physical economy of man: What do you find? The jaws armed with teeth: Are they anything but pliers? The stomach is but a retort; the veins, the arteries, the entire system of blood vessels are hydraulic tubes; the heart is a spring; the viscera are but filters, screens; the lungs are but bellows. And what are the muscles, if not cords? What is the ocular angle, if it is not a pulley? And so on. Let us leave it to the chemists with their grand words of "fusion," of "sublimation," of "precipitation" to want to explain nature and thus to establish a separate philosophy; it is nonetheless incontestable that all these phenomena must be related to the laws of equilibrium, of angles, of cords, of the spring, and of the other elements of mechanics.

This text is not from whom one might think, but from the *De praxi medica*,[5] published in 1696 and written by Giorgio Baglivi (1668–1706), an Italian doctor of the iatromechanic school. Founded by Giovanni Alfonso Borelli (1608–79), this school of iatromechanists clearly seems to have been influenced by Descartes, despite the fact that in Italy the school is more commonly linked to Galileo, for reasons of national prestige.[6] This text is of interest because it places angle, cord, and spring on the same level as principles of explanation. It is clear, nevertheless, that from a mechanical point of view there is a difference between these engines; whereas the cord is a mechanism of transmission and the angle a mechanism for the transformation of a given movement, the spring is a motor. No doubt, it is a motor that merely gives back what has been lent to it, but at the moment of its action it appears to be endowed with independence. In Baglivi's text, it is

the heart—the *primum movens*—that is likened to a spring. In it resides the motor of the whole organism.

The formation of a mechanist explanation of organic phenomena thus requires that, in addition to machines in the sense of kinematic devices, there exist machines as motors, drawing their energy, at the moment of its use, from a source other than animal muscle. This is why, although Baglivi's text should refer us to Descartes, we must actually trace back to Aristotle the likening of the organism to a machine. When considering the Cartesian theory of the animal-machine, it is difficult to establish whether Descartes had precursors in the matter. Those who look for Descartes' predecessors generally cite Gómez Pereira, a Spanish doctor of the second half of the sixteenth century. It is quite true that Pereira, before Descartes, thought he was able to demonstrate that animals are pure machines and that, in any case, they do not possess the sensory soul so often attributed to them.[7] But it is indisputable that Aristotle found in the construction of war machines such as catapults license to liken the movements of animals to mechanical, automatic movements. This has been established by Alfred Espinas in his article "L'organisme ou la machine vivante en Grèce au IVe siècle avant J.C." (The Organism or Living Machine in the Greece of the Fourth Century B.C.).[8] Espinas traces the kinship of the problems treated by Aristotle in his treatise *De motu animalium* and his collection *Quaestiones mechanicae*.[9] Aristotle indeed likens the organs of animal motion to *organa*, that is, to the parts of war machines (e.g., to the arm of a catapult, which launches a projectile), and he compares the course of their movement to that of machines capable of releasing, after being set off, a stored-up energy, automatic machines, of which catapults were the typical example in his period. In the same work, Aristotle likens the movement of limbs to mechanisms, in the sense given above—he is on this point faithful to Plato, who, in the *Timeaus*, defines the movement of vertebrates on the basis of pivots.[10]

It is true that Aristotle's theory of movement is very different from that of Descartes. According to Aristotle, the principle of all movement is the soul. All movement requires a first motor. Movement presupposes the immobile: what moves the body is desire, and what explains desire is the soul, just as what explains potentiality is actuality. Despite this difference in the explanation of motion, the fact remains that for Aristotle, as later for Descartes, the comparison of the organism to a machine presupposes man-made devices in which an automatic mechanism is linked to a source of energy

whose motor effects continue well after the human or animal effort they release has ceased. It is this interval between the storing up and the release of energy by the mechanism that allows one to forget the relationship of dependence between the mechanism's effects and the action of a living being. When Descartes turns to machines to find analogies in his explanation of the organism, he invokes automatons with springs and hydraulic automatons. He is thus a tributary, intellectually speaking, of the technical forms of his age: of the existence of clocks and watches, water mills, artificial fountains, pipe organs, etc. We may therefore say that, so long as a living human or animal "sticks" to the machine, the explanation of the organism by way of the machine cannot be born. This explanation can only be conceived once human ingenuity has constructed apparatuses that imitate organic movements: for example, the launching of a projectile, the back-and-forth movement of a saw—apparatuses whose action (their construction and activation aside) takes place independently of man.

We have just said it twice: *can* be born. Is that to say that this explanation *must* be born? How do we account for the appearance, so clear and abrupt in Descartes' thought, of a mechanist interpretation of biological phenomena? This theory is evidently related to a change in the economic and political structure of Western societies, but the nature of this relationship remains obscure.

This question has been addressed by Pierre-Maxime Schuhl in *Machinisme et philosophie*.[11] Schuhl has shown that within ancient philosophy the opposition between science and technics overlies the oppositions between freedom and servitude, and, more profoundly, between nature and art. Schuhl refers to the Aristotelian opposition between natural and violent movement. The latter is engendered by mechanisms in order to counteract nature and has the following characteristics: it exhausts itself quickly, and it never engenders a habit—that is to say, a permanent, self-reproducing disposition.

Here we come across a rather difficult problem in the history of civilization and in the philosophy of history. In Aristotle, the hierarchy of freedom and servitude, theory and practice, nature and art parallels an economic and political hierarchy—the hierarchy, within the city, of free men and slaves.[12] A slave, says Aristotle in the *Politics*, is an animate machine.[13] From this emerges a question that Schuhl merely indicates. Does the Greek conception of the dignity of science engender contempt for technology and

thereby a paucity of inventions, thus leading, in a certain sense, to a difficulty in transposing the results of technical activity to the explanation of nature?[14] Or, rather, does the concept of the eminent dignity of a purely speculative science, a contemplative and disinterested knowledge, translate the absence of technological inventions? Is a contempt for work the cause of slavery, or does an abundance of slaves, in connection with military supremacy, engender contempt for work? Must we here explain ideology by the economic structure of society or, rather, that structure by the orientation of ideas? Is it the ease with which man exploits man that leads to disdain for techniques of man's exploitation of nature—or is it the difficulty of man's exploitation of nature that necessitates justification of man's exploitation of man? Is there a causal relation here, and if so, in which direction? Or are we faced with a global structure of reciprocal relations and influences?

Father Lucien Laberthonnière poses an analogous problem in *Les études sur Descartes*, notably in the appendix to volume 2, "La physique de Descartes et la physique d'Aristote," which contrasts a physics of the artist and aesthete to a physics of the engineer and artisan.[15] Father Laberthonnière seems to think that here what is determinative is the idea, since the Cartesian revolution in the philosophy of technics presupposes the Christian revolution. For his right and duty to exploit matter, without any regard for it, to be affirmed, man first had to be conceived of as a being that transcends nature and matter. In other words, it was necessary that man be valorized for nature to be devalorized. It was then necessary that men be thought of as radically and originally equal so that, the political technique of the exploitation of man by man having been condemned, the possibility and duty of a technique for man's exploitation of nature could appear. This allows Father Laberthonnière to speak of the Christian origin of Cartesian physics. He himself then raises the following two objections. First, the physics and techniques made possible by Christianity came, with Descartes, well after the foundation of Christianity as a religion. Second, is there not an opposition between humanist philosophy, which sees man as master and possessor of nature, and Christianity, which was considered by the humanists to be a religion of salvation, of flight into the beyond, and thus responsible for a contempt for vital and technique-related values, for any technical arrangement of human life in this world below? Father Laberthonnière says: "Time plays no role in the matter." It is not certain that time plays no role in the matter. In any case, one cannot deny—and this has been shown in

classic texts—that certain technical inventions, such as the horseshoe or the yoke, modifying the usage of animal motor force, did more for the emancipation of slaves than any preaching could.

We said earlier that one might look for a solution to the problem of the relationship between mechanist philosophy and the ensemble of economic and social conditions in which it arises in either of two directions: either in a causal relation or in a global structure. Franz Borkenau, in his book *Der Übergang vom feudalem zum bürgerlichen Weltbild* (*The Transition from a Feudal to a Bourgeois Worldview*), sees it as a causality.[16] This author affirms that, at the beginning of the seventeenth century, the mechanist conception eclipsed the qualitative philosophy of antiquity and of the Middle Ages. The success of this conception translates, within the ideological sphere, the economic fact of the organization and spread of factories. For Borkenau, the division of artisanal work into uniform and qualityless segmented acts of production imposed the conception of an abstract social work. The breakdown of work into simple, identical, repeated movements demanded a comparison of labor hours, so that prices and salaries could be calculated, and thus led to the quantification of a process previously regarded as qualitative.[17] For him, the calculation of work as a pure, mathematically treatable quantity was the basis and the point of departure for a mechanist conception of the universe of life. It is thus through the reduction of all value to economic value, to a "callous cash payment," as Marx puts it in *The Communist Manifesto*, that the mechanist conception of the universe was a fundamentally bourgeois *Weltanschauung*.[18] Ultimately, says Borkenau, behind the theory of the animal-machine we should detect the norms of the nascent capitalist economy. Descartes, Galileo, and Hobbes would thus have been the unconscious harbingers of this economic revolution.

These ideas of Borkenau have been outlined and critiqued with great vigor in an article by Henryk Grossman.[19] According to Grossman, Borkenau does away with 150 years of economic and ideological history by making the mechanist conception contemporaneous with the appearance of manufacturing at the beginning of the seventeenth century. Borkenau writes as if Leonardo da Vinci had never existed. Referring to Pierre Duhem's work, in *Les origines de la statique*,[20] and to the 1904–1907 publication of Leonardo's manuscripts,[21] Grossman affirms, along with Gabriel Séailles, that the publication of Leonardo's manuscripts pushes the origins of modern science back by more than a century. The quantification of the notion

of work is first of all mathematical, and this precedes its economic quantification. In addition, the norms for the capitalist assessment of production had been defined by Italian bankers beginning in the thirteenth century. Relying on Marx, Grossman reminds us that, as a general rule, there was, originally, no true division of labor in factories. Rather, the factory originally brought together in the same locale hitherto scattered artisans. It is thus not, according to him, the calculation of prices by labor hours but rather the development of mechanization that is the authentic cause of the mechanist conception of the universe. The development of mechanization has its origins in the Renaissance period. Descartes thus consciously rationalized a mechanist technique much more than he unconsciously translated the practices of a capitalist economy. Mechanics is, for Descartes, a *theory of machines*—it presupposes a spontaneous invention, which science must then consciously and explicitly promote.

Which machines modified man's relationship to nature before Descartes, giving birth to a hope unknown to the ancients and calling for the justification and the rationalization of this hope? They were, first and foremost, firearms, which interested Descartes scarcely at all, and only insofar as they related to the problem of projectiles.[22] By contrast, Descartes was greatly interested in watches and clocks, in hoisting machines, in water-powered machines, etc.

Consequently, we say that Descartes integrated into his philosophy a human phenomenon—the construction of machines—much more than he transposed into ideology the social phenomenon of capitalist production.

What are, then, in Cartesian theory, the relations between mechanism and finalism contained within the comparison of organism to machine?

The theory of animal-machines is inseparable from *Cogito ergo sum*. The radical distinction between soul and body, thought and extension, entails affirming the substantial unity of all matter, regardless of its form, and of all thought, regardless of its function.[23] Given that the soul has but one function, that of judgment, it is impossible to admit the existence of animal souls, since we have no sign that animals judge, being incapable of language and invention.[24]

The refusal to grant a soul—that is to say, reason—to animals does not entail, according to Descartes, denying that they have life, which consists in

no more than the warmth of the heart, or sensitivity, inasmuch as this depends on the arrangement of organs.[25]

In the same letter, there appears a moral foundation for the theory of the animal-machine. Descartes does to the animal what Aristotle did to the slave: he devalorizes it in order to justify its use by man as an instrument: "My opinion is not so much cruel toward animals as indulgent toward human beings—at least to those who are not given to the superstitions of Pythagoras—since it absolves them from the suspicion of crime when they eat or kill animals."[26] Remarkably, one finds this same argument reversed in a text by Leibniz:[27] if one is forced to see the animal as more than a machine, one must become a Pythagorean and give up dominating animals.[28] We find ourselves here in the presence of an attitude typical of Western man. The theoretical mechanization of life and the technical utilization of the animal are inseparable. Man can make himself master and possessor of nature only if he denies all natural purpose and can consider all of nature, including, apparently, animate nature—except for himself—to be a means.

This is what legitimates the construction of a mechanical model of the living body, including the human body—for already in Descartes the human body, if not man, is a machine. Descartes finds this mechanical model, as we have said, in automatons: that is to say, in moving machines.[29]

In order to give the full meaning of Descartes' theory, we now propose to read the beginning of his *Traité de l'homme* (*Treatise of Man*), first published in Leyden from a Latin version in 1662, and in French for the first time in 1664:

> These men will be composed, as we are, of a soul and a body, and I must first separately describe for you the body; then, also separately, the soul; and finally I must show you how these two natures would have to be joined and united to constitute men resembling us. I assume their body to be but a statue, an earthen machine formed intentionally by God to be as much as possible like us. Thus not only does He give it externally the shapes and colors of all the parts of our bodies; He also places inside it all the pieces required to make it walk, eat, breathe, and imitate whichever of our own functions can be imagined to proceed from mere matter and to depend entirely on the arrangement of our organs. We see clocks, artificial fountains, mills, and similar machines which, though made entirely by man, lack not the power to move, of themselves, in various ways. And I think you will agree that the present machine could have even more sorts of movements than I have imagined and more ingenuity than I have assigned, for our supposition is that it was created by God.[30]

If one reads this text as naïvely as possible, it seems that the theory of the animal-machine depends for its meaning on the enunciation of two postulates, which are too often neglected. The first is that there exists a builder God, and the second is that the living is given as such, prior to the construction of machines. In other words, it is necessary, in order to understand the machine-animal, to see it as having been preceded, logically and chronologically, both by God as efficient cause and by a pre-existing living being as formal and final cause to be imitated. In short, in the theory of the animal-machine, which has generally been seen as a rupture with the Aristotelian conception of causality, we propose that all the types of causality invoked by Aristotle are found, though not in the same place and not simultaneously.

The construction of the living machine implies, if one reads the text well, an obligation to imitate a prior organic given. The construction of a mechanical model presupposes a vital original, and, in the end, we may wonder whether Descartes is not closer here to Aristotle than to Plato. The Platonic demiurge copies the Ideas. The Idea is a model of which the natural object is a copy. The Cartesian God, the *Artifex Maximus*, works to equal the living itself. The model for the living machine is the living itself. The Idea of the living, which divine art imitates, is the living thing. And just as a regular polygon is inscribed within a circle, and in order to derive the circle from it, it is necessary to pass through infinity, so the mechanical artifice is inscribed within life, and to derive one from the other, it is necessary to pass through infinity—that is to say, God. It is this that seems to emerge at the end of the text: "And I think you will agree that the present machine could have even more sorts of movements than I have imagined and more ingenuity than I have assigned, for our supposition is that it was created by God."[31] The theory of the animal-machine would thus be to life what axiomatics is to geometry—that is to say, merely a rational reconstruction, which ignores only by means of a feint the existence of what it represents and the anteriority of production over rational legitimization.

This aspect of the Cartesian theory, moreover, was noticed by an anatomist of the time, the famous Nicolas Steno, in the "Discours sur l'anatomie du cerveau" (Discourse on the Anatomy of the Brain), delivered in Paris in 1665—that is, one year after the appearance of the *Treatise of Man*. Steno, while paying homage to Descartes (all the more remarkable given that anatomists have not always had much sympathy for Descartes' anatomy), observes that Descartes' man is man reconstructed by Descartes under the

ver of God, but that this is not the man of the anatomist.[32] It may thus be id that, in substituting mechanism for the organism, Descartes effaces leology from life, but he does so only in appearance, for he reassembles in its entirety, at his point of departure. Anatomical form substitutes r dynamic formation, but as this form is a technical product, all possible leology is contained within the technique of production. In truth, one nnot, it seems, oppose mechanism and finalism, one cannot oppose mechism and anthropomorphism, for if the functioning of a machine is *ex-ained* by relations of pure causality, the construction of a machine can be *derstood* neither without purpose nor without man. A machine is made by an and for man, with a view toward certain ends to be obtained, in the rm of effects to be produced.[33]

Thus, Descartes' project of explaining life mechanically eliminates pur-se in its anthropomorphic form. Yet in realizing this project, one anthro-omorphism substitutes for another. A technological anthropomorphism bstitutes for a political anthropomorphism.

In "La description du corps humain" ("Description of the Human ody"), a short treatise written in 1648, Descartes undertakes to explain oluntary movement in man. He makes the case that the body obeys the ul only on the condition of first being mechanically predisposed to do —a claim that held sway over the entire theory of automatic and reflex ovements until the nineteenth century. The soul's decision is not a suffi-ent condition for the movement of the body. Descartes says: "The soul nnot produce any movement without the appropriate disposition of the odily organs which are required for making the movement. On the con-ary, when all the bodily organs are disposed for some movement, the body as no need of the soul in order to produce that movement."[34]

Descartes means that when the soul moves the body, it does not do so in e way that (as popular representation would have it) a king or a general ommands his subjects or soldiers. Instead, by likening the body to a clock echanism, he means to say that the movements of the organs direct one nother like interlocked cogwheels. Thus, in Descartes, the technological nage of "command" (a type of positive causality by a device or by the play f mechanical connections) substitutes for the political image of command-ent (a kind of magical causality; causality by word or by sign).

Descartes' argument here is the opposite of Bernard's in his critique of talism in *Leçons sur les phénomènes de la vie communs aux animaux et aux végétaux* (1878–79).[35] While refusing to accept the separate existence of a vital force, because such a force "could not possibly do anything," Bernard surprisingly admits that it could, however, direct "phenomena that it does not produce."[36] In other words, Bernard substitutes for the notion of a vital force conceived as a worker the notion of a vital force conceived as a legislator or a guide. This is to accept that it is possible to direct without acting; we might call this a magical conception of direction, because it implies that directing transcends execution. On the contrary, according to Descartes, a mechanical device that executes replaces a power that directs and commands—but God has set the direction once and for all; the direction of the movement is included by the builder in the mechanical device that executes it.

In short, with the Cartesian explanation, in spite of appearances, it may seem that we have not taken a single step outside finalism. The reason is that mechanism can explain everything so long as we take machines as already granted, but it cannot account for the construction of machines. No machine builds machines—and one could even say that, in a certain sense, to explain organs or organisms through mechanical models is to explain the organ using the organ. It is a tautology, basically, because—and we shall try to justify this interpretation—machines can be considered organs of the human species.[37] A tool or a machine is an organ, and organs are tools or machines. Consequently, it is hard to see where the opposition between mechanism and finalism lies. No one doubts that a mechanism is needed to ensure the success of a given purpose, and inversely, every mechanism must have a sense, for a mechanism is not just an accidental series of interdependent movements. In reality, the opposition is between those mechanisms whose sense is manifest and those whose sense is latent. The sense of a lock or a clock is manifest; the sense of the pincers of a crab, so often invoked as marvels of adaptation, is latent. As a result, it does not seem possible to deny the purpose of certain biological mechanisms. Let us take an example that often serves as an argument for certain mechanist biologists. They deny the purpose of the enlargement of a woman's pelvis prior to giving birth; yet one need only turn the question around: given that the widest dimension of the fetus exceeds the widest dimension of the womb by 1 to 1.5 centimeters, if the womb were not to enlarge a bit, by a kind of loosening of the symphyses and a backward rocking motion of the sacrococcygien, then birth would be impossible. We are warranted in rejecting the suggestion that an

act whose biological sense is so clear is possible only because a mechanism without any biological sense allows it. And we have to use the word *allow* here because the absence of this mechanism would forbid it. It is well known that, when confronted with an unfamiliar mechanism, in order to verify that it really is a mechanism—a necessary sequence of operations—we are obliged to try to find out what effect is expected from it, what end has been envisioned. We cannot determine its use from the form and structure of the apparatus unless we already know the machine's use, or that of analogous machines. It is thus necessary first to see the machine functioning so as then to appear able to deduce the function from the structure.

We have come to the point where the Cartesian relationship between machine and organism is reversed.

In an organism—and this is too well known to need insisting—one observes phenomena of self-construction, self-conservation, self-regulation, and self-repair.

In a machine, its construction is foreign and presupposes the ingenuity of the mechanic; conservation demands the constant surveillance and vigilance of the machinist, and we know how irreparably certain complicated machines can be damaged through lack of attention or surveillance. As for regulation and repair, they also presuppose the periodic intervention of human action. There are doubtless devices that regulate themselves, but these are machines superposed upon machines by man. The construction of servomechanisms or electronic automatons displaces the relationship of man to machine but does not alter its sense.

In the machine, the rules of a rational accounting are rigorously verified. The whole is strictly the sum of the parts. The effect is dependent on the order of causes. In addition, a machine displays a clear functional rigidity, a rigidity made increasingly pronounced by the practice of standardization. Standardization is the simplification of models and replacement parts, the rendering uniform of metric and qualitative characteristics, which allows for the interchangeability of parts. Any part is equivalent to any other with the same purpose—within, naturally, a margin of tolerance that defines manufacturing limits.

With the properties of a machine in comparison to those of the organism thus defined, is there more or less purpose in the machine than in the organism?

It can easily be said that there is more purpose in the machine than in the organism, because the purpose of the machine is rigid, univocal, univalent. A machine cannot replace another machine. The more limited the purpose, the more the margin of tolerance is reduced, and the more hardened and pronounced the purpose appears to be. In the organism, by contrast, one observes—and this again is too well known to be insisted upon—a vicariousness of functions, a polyvalence of organs. Doubtless, this vicariousness of functions and polyvalence of organs are not absolute, but they are so much greater than in the machine that there can really be no comparison.[38] As an example of the vicariousness of functions, one may cite a simple, well-known case: childhood aphasia. Hemiplegia on the right side is almost never accompanied by aphasia, because other regions of the brain ensure the language function. And when aphasia appears in a child under nine years old, it dissipates rapidly.[39] As for the matter of the polyvalence of organs, one may simply cite the fact that, although we believe that for most organs there is some defined function, in reality we are ignorant of other functions they may serve. In this manner, the stomach is said in principle to be the organ of digestion. Yet it is a fact that, following a gastrectomy to treat an ulcer, one observes problems of digestion less than problems of hæmatopoiesis. It was thus discovered that the stomach behaves like an internal secretion gland. We could also cite here—and not just as a display of wonders—the recent example of an experiment performed by Robert Courrier, professor of biology at the Collège de France. Courrier made an incision on a gravid rabbit's uterus, extracted one placenta, and placed it in the peritoneal cavity. The placenta grafted onto the intestine and nourished itself as normal. Once the graft was effected, the rabbit's ovaries were removed—that is to say, the pregnancy function of the *corpus luteum* was thereby suppressed. At this moment, all the placentas in the uterus aborted, and only the placenta placed in the peritoneal cavity came to term. Here is an example where the intestine behaves like a uterus, even, one could say, with more success than the uterus itself.

On this point, we are thus tempted to reverse a proposition of Aristotle's. He writes in the *Politics*: "For nature is not stingy, like the smith who fashions the Delphian knife for many uses; she makes each thing for a single use, and every instrument is best made when intended for one and not many things."[40] On the contrary, it seems that this definition of purpose is better suited to the machine than to the organism. We must at least admit that, in

e organism, a plurality of functions can adapt to the singularity of an gan. An organism thus has greater latitude of action than a machine. It s less purpose and more potentialities.[41] The living organism acts in ac- rdance with empiricism, whereas the machine, which is the product of lculation, verifies the norms of calculation, that is, the rational norms of entity, consistency, and predictability. Life, by contrast, is experience, that to say, improvisation, the utilization of occurrences; it is an attempt in all rections. From this follows a massive and often neglected fact: life toler- es monstrosities. There is no machine monster. There is no mechanical thology, as Bichat already observes in 1801 in *Anatomie générale appliquée la physiologie et à la médecine* (*General Anatomy Applied to Physiology and edicine*).[42] Whereas monsters are still living beings, there is no distinction tween normal and pathological in physics and mechanics. The distinction tween the normal and the pathological holds for living beings alone.

Above all, what led to the abandonment of mechanist representations in e interpretation of living phenomena was work in experimental embryol- gy, which showed that the seed does not contain within it a sort of "specific achinery" (Cuénot[43]) destined, once set in motion, automatically to pro- ıce such and such an organ. That was undoubtedly Descartes' conception. the "Description of the Human Body," he writes: "If one knew well all e parts of the seminal fluid of a species of particular animal—for example, an—one could deduce, from this alone and for sure and mathematical asons, the entire figure and conformity of each of its members—just as, ciprocally, by knowing several particularities of this conformity, one could educe the seminal fluid."[44] However, as Guillaume points out, it seems at the more one compares living beings to automatic machines, the better ne understands their function but the less one understands their genesis.[45] the Cartesian conception were true—that is to say, if there were both reformation in the seed and mechanism in development, an alteration the outset would disturb or even entirely prevent the development of ne egg.

In fact, this is far from being so—as, thanks to the works of Driesch, Hörstadius, Spemann, and Mangold, the study of the potentialities of the gg has made clear the difficulty of reducing embryological development to mechanist model. Let us take as an example Hörstadius's experiments on ne sea urchin egg. He cut sea urchin egg *A* at stage 16 along a horizontally mmetrical plane, and egg *B* along a vertically symmetrical plane. He then

joined one-half of *A* to one-half of *B*, and the resulting egg developed normally. Driesch took a sea-urchin egg at stage 16 and compressed it between two strips, modifying the reciprocal position of the cells at the two poles; the egg developed normally. These two experiments allow us to conclude that the effect is indifferent to the way in which the causes are arranged. Another experiment is even more striking. It is also Driesch's, and it consists in extracting the blastomeres of the sea-urchin egg at stage 2. The blastomeres are dissociated either mechanically or chemically, in sea water depleted of calcium salts. The result is that each blastomere gives birth to a larva that is normal, apart from its dimensions. Here, consequently, the effect is indifferent to the quantity of the cause. The quantitative decrease in cause does not qualitatively alter the effect. And conversely, when one conjoins two sea-urchin eggs, one obtains a single larva, larger than normal. This is further confirmation of the effect's indifference to the quantity of the cause. The experiment by multiplication of the cause confirms the experiment by division of the cause.

It must be said that it is impossible to reduce the development of all eggs to this schema. It has long been asked whether we are dealing with two sorts of eggs—regulated eggs of the sea-urchin egg type and mosaic eggs of the frog-egg type, in which the cellular future of the first blastomeres, whether they are dissociated or stay together, is identical. Most biologists at present accept that there is simply a difference of precocity in the appearance of determination among "mosaic" eggs. For one thing, from a certain stage onward, regulation eggs behave like mosaic eggs; for another, the blastomere of a frog egg at stage 2 produces a complete embryo, as does a regulation egg if it is turned upside down.[46]

It seems to us, then, that it is an illusion to think that purpose can be expelled from the organism by comparing it to a composite of automatisms, no matter how complex. So long as the construction of the machine is not a function of the machine itself, so long as the totality of an organism is not equivalent to the sum of its parts (parts discovered by analysis once the organism has already been given), it seems legitimate to hold that biological organization must necessarily precede the existence and meaning of mechanical constructions. From the philosophical point of view, it is less important to explain the machine than to understand it. And to understand it is to inscribe it within human history by inscribing human history in life,

ithout, however, neglecting the appearance, with man, of a culture irreucible to simple nature.

Thus we have come to see in the machine a *fact of culture* expressing itself n mechanisms that, for their part, are nothing but a *fact of nature to be xplained.* In a famous text of the *Principles*, Descartes writes: "It is certain nat all the rules of mechanics belong to physics, *to the extent that all artificial hings are thereby natural.* Since, for example, when a watch counts the hours, y using the cogs from which it is made, this is no less natural for it than or a tree to produce fruit."[47] But, from our point of view, we can and we nust invert the relationship between the watch and the tree, and say that he wheels a watch is made of, so as to show the hours, and, in general, all he pieces of mechanisms assembled so as to produce an effect—an effect at irst only dreamed or desired—are the immediate or derived products of a echnical activity as authentically organic as the bringing forth of fruit by rees, an activity, in the beginning, as little conscious of the rules and laws ensuring its efficacy as plant life is. The logical anteriority, at any given noment, of a knowledge of physics to the construction of machines cannot and must not allow us to forget the absolute chronological and biological nteriority of the construction of machines to the knowledge of physics.

Now, contrary to Descartes, one author has affirmed both the irreducibility of the organism to the machine and, symmetrically, the irreducibility of art to science. This is Kant, in the *Critique of Judgment.* It is true that in France we are not used to looking for a philosophy of techniques in Kant, but German writers who have been interested in these problems, especially from 1870 onward, have not failed to do so.

In paragraph 65 of the "Critique of the Teleological Power of Judgment," Kant uses the example of the watch, so dear to Descartes, to distinguish machine from organism. In a machine, he writes, each part exists for another, but not by another. No piece is produced by another piece; no piece is produced by the whole; nor is any whole produced by another whole of the same species. There is no watch-making watch. No part replaces itself by itself. No whole replaces a missing part. The machine thus possesses motor force, but not a formative energy capable of transmitting itself to external matter and propagating itself. In paragraph 75, Kant distinguishes man's intentional technique from life's unintentional technique. But in paragraph 43 (from the "Critique of the Aesthetic Power of Judgment"),

Kant defines the originality of this intentional human technique relative to knowledge in an important text:

> Art, as human skill, is distinguished also from *science* (as *ability* from *knowledge*), as a practical from a theoretical faculty, as technic from theory (as the art of surveying from geometry). For this reason, also, what one *can* do the moment one only *knows* what is to be done, hence without anything more than sufficient knowledge of the desired result, is not called art. To art that alone belongs for which the possession of the most complete knowledge does not involve one's having then and there the skill to do it. *Camper* describes very exactly how the best shoe must be made, but he, doubtless, was not able to turn one out himself.[48]

This text is cited by Paul Krannhals in *Der Weltsinn der Technik* (*The Universal Meaning of Technique*); he sees in it, rightly, it would seem, a recognition of the fact that every technique essentially and positively includes a vital originality irreducible to rationalization.[49] Indeed, let us consider the fact that dexterity in making an adjustment, or synthesis in the process of production—what we customarily call ingenuity, responsibility for which we sometimes delegate to an instinct—all this is as inexplicable in its formative movement as the production of a mammal egg outside of the ovary may be, even if we were to presume the physico-chemical composition of protoplasm and the sexual hormones to be completely known.

We therefore find that the works of ethnographers shed more (though still weak) light on the construction of machines than those of engineers.[50] In France, it is ethnographers who are today closest to constituting a philosophy of technique, in which philosophers have lost interest, since they have been attentive, above all, to the philosophy of science. Ethnographers, by contrast, have been attentive to the relationship between the production of the first tools, the first devices [*dispositifs*] for acting on nature, and organic activity itself. The only philosopher in France who, to our knowledge, has asked questions of this order is Alfred Espinas, and we refer the reader to his classic 1897 work *Les origines de la technologie.*[51] This work includes an appendix, the outline of a course on Will given at the Faculté des Lettres in Bordeaux around 1890; in it, Espinas discusses human practical activity and, in particular, the invention of tools under the name of *will.* We know that Espinas borrowed his theory of organic projection, which he uses to explain the construction of the first tools, from a German author, Ernst Kapp (1808–96), who presented it for the first time in his 1877 work *Grundlinien*

einer Philosophie der Technik (*Outlines of a Philosophy of Technique*).[52] This work, a classic in Germany, was so little known in France that certain psychologists who, on the basis of studies by Wolfgang Köhler and Paul Guillaume, have taken up the problems of animal intelligence and the use of tools by animals, attribute this theory of projection to Espinas himself, without noticing that Espinas explicitly declares at several points that he is borrowing from Kapp.[53] According to the theory of projection (whose philosophical foundations reach back, through Eduard von Hartmann and his *Philosophy of the Unconscious*,[54] to Schopenhauer), the first tools were no more than prolongations of human organs in motion. Flints, clubs, and levers prolong and extend the arm's organic movement of percussion. This theory, like all theories, has its limits and encounters notable obstacles in explaining inventions like fire or the wheel, which are so characteristic of human technique. One could search in vain, here, for the gestures and organs of which fire or the wheel would be the prolongation or extension, yet it is certain that this explanation is acceptable for instruments derived from the hammer or the lever, for all these families of instruments. In France, thus ethnographers have gathered not only the facts but also the hypotheses upon which a biological philosophy of technique could be constituted. Leroi-Gourhan, in his *Milieu et Techniques*,[55] takes up what the Germans developed by way of philosophy[56]—for example, a theory of the development of inventions founded on Darwinian notions of variation and natural selection[57] or a theory of the construction of machines as a "tactic of life"[58]—without, so far as we know, any direct derivation. Leroi-Gourhan seeks to understand the phenomenon of the construction of the tool through a comparison with the movement of an amoeba, pushing out of its mass an extension that grasps and captures the external object of its desire in order to digest it. He writes: "If percussion has been proposed as the fundamental technical act, it is because there is, in almost all technical acts, the attempt to contact by touch, but while the expansion of the amoeba always pulls its prey toward the same digestive process, between the matter to be dealt with and the technical thought that envelops it are created, in each circumstance, specific organs of percussion."[59] The last chapters of this work constitute what is today the most striking example of a systematic and duly detailed attempt to bring biology and technology together. If one takes these views as a point of departure, the problem of the construction of machines receives a totally different solution from the traditional one, which was situated within a perspective that, for lack of a better term, we might call

Cartesian, a perspective according to which technical invention consisted in the application of knowledge.

It is traditional to present the construction of the locomotive as a "marvel of science." And yet the construction of the steam engine is unintelligible if one does not understand that it is not an application of pre-existing theoretical knowledge but the solution to a millennial, truly technical problem—the problem of draining mines. To understand that the essential organ in a locomotive is a cylinder and piston, one must know the natural history of the forms of the pump; one must know of the existence of fire pumps, in which steam did not at first play the role of motor but served rather to create, by condensation under the piston of the pump, a vacuum that allowed the atmospheric pressure to act as a motor and to push down the piston.[60]

Leroi-Gourhan goes even further along these lines, and he looks for one of the locomotive's ancestors (in the biological sense of the word) in the spinning wheel. He writes: "Steam engines and actual motors developed from machines such as the spinning wheel. Around the circular movement is clustered all that the inventive spirit of our times has discovered that is highest among techniques: the crank, the pedal, the conveyor belt."[61] And later: "The reciprocal influence of inventions has not been sufficiently brought to light and we ignore that, without the spinning wheel, we would not have had the locomotive."[62] Further on: "The beginning of the nineteenth century did not know the forms that would become the materially utilizable embryos for the locomotive, the automobile, and the airplane. We discover the mechanical principles scattered in twenty applications known for several centuries. Therein lies the phenomenon that explains invention, but what is proper to invention is that it materializes, as it were, instantaneously."[63] One sees how, in light of these remarks, Science and Technique must be considered not as two types of activity, one of which is grafted onto the other, but as two types of activity, each of which borrows from the other sometimes its solutions, sometimes its problems. The rationalization of techniques makes one forget the irrational origin of machines. And it seems that in this area, as in any other, one must know how to cede a place to the irrational, even and especially when one wants to defend rationalism.[64]

To this we must add that the reversal of the relation between machine and organism that is brought about by a systematic understanding of technical inventions as behaviors of the living finds some confirmation in the attitude that the generalized use of machines has little by little imposed on men

contemporary industrialized societies. Georges Friedmann's important rk *Problèmes humains du machinisme industriel* depicts the stages in the ction that has restored the organism to first place in the relation between chine and human organism.[65] With Taylor and the first technicians of e rationalization of workers' movements, we see the human organism gned, so to speak, with the functioning of the machine. Properly speak-g, rationalization is a mechanization of the organism, inasmuch as it aims eliminate movements that appear useless because they are seen solely m the viewpoint of output, considered as a mathematical function of tain factors. But the observation that technically superfluous movements e biologically necessary was the first stumbling block encountered by this clusively technicist assimilation of the human organism to the machine. om here, the systematic examination of conditions physiological, psycho-chnical, and even psychological, in the most general sense of the word ecause by taking values into consideration one arrives at the most origin-y core of the personality), has led to a reversal: Friedmann sees the devel-ment of a technique for adapting machines to the human organism as an eluctable revolution. This technique seems to him a scientific rediscovery the empirical processes by which primitive peoples have always sought adapt their tools to the organic norms of an efficient and biologically onomical action—that is to say, an action that situates positive value in e evaluation of technical norms within the organism at work, which spon-neously defends itself against any exclusive subordination of the biological the mechanical.[66] Friedmann can thus claim, without irony or paradox, at it is legitimate to consider the industrial development of the West from ethnographic point of view.[67]

summary, by considering technique to be a universal biological phenom-non and no longer only an intellectual operation of man,[68] one is led, first, affirm the creative autonomy of arts and crafts from any knowledge capa-e of appropriating them so as to apply itself to them or informing them as to multiply their effects. Second, in consequence, one is led to inscribe e mechanical within the organic. It is then naturally no longer a question f asking in what way the organism can or must be considered to be a ma-ine, whether from the viewpoint of its structure or from the viewpoint of s functions. Rather, it is necessary to look for the reasons why the opposite, artesian opinion could have been born. We have tried to elucidate this

problem. We have proposed that, in spite of initial appearances, a mechanist conception of the organism is no less anthropomorphic than a teleological conception of the physical world. The solution we have tried to defend has the advantage of showing man in continuity with life through technique prior to insisting on the rupture for which he assumes responsibility through science. This solution doubtless suffers from the inconvenience of appearing to reinforce the nostalgic indictments that, without much regard for the originality of their themes, too many writers address to technology and its progress. It is not our intention to come to their aid. It is quite clear that, if the human living has provided itself with a technique of the mechanical type, this massive phenomenon has a sense that is not gratuitous and that therefore cannot be revoked at will. But that is a question completely different from the one we have just examined.

FIVE

The Living and Its Milieu

The notion of milieu is becoming a universal and obligatory mode of apprehending the experience and existence of living beings; one could almost say it is now being constituted as a category of contemporary thought. But until now it has been quite difficult to perceive as a synthetic unity the historical stages in the formation of this concept, the various forms of its utilization, and the successive inversions of the relationship in which it is one of the terms—in geography, in biology, in psychology, in technology, in economic and social history. For this reason, philosophy must take the initiative in synoptically investigating the meaning and value of this concept. By initiative, we do not mean what appears to be an initiative but only consists in reflecting on the sequence of scientific explorations so as to compare their appearance and results. Rather, through a critical comparison of several approaches, we mean, if possible, to bring to light their common point of departure and to postulate their fecundity for a philosophy of nature centered on the problem of individuality. We shall thus examine one by one

the simultaneous and successive components of the notion of *milieu*, the varieties of its use, from 1800 to our time, the various reversals of the relationship between organism and milieu, and, finally, the general philosophical impact of these reversals.

Historically speaking, the notion and term *milieu* were imported from mechanics into biology during the second half of the eighteenth century. The mechanical notion (though not the term) appeared with Newton, and in its mechanical meaning the term can be found in the article "Milieu" in d'Alembert and Diderot's *Encyclopédie*.[1] Lamarck, inspired by Buffon, introduced it into biology, but he used it only in the plural. This usage was established by Henri de Blainville. Étienne Geoffroy Saint-Hilaire (in 1831) and Auguste Comte (in 1838) used the term in the singular, as an abstract term. Honoré de Balzac introduced it into literature in 1842 (in the preface to *The Human Comedy*), and Hippolyte Taine established it as one of the three principles of the analytic explanation of history—the other two being race and moment.[2] It is from Taine, rather than from Lamarck, that French neo-Lamarckian biologists after 1870—Alfred Giard, Félix Le Dantec, Frédéric Houssay, Johann Costantin, Gaston Bonnier, and Louis Roule—inherited this term. The idea came from Lamarck, but the term, as universal and abstract, was transmitted to them by Taine.

The French mechanists of the eighteenth century called "milieu" what Newton had referred to as "fluid." In Newton's physics, the type—if not the sole archetype—of fluid is ether.[3] In Newton's time, the problem mechanics had to solve was that of the action of distinct physical bodies at a distance. This was the fundamental problem in the physics of central forces. It was not an issue for Descartes, however. For him, there is but one mode of physical action, collision, in one possible physical situation, contact. This is why we can say that the notion of milieu has no place in Cartesian physics. Descartes' "subtle matter" is in no way a milieu. But there was difficulty in extending the Cartesian theory of collision and contact to the case of distinct physical bodies, for their actions blend together. We thus understand how Newton came to pose the problem of the medium of action.[4] For him, luminiferous ether is fluid as the medium of action at a distance. This explains the passage from the notion of fluid as vehicle to that of its designation as milieu. The fluid is an intermediary between two bodies; it is their milieu; and insofar as the fluid penetrates all these bodies, they are situated in the middle of it [*au milieu de lui*]. According to Newton and the physics

of central forces, one can speak of an environment, a milieu, because there exist centers of force. The notion of milieu is an essentially relative one. When we consider separately the body that receives an action transmitted by the milieu, we forget that a *milieu* is a medium, *in between two centers*, and we retain only its function as a centripetal transmitter, its position as that which surrounds a body. In this way, milieu tends to lose its relative meaning and to take on that of an absolute, a reality in itself.

Newton is perhaps responsible for the importation of the term from physics into biology. He used ether not only to solve the problem of the phenomenon of illumination but also to explain the physiological phenomenon of vision and, finally, to explain the physiological effects of the sensation of light, that is, muscular reactions. In his *Optics*, Newton considers ether to be continuous in the air, the eye, the nerves, and the muscles. It is thus the action of the milieu that guarantees the relation of dependence between the illumination of a perceived light source and the movement of the muscles by which man reacts to this sensation. This, it seems, is the first example of an organic reaction being explained by the action of a milieu, that is to say, by the action of a fluid strictly defined by physical properties.[5] Indeed, the aforementioned *Encyclopédie* article confirms this view and borrows all its examples of a milieu from Newton's physics. And it is in a purely mechanical sense that water is said to be a milieu for the fish that move about in it. It is also in this mechanical sense that Lamarck first uses the term.

Lamarck always speaks of milieus—in the plural—by which he expressly means fluids like water, air, and light. When Lamarck wishes to designate the ensemble of actions that act on a living being from the outside—what we today call the milieu—he never says "milieu," but always "influencing circumstances."[6] Consequently, circumstance is for Lamarck a genus, whose species are climate, place, and milieu. This is why Léon Brunschvicg, in *Les étapes de la philosophie mathématique*,[7] could write that Lamarck had borrowed from Newton the model for a physical-mathematical explanation of the living by a system of connections with its environment. The connections between Lamarck and Newton are direct at the intellectual level and indirect historically. Buffon links Lamarck to Newton. We might simply recall that Lamarck was Buffon's student and the tutor of his son.

Buffon in fact combines two influences in his conception of the relations between the organism and the milieu. The first is Newton's cosmology, of

which Buffon was a constant admirer.[8] The second is the tradition of anthropo-geographers, which, after Machiavelli, Jean Bodin, and John Arbuthnot, was kept alive in France by Montesquieu. The Hippocratic treatise *On Airs, Waters, and Places* can be considered the first work to have given a philosophical form to this anthropo-geographical conception.[9] These are the two elements Buffon brought together in his principles of animal ethology, to the extent that the mores of animals are distinctive and specific characteristics and can be explained by the same method geographers use to explain the diversity of men—the variety of races and peoples on the earth's surface.[10]

Thus, as teacher and precursor to Lamarck in his theory of milieu, Buffon appears at the convergence of the two components of this theory: the mechanical and the anthropo-geographical. Here is posed a problem of epistemology and of the historical psychology of knowledge, a problem whose scope greatly exceeds the present example. Shouldn't we interpret the fact that two or more guiding ideas combine at a certain moment to form a single theory as a sign that—in the final analysis and despite their apparent differences—they have a common origin, whose meaning and very existence we forget when we consider separately their disjointed parts? We will return to this problem at the end of the present essay.

The Newtonian origins of the notion of milieu thus suffice to account for its initial mechanical signification and the use that was first made of it. The origin determines the meaning and the meaning determines the usage, to such an extent that Comte, when proposing a general biological theory of milieu in 1838 (in the fortieth lesson of his *Course of Positive Philosophy*), had the impression he was using *milieu* as a neologism and claimed responsibility for erecting it into a universal and abstract notion of biological explanation. Comte says that by this term he no longer means only "the fluid into which a body is immersed" (thereby confirming the mechanical origins of the notion) but "the total ensemble of exterior circumstances necessary for the existence of each organism." But we also see in Comte—who has a perfectly clear sense of the origins of the notion, as well as of the import he would like to give to it in biology—that its usage will remain dominated by the mechanical origins of the notion, if not of the term. Indeed, it is quite interesting to notice that Comte is on the brink of forming a dialectical conception of the relations between the organism and the milieu. We are

alluding here to the passages in which he defines the relation of the "appropriate organism" and the "suitable milieu" as a "conflict of forces," and the act constituting that conflict as function.[11] He posits that "the ambient system could not possibly modify the organism if the organism did not exert on it in turn a corresponding influence." But, apart from the human species, he holds the organism's action on the milieu to be negligible. In the case of the human species, Comte, faithful to his philosophical conception of history, admits that, by the intermediary of collective action, humanity modifies its milieu. Still, for the living in general Comte refuses to consider this reaction of the organism on the milieu—judging it to be simply negligible. This is because he very explicitly looks for a guarantee of this dialectical link, this reciprocal relation between milieu and organism, in the Newtonian principle of action and reaction. Indeed, from a mechanical point of view, the action of the living on the milieu is almost negligible. And Comte ends up posing the biological problem of the relations between the organism and the milieu in the form of a mathematical problem: "In a given milieu, and given an organ, find the function—and vice versa." The link between the organism and the milieu is thus that of a function to an ensemble of variables, an equation by way of which, "all other things being equal," one can determine the function by the variables, and each variable by the function.[12]

In the forty-third lesson of the *Course of Positive Philosophy*, Comte analyses the variables for which the milieu is the function. These variables are weight, air and water pressure, movement, heat, electricity, and chemical species—all factors that can be studied experimentally and quantified by measurements. The quality of an organism is reduced to an ensemble of quantities, despite Comte's professed distrust of the mathematical treatment of biological problems—a distrust that came to him from Bichat.

In sum, the benefit of even a cursory history of the importation of the term *milieu* into biology during the first years of the nineteenth century is that it accounts for the originally strictly mechanistic acceptance of the term. If in Comte there appears a hint of an authentically biological acceptance and a more flexible usage of the word, this immediately gives way to the prestige of mechanics, an exact science in which prediction is based on calculation. To Comte, the theory of milieu seems clearly to be a variant of the fundamental project that the *Course of Positive Philosophy* endeavors to complete: first the world, then man; to go from the world to man. If Comte

anticipates the idea of a subordination of the mechanical to the vital—the idea he would later formulate in mythical form in *The System of Positive Polity* and *The Subjective Synthesis*—here he nevertheless deliberately represses it.

But there is still one lesson to be taken from the use—absolute and without qualification—of the term *milieu* as it was definitively established by Comte. The term would henceforth designate the equivalent of Lamarck's "circumstances" and Étienne Geoffroy Saint-Hilaire's "ambient milieu" (in his 1831 thesis at the Académie des Sciences). These terms, *circumstances* and *ambience*, point to a certain intuition of a formation around a center. With the success of the term *milieu*, the representation of an indefinitely extendible line or plane, at once continuous and homogeneous, and with neither definite shape nor privileged position, prevailed over the representation of a sphere or circle, which are qualitatively defined forms and, dare we say, attached to a fixed center of reference. *Circumstances* and *ambience* still retain a symbolic value, but *milieu* does not evoke any relation except that of a position endlessly negated by exteriority. The now refers to the before; the here refers to its beyond, and thus always and ceaselessly. The milieu is truly a pure system of relations without supports.

From there one can understand the prestige of the notion of milieu for analytic scientific thought. The milieu becomes a universal instrument for the dissolution of individualized organic syntheses into the anonymity of universal elements and movements. When the French neo-Lamarckians borrowed from Lamarck, if not the term *milieu* in the singular and in its absolute sense, then at least the idea of it, they retained of the morphological characteristics and functions of the living only their formation by exterior conditioning—only, so to speak, their formation by deformation. It is enough to recall J. Costantin's experiments on the forms of the arrowhead leaf or Frédéric Houssay's experiments on the form, fins, and metamerism of fish.[13] Louis Roule was able to write, in his small book *La vie des rivières*, that "fish do not lead their lives on their own; it is the river that makes them lead it; they are persons without personality."[14] We have here an example of what a strictly mechanist usage of the notion of milieu necessarily leads to.[15] We are brought back to the theory of animal-machines. In the end, this is just what Descartes said, in saying of animals that "it is nature which acts in them by means of their organs."[16]

From 1859 on—that is to say, after the publication of Darwin's *The Origin of Species*—the problem of the relations between organism and milieu is dominated by the polemic between Lamarckians and Darwinians. To understand the meaning and importance of this polemic, it is necessary to recall the originality of their respective points of departure.

In his 1809 *Zoological Philosophy*, Lamarck writes that if by action of circumstances or milieus one takes him to mean direct action by the exterior milieu on the living, one is putting words into his mouth.[17] It is via the intermediary of need, a subjective notion implying reference to a positive pole of vital values, that the milieu dominates and compels the evolution of living beings. Changes in circumstances lead to changes in needs; changes in needs lead to changes in actions. If these actions are long-lasting, the use or nonuse of certain organs causes the organs to develop or atrophy, and these morphological acquisitions or losses, obtained by individual habit, are preserved by the mechanism of heredity, on condition that the new morphological characteristic is common to both parents.

According to Lamarck, the situation of the living in the milieu is distressful and distressed. Life exists in a milieu that ignores it, as two asynchronous series of events. Circumstances change on their own, and the living must take the initiative to make an effort not to be "dropped" by its milieu. Adaptation is a renewed effort by life to continue to "stick" to an indifferent milieu. Since it is the result of an effort, adaptation is thus neither harmonious nor providential; it is gained and never guaranteed. Lamarckism is not mechanist, and it would also be inaccurate to call it finalistic. In reality, it is a bare vitalism. There is an originality in life for which the milieu does not account and which it ignores. Here the milieu is truly exterior, in the proper sense of the word: it is foreign, it does nothing for life. This is truly a vitalism because it is a dualism. Life, says Bichat, is the ensemble of functions that resist death. In Lamarck's conception, life resists solely by deforming itself so as to outlive itself. To our knowledge, no portrait of Lamarck, no summary of his doctrine, surpasses the one given by Charles Augustin Sainte-Beuve in his novel *Volupté*.[18] One sees how far one has to go to get from Lamarck's vitalism to the French neo-Lamarckians' mechanism. Edward Cope, an American neo-Lamarckian, was more faithful to the spirit of the doctrine.

Darwin had a completely different idea of the environment of the living, as well as of the appearance of new forms. In the introduction to *The Origin of Species*, he writes: "Naturalists continually refer to external conditions such as climate, food, etc. as the only possible cause of variation. In one limited sense, . . . this may be true."[19] It seems that Darwin later regretted having attributed only a secondary role to the direct action of physical forces on the living. This comes across in his correspondence. Marcel Prenant, in his introduction to a collection of Darwin's texts, has published some particularly interesting passages on this topic.[20] Darwin looks for the appearance of new forms in the conjunction of two mechanisms: one that produces differences, namely, variation; and one that reduces and tests the differences thereby produced, namely, the struggle for life and natural selection. The fundamental biological relation, in Darwin's eyes, is the relation of one living being to others; it prevails over the relation between the living and the milieu conceived as an ensemble of physical forces. The first milieu an organism lives in is an entourage of living beings, which are for it enemies or allies, prey or predators. Between these living beings are established relations of use, destruction, and defense. In this competition of forces, accidental morphological variations count as advantages or disadvantages. And variation—the appearance of small morphological differences by which a descendant does not exactly resemble its ancestors—stems from a complex mechanism: the use or nonuse of organs (the Lamarckian factor applies only to adults), correlations or compensations in growth (for the young), or the direct action of the milieu (on germ seeds).

In this sense, one can say that for Darwin, by contrast to Lamarck, the initiative to variation comes sometimes—but only sometimes—from the milieu. One gets a somewhat different idea of Darwin depending on whether one accentuates this action or not and whether one limits oneself to his classic works or instead considers the entirety of his thought, as revealed in his correspondence. In any case, for Darwin, to live is to submit an individual difference to the judgment of the ensemble of living beings. This judgment has only two possible outcomes: either death or becoming oneself part of the jury for a while. So long as one lives, one is always judge and judged. As a result, in Darwin's oeuvre as he left it to us, the thread linking the formation of the living being to the physico-chemical milieu can seem fairly thin. And when mutationism, a new theory of the evolution of species, used genetics to explain the appearance of immediately hereditary species variations (Darwin had underestimated this phenomenon), the role of the milieu was reduced to eliminating the worst without participating in

the production of new beings, normalized by their unpremeditated adaptation to new conditions of existence, monstrosity becoming the rule and originality a temporary banality.

In the polemic between Lamarckians and Darwinians, the same arguments and objections are made in both directions and applied to both authors: finalism is denounced and mechanism celebrated sometimes in one, sometimes in the other. This is no doubt a sign that the question has been badly put. In Darwin, one can find finalism not in things themselves but in his choice of words—he has been frequently reproached for his term *selection*. In Lamarck, it is less finalism than vitalism. Both are authentic biologists, to whom life appears as a given that each seeks to characterize, instead of trying analytically to explain it. These two authentic biologists are complementary. Lamarck thinks of life in terms of duration, and Darwin thinks of it mostly in terms of interdependence: a living form presupposes a plurality of other forms in relation to it. The synoptic vision that is the essence of Darwin's genius is missing in Lamarck. Darwin is more closely related to the geographers, and we know how much he owed to his voyages and explorations. The milieu in which Darwin depicts the life of the living is a bio-geographical milieu.

At the beginning of the nineteenth century, two names stand for the birth of geography as a science conscious of its method and dignity: Carl Ritter and Alexander von Humboldt.

In 1817, Ritter published his *Comparative Geography*.[21] Humboldt published, during the decade beginning in 1845, a book whose title, *Kosmos*, perfectly captures its spirit.[22] In these two works are united the traditions of Greek geography: that is to say, on the one hand, the science of the human ecumene since Aristotle and Strabo, and on the other, the science of the coordination of human space in relation to celestial configurations and movements—the science of mathematical geography, which Eratosthenes, Hipparchus, and Ptolemy are considered to have founded.

According to Ritter, without man's relation to the land—to all land—human history is unintelligible. The earth, considered as a whole, is the stable ground for the vicissitudes of history. Terrestrial space and its configuration are, consequently, not only geometrical and geological objects of knowledge but also sociological and biological ones.

Humboldt was a naturalist-traveler, who repeatedly covered what it was possible to cover of the world in his time and who applied a whole system of barometric, thermometric, and other measurements to his investigations. Humboldt's interest was above all focused on the distribution of plants according to climate: he is the founder of botanical geography and zoological geography. *Kosmos* is a synthesis of knowledge concerning life on earth and the relations of life to the physical milieu. This synthesis does not aim to be an encyclopedia but rather to arrive at an intuition of the universe; it begins with a history of *Weltanschauungen*, with a history of the Cosmos whose equivalent it would be difficult to find in a work of philosophy. It is an absolutely remarkable overview.

It is essential to note that Ritter and Humboldt applied to their object—the relations between historical man and milieu—the category of totality. Their object is the whole of humanity on the whole Earth. With Ritter and Humboldt, the idea of determining historical relations by the geographical substrate was consolidated in geography. It gave rise first to Friedrich Ratzel and anthropo-geography in Germany, and then to geopolitics. The idea then invaded history by contagion, starting with Michelet (let us recall his *Le tableau de la France*).[23] Finally, as we have already said, Taine contributed to the spread of the idea to all milieus, including the literary milieu. We can sum up the spirit of this theory of the relations of geographical milieu to man by saying that doing history came to consist in reading a map, where this map is the figuration of an ensemble of metrical, geodesic, geological, and climatological data, as well as descriptive bio-geographical data.

The treatment of anthropological and human ethological questions—a treatment that became more and more deterministic or, rather, mechanistic the farther one went from the spirit of its founders—was doubled by a parallel, if not exactly synchronous treatment in the domain of animal ethology. The mechanistic explanation of the organism's movements in the milieu succeeded the mechanistic interpretation of the formation of organic forms. Let us simply recall the works of Jacques Loeb and John B. Watson. Generalizing the conclusions of his research on phototropisms in animals, Loeb considered all movement of the organism to be movement forced on it by the milieu. The reflex, considered to be an elementary response of a segment of the body to an elementary physical stimulus, is the simple mechanism whose composition allows one to explain all behaviors of the living.

Along with Darwinism, this exorbitant Cartesianism is incontestably at the origin of the postulates of behaviorist psychology.[24]

Watson assigned to psychology the task of conducting analytic research into the conditions of the adaptation of the living to the milieu by experimentally producing excitation and response relations (the stimulus-response pair). There is a physical determinism in the relation between excitation and response. The biology of behavior is reduced to neurology, which itself is reducible to energetics, the science of energy. The evolution of Watson's thought led him from a conception that simply neglects consciousness as useless to one that nullifies it as illusory. The milieu thus comes to be invested with all power over individuals; its power [*puissance*] dominates and even abolishes that of heredity and genetic constitution. Since the milieu is given, the organism gives itself nothing it does not, in reality, already receive. The situation of the living, its being in the world, is a condition or, more exactly, a conditioning.

Albert Weiss intended to construct biology like a deductive physics, by proposing an electronic theory of behavior. It fell to the psycho-technicians—who expanded Taylorist techniques for timing movements through the analytic study of human reactions—to perfect the work of behaviorist psychology and constitute, through their science, man as a machine reacting to machines, as an organism determined by the "new milieu" (Friedmann).

In short, because of its origins, the notion of milieu first developed and spread in a perfectly determined way, and we can say, applying to this notion the methodological norm it stands for, that its intellectual power was a function of the intellectual milieu in which it had been formed. The theory of milieu was at first the positive and apparently verifiable translation of Condillac's fable of the statue.[25] When the air smells like roses, a statue is rose-scented. In the same way, the living, within the physical milieu, is light and heat, carbon and oxygen, calcium and weight. It responds by muscular contractions to sensory excitations; it responds with a scratch to an itch, with flight to an explosion. But one can and must ask: Where is the living? We see individuals, but these are objects; we see gestures, but these are displacements; centers, but these are environments; machinists, but these are machines. The milieu of behavior coincides with the geographical milieu; the geographical milieu, with the physical milieu.

It was normal, in the strong sense of the word, for this methodological norm to have first reached its limits and the occasion for its reversal in

geography. Geography has to do with complexes—complexes of elements whose actions mutually limit each other and in which the effects of causes become causes in turn, modifying the causes that gave rise to them. Trade winds are a typical example of a complex in this respect. They displace surface water that has been heated by contact with the air; the cold deep waters rise to the surface and cool the atmosphere; low temperatures engender low pressure, which generates winds; the cycle is closed and begins again. The same type of complex can be observed in plant geography. Vegetation grows in natural ensembles, in which different species limit each other reciprocally and where, in consequence, each contributes to creating an equilibrium for the others. The ensemble of these plant species ends up constituting its own milieu. Thus the exchanges between plants and the atmosphere end up creating a sort of vapor screen around the vegetal zone, which limits the effect of radiation, and this cause gives rise to an effect that will in turn slow down the cause, and so on.[26]

The same approaches must be applied to animals and to man. However, the human reaction to provocation by the milieu is diversified. Man can give several different solutions to a single problem posed by the milieu. The milieu proposes, without ever imposing, a solution. To be sure, in a given state of civilization and culture, the possibilities are not unlimited. But the fact of considering as an obstacle something that may later be seen as a means to action ultimately derives from the idea, the representation, that man (collective man, of course) builds himself out of his possibilities, his needs. In short, it results from what he represents to himself as desirable, which is inseparable from the ensemble of values.[27]

Thus, the relation between the milieu and the living being ends up reversed. Man, as a historical being, becomes the creator of a geographical configuration; he becomes a geographical factor. We simply call to mind here that the works of Paul Vidal-Lablache, Jean Brunhes, Albert Demangeon, and Lucien Febvre and his school have shown that, for man, there is no pure physical milieu. Within a human milieu, man is obviously subjected to a kind of determinism, but this is the determinism of artificial creations, from which the spirit of invention that brought them into existence has been alienated. In the same line of thought, the work of Friedmann shows how, in the new milieu that machines create for man, the same reversal has already been brought about. Pushed to the extreme limits of its ambition, the engineers' psycho-technics that descended from Taylor's

ideas succeeds in grasping, as an irreducible center of resistance, the presence in man of man's own originality in the form of a sense of values. Even when subordinated to machines, man cannot apprehend himself as a machine. His productive efficiency improves the better aware he is of his centrality with regard to mechanisms intended to serve him.

Much earlier, the same reversal of the relation between organism and milieu had taken place in animal psychology and the study of behavior. Jacques Loeb led to Herbert Spencer Jennings, and John B. Watson to Robert Jacob Kantor and Edward C. Tolman.

Here, the influence of pragmatism is obvious and well-established. If pragmatism served as an intermediary between Darwinism and behaviorism—in one sense by generalizing and extending the notion of adaptation to the theory of knowledge, and in another by emphasizing the role of values in relation to the interests of an action—John Dewey led the behaviorists to see the reference of organic movements to the organism itself as essential. The organism is considered a being on which not everything can be imposed, because its existence as organism consists in its proposing itself to things on the basis of certain orientations that are proper to it. Tolman's teleological behaviorism, first developed by Kantor, consists in searching for and recognizing the meaning and intention of animal movement. What appears essential in the movement of reaction is that it persists, through a variety of phases, which can be errors or lapses, until the moment when the reaction either brings the excitation to an end and re-establishes rest or leads to a new series of acts, entirely different from those that have been concluded.

Before Tolman, Jennings, in his theory of trial and error, had shown (against Loeb), that the animal does not react as a sum of distinct molecular reactions to a stimulant that can be divided into units of excitation. Instead, the animal reacts as a whole to total objects, and its reactions are regulators for the needs that govern them. Naturally, one must recognize here the considerable contribution of *Gestalttheorie*, and in particular of Kurt Koffka's distinction between the milieu of behavior and the geographical milieu.[28]

Finally, the relation between organism and milieu is reversed in von Uexküll's studies of animal psychology and in Goldstein's studies of human pathology. Each of them makes this reversal with a lucidity that comes from a fully philosophical view of the problem. Von Uexküll and Goldstein agree

on this fundamental point: to study a living being in experimentally constructed conditions is to make a milieu for it, to impose a milieu on it; yet it is characteristic of the living that it makes its milieu for itself, that it composes its milieu. Of course, we might still speak of interaction between the living and the milieu even from a materialist point of view—between one physico-chemical system cut out from a larger whole, and its environment. But to speak of interaction does not suffice to annul the difference between a relation of the physical type and a relation of the biological type.

From the biological point of view, one must understand that the relationship between the organism and the environment is the same as that between the parts and the whole of an organism. The individuality of the living does not stop at its ectodermic borders any more than it begins at the cell. The biological relationship between the being and its milieu is a functional relationship, and thereby a mobile one; its terms successively exchange roles. The cell is a milieu for intracellular elements; it itself lives in an interior milieu, which is sometimes on the scale of the organ and sometimes of the organism; the organism itself lives in a milieu that, in a certain fashion, is to the organism what the organism is to its components. In order to judge biological problems, we thus require a biological sense, to whose formation von Uexküll and Goldstein can greatly contribute.[29]

Von Uexküll chooses the words *Umwelt*, *Umgebung*, and *Welt* and distinguishes between them with great care. *Umwelt* designates the milieu of behavior proper to a certain organism; *Umgebung* is the banal geographical environment; *Welt* is the universe of science. The milieu of behavior proper to the living (*Umwelt*) is an ensemble of excitations, which have the value and signification of signals. To act on a living being, a physical excitation has not only to occur but also to be noticed. Consequently, insofar as the excitation acts on the living being, it presupposes the orientation of the living being's interest; the excitation comes not from the object but from the living. In order for the excitation to be effective, it must be anticipated by an attitude of the subject. If the living is not looking, it will not receive anything. A living being is not a machine, which responds to excitations with movements, it is a machinist, who responds to signals with operations. Naturally, this is not to contest that it happens through reflexes whose mechanism is physico-chemical. That is not where the question lies for the biologist. Rather, the question lies in the fact that out of the abundance of the physical milieu, which produces a theoretically unlimited number of

excitations, the animal retains only some signals (*Merkmale*). Its life rhythm orders the time of this *Umwelt*, just as it orders space. Along with Buffon, Lamarck used to say that time and favorable circumstances constitute the living bit by bit. Von Uexküll turns the relation around and says: time and favorable circumstances are relative to certain living beings.

The *Umwelt* is thus an elective extraction from the *Umgebung*, the geographical environment. But the environment is nothing other than the *Umwelt* of man, that is to say, the ordinary world of his perspective and pragmatic experience. Just as this *Umgebung*, this geographic environment external to the animal, is, in a sense, centered, ordered, oriented by a human subject—that is to say, a creator of techniques and a creator of values—the *Umwelt* of the animal is nothing other than a milieu centered in relation to that subject of vital values in which the living essentially consists. We must see at the root of this organization of the animal *Umwelt* a subjectivity analogous to the one we are bound to see at the root of the human *Umwelt*. One of the most gripping examples cited by von Uexküll is the *Umwelt* of the tick.

Ticks live off the warm blood of mammals. The adult female, after mating, climbs to the end of a tree branch and waits. She can wait up to eighteen years. At the Rostock Institute of Zoology, ticks were kept alive in captivity without eating for eighteen years. When a mammal passes under the tick's lookout and hunting post, she drops down. It is the smell of rancid butter emanating from the animal's coetaneous glands that guides her. This is the only stimulant that can set off this falling movement. This is the first stage. When she has fallen onto the animal, she attaches herself there. If the odor of rancid butter has been artificially produced—on a table, for example—the tick will not stay there, but will climb back up to her observation post. Only the temperature of the blood keeps her on the animal. She is fixed to the animal by her thermal sense and, guided by her tactile sense, she seeks out places on the skin where there are no hairs. She buries her head there, and sucks the blood. Only at the moment when the mammal's blood enters into her stomach do the tick eggs (encapsulated ever since the moment of mating and capable of remaining encapsulated for eighteen years) open, mature, and develop. The tick can live for eighteen years to perform her reproductive function in several hours. It is noteworthy that, over a long period of time, the animal can remain totally indifferent, insensible to all the excitations that emanate from a milieu such as the forest, and that the sole excitation that can release its movement—to the exclusion of all others—is the odor of rancid butter.[30]

A comparison with Goldstein is imperative here, for Goldstein bases his theory on a critique of the mechanical theory of reflexes. A reflex is not an isolated or gratuitous reaction. A reaction is always a function of the opening of a sense to stimulations, and of its orientation with regard to them. This orientation depends on the signification of a situation indistinct from this ensemble. Isolated stimuli have meaning for human science, but none for the sensibility of a living being. An animal in an experimental situation is in an abnormal situation, a situation it does not need according to its own norms; it has not chosen this situation, which is imposed on it. An organism is thus never equal to the theoretical totality of its possibilities. One cannot understand its actions without appealing to the notion of privileged behavior. "Privileged" does not mean objectively simpler—just the inverse. The animal finds it simpler to do what it privileges. It has its own vital norms.

The relation between the living and the milieu establishes itself as a debate (*Auseinandersetzung*), to which the living brings its own proper norms of appreciating situations, both dominating the milieu and accommodating itself to it. This relation does not essentially consist (as one might think) in a struggle, in an opposition. That applies to the pathological state. A life that affirms itself against the milieu is a life already threatened. Movements of force—for example, reactions of muscular extension—translate the exterior's domination of the organism.[31] A healthy life, a life confident in its existence, in its values, is a life of flexion, suppleness, almost softness. The situation of a living being commanded from the outside by the milieu is what Goldstein considers the archetype of a catastrophic situation. And that is the situation of the living in a laboratory. The relations between the living and the milieu as they are studied experimentally, objectively, are, among all possible relations, those that make the least sense biologically; they are pathological relations. Goldstein says that, in the organism, "'meaning' and 'being' are the same"; we can say that the being of an organism is its meaning.[32] Certainly, the living can and must be analyzed in physico-chemical terms. This has its theoretical and practical interest. But this analysis is a chapter in physics. In biology, everything is still to be done. Biology must first hold the living to be a significative being, and it must treat individuality not as an object but as an attribute within the order of values. To live is to

radiate; it is to organize the milieu from and around a center of reference, which cannot itself be referred to without losing its original meaning.

While the relation between organism and milieu was being reversed in animal ethology and in the study of behavior, the explanation of morphological characteristics was undergoing a revolution that led to the acceptance of the autonomy of the living in relation to the milieu. We are alluding here to the well-known works of William Bateson, Lucien Cuénot, Thomas Hunt Morgan, Hermann Müller, and their collaborators, who took up and extended Gregor Mendel's research on hybridization and heredity.[33] In creating the science of genetics, they came to maintain that the acquisition by the living being of its form and, hence, its function depends, in a given milieu, on its own hereditary potential and that the milieu's action on the phenotype leaves the genotype intact. The genetic explanation of heredity and evolution (the theory of mutations) converged with August Weismann's theory. Premature isolation of the germ-plasm during ontogenesis nullified the influence on the development of the species of somatic modifications determined by the milieu. Albert Brachet, in his *La vie créatrice des formes*, could write that "the milieu is not, properly speaking, an agent of formation, but rather of realization,"[34] invoking as an example the variety of forms of oceanic living beings within an identical milieu. And Maurice Caullery concludes his discussion in *Problème de l'évolution* by recognizing that evolution depends much more on the intrinsic properties of organisms than on the ambient milieu.[35]

But we know that the conception of the total autonomy of hereditary genetic material has been criticized. One critique emphasized that nucleoplasmatic disharmony tends to limit the hereditary omnipotence of genes. In sexual reproduction, although each parent supplies half of the genes, the mother supplies the egg cytoplasm. Now, the fact that offspring from the crossbreeding of two different species are not the same—depending on which of the species is the father or the mother—leads one to think that the genes' strength varies as a function of the cytoplasmic milieu. At the same time, H. Müller's experiments (1927) inducing mutations in fruit flies through the action of a milieu of penetrative radiation (X-rays), seemed to shed light on how an organic phenomenon that has perhaps been too smugly used to highlight the separation of the organism from the environment can be conditioned from the outside. Finally, there was a renewal of Lamarckism in the polemics—at least as ideological as scientific—surrounding the

indignant repudiation of the "pseudo-science" of Russian geneticists, whom Trofim Lysenko led back to the "sound method" of Ivan Vladimirovich Michurin (1855–1935). Experiments on the vernalization of cultivated plants such as wheat and rye led Lysenko to affirm that hereditary modifications can be obtained and reinforced by variations in conditions of nutrition, maintenance, and climate, leading to a dislocation or rupture of the hereditary constitution of the organism, wrongly supposed by geneticists to be stable. Insofar as we can summarize the complex experimental facts within our present scope, we can say that, according to Lysenko, heredity is dependent on metabolism and metabolism is dependent on conditions of existence. Heredity would thus be the assimilation, by the living, over the course of succeeding generations, of exterior conditions. The ideological commentaries surrounding these facts and this theory do indeed bring to light its sense, regardless of its ability to accommodate, or even to withstand, the experimental counter-proofs and criticisms that are the rule in scientific discussion and that, of course, lie outside our competence.[36] It seems that the technical—that is, agronomic—aspect of the problem is essential. The Mendelian theory of heredity, by establishing the spontaneous character of mutations, tends to damp human—and specifically Soviet—ambitions for the total domination of nature and to limit the possibility of intentionally altering living species. Finally, and above all, recognition of the milieu's determining action has a political and social impact: it authorizes man's unlimited action on himself via the intermediary of the milieu. It offers hope for an experimental renewal of human nature. It thus appears progressive in the highest degree. Theory and practice are inseparable, as befits Marxist-Leninist dialectics. One can then understand how it is that genetics could be charged with all the sins of racism and slavery, and Mendel presented as the head of a retrograde, capitalist, and idealist biology.

It is clear that, although the heredity of acquired characteristics may have regained favor, this does not authorize one to designate the recent theories of Soviet biologists as Lamarckian without qualification. What is essential in Lamarck's ideas, as we have seen, is that the organism's adaptation to its milieu is attributed to the initiative of the organism's needs, efforts, and continual reactions. The milieu provokes the organism to orient its becoming by itself. Biological response by far exceeds physical stimulation. By rooting the phenomena of adaptation in need, which is at once pain and

impatience, Lamarck centered the indivisible totality of the organism and the milieu on the point where life coincides with its own sense, where, through its sensibility, the living situates itself absolutely, either positively or negatively, within existence.

In Lamarck, as in the first theoreticians of the milieu, the notions of "circumstances" and "ambience" had a very different meaning from that in ordinary language. They evoked a spherical, centered arrangement. The terms *influences* and *influencing circumstances*, which Lamarck also used, take their meaning from astrological conceptions. When Buffon, in *De la dégénération des animaux*, speaks of "dye" from the sky, which man gradually receives, he uses, no doubt unconsciously, a term borrowed from Paracelsus.[37] The very notion of "climate" is, in the eighteenth century[38] as well as at the beginning of the nineteenth, an undivided notion, at once geographical, astronomical, and astrological. The climate is the change in the sky's appearance, degree by degree, from the equator to each pole, and it is also the influence that the sky exerts on the earth.

We have already indicated that, in the beginning, the biological notion of the milieu combined an anthropo-geographical component with a mechanical one. The anthropo-geographical component was even, in a sense, the entirety of the notion, for it included the astronomical component, which Newton had converted into a notion of celestial mechanics. At its origin, geography was, for the Greeks, the projection of the heavens onto the earth, the bringing into correspondence of the sky and the earth: a correspondence at once topographical (geometry with cosmography) and hierarchical (physics and astrology). The co-ordination of the parts of the earth, and the subordination to the sky of an earth whose area is coordinated, were underlain by an astro-biological intuition of the Cosmos. Greek geography had its philosophy—that of the Stoics.[39] The intellectual relations between Posidonius, on the one hand, and Hipparchus, Strabo, and Ptolemy, on the other, are incontestable. What gives meaning to the geographical theory of milieu is the theory of universal sympathy, a vitalist intuition of universal determinism. This theory implies the comparison of the totality of things to an organism and the representation of this totality in the form of a sphere, centered on the situation of a privileged living being: man. This biocentric conception of the Cosmos persisted through the Middle Ages and blossomed in the Renaissance.

We know what became of the idea of the Cosmos with Copernicus, Kepler, and Galileo, and how dramatic the conflict was between the organic conception of the world and the conception of a universe decentered in relation to the ancient world's privileged center of reference, the land of living beings and man. From Galileo and Descartes on, one had to choose between two theories of milieu, that is, between two theories of space: a centered, qualified space, where the mi-*lieu* is a center; or a decentered, homogeneous space, where the *mi*-lieu is an intermediary field. Pascal's famous text *Disproportion of Man* clearly shows the ambiguity of this term for a mind that cannot or does not want to choose between the need for existential security and the demands of scientific knowledge.[40] Pascal knows perfectly well that the Cosmos has broken to pieces, but the eternal silence of infinite spaces terrifies him. Man is no longer in the middle [*milieu*] of the world, but *he is a milieu* (a milieu between two infinities, a milieu between nothing and everything, a milieu between two extremes[41]); the milieu is *the state in which nature has placed us; we are floating on a vast milieu; man is in proportion with parts of the world, he has a relation to all that he knows*: "He needs space to contain him, time to exist in, motion to be alive, elements to constitute him, warmth and food for nourishment, air to breathe. He sees light, he feels bodies, everything in short is related to him."[42] We thus see three meanings of *milieu* intervene here: medial situation, fluid of sustenance, and vital environment. In developing the last sense of the term, Pascal presents his organic conception of the world, a return to Stoicism beyond and against Descartes:

> Since all things are both caused and causing, assisted and assisting, mediate and immediate, providing mutual support in a chain linking together naturally and imperceptibly the most distant and different things, I consider it as impossible to know the parts without knowing the whole as to know the whole without knowing the individual parts.[43]

And when Pascal defines the universe as an "infinite sphere whose center is everywhere and circumference nowhere,"[44] he paradoxically attempts, by using an image borrowed from the theosophical tradition, to reconcile the new scientific conception (which makes the universe an indefinite and undifferentiated milieu) with the ancient cosmological vision (which makes the world a finite totality connected to its center). The image Pascal uses

here is a permanent myth of mystical thought, a myth of Neo-Platonic origin, in which the intuition of a spherical world centered on and by the living is combined with the already heliocentric cosmology of the Pythagoreans.[45]

Up to and including Newton, there was no one who did not take from Jacob Boehme, Henry More ("the Platonist of Cambridge"), and their Neo-Platonist cosmology some symbolic representation of what a ubiquitous action radiating out from a center would be. Newtonian space and ether maintain an absolute quality, which the scholars of the eighteenth and nineteenth centuries were not able to recognize: space, as the means for God's omnipresence, and ether, as the support and vehicle of forces. Newtonian science, which was to underlie so many empiricist and relativist professions of faith, is founded on metaphysics. Its empiricism masks its theological foundations. And in this way, the natural philosophy at the origin of the positivist and mechanicist conception of the milieu is in fact itself supported by the mystical intuition of a sphere of energy whose central action is identically present and effective at all points.[46]

If today it seems completely normal to anyone trained in mathematics or physics that the ideal of the objectivity of knowledge demands a decentering of the vision of things, it also seems that the moment has come to understand that in biology, following the words of J. S. Haldane in *The Philosophy of a Biologist*, "it is physics that is not an exact science." As Edouard Claparède writes: "What distinguishes the animal is the fact that it is a *center* in relation to ambient forces that are, in relation to it, no more than stimulants or signals; a center, that is to say, a system with internal regulation, whose reactions are determined by an internal cause: momentary need."[47] In this sense, the milieu on which the organism depends is structured, organized, by the organism itself. What the milieu offers the living is a function of demand. It is for this reason that, within what appears to man as a single milieu, various living beings carve out their specific and singular milieus in incomparable ways. Moreover, as a living being, man does not escape from the general law of living beings. The milieu proper to man is the world of his perception—in other words, the field of his pragmatic experience, the field in which his actions, oriented and regulated by the values immanent to his tendencies, pick out quality-bearing objects and situate them in relation to each other and to him. Thus the environment to which he is supposed to react is originally centered on him and by him.

Yet man as scientist and bearer of knowledge constructs a universe of phenomena and laws that he holds to be an absolute universe. The essential function of science is to devalorize the qualities of objects that comprise the milieu proper to man; science presents itself as the general theory of a real, that is to say, inhuman milieu. Sensory data are disqualified, quantified, identified. The imperceptible is presumed, and then detected and proven. Measurements substitute for appreciations, laws for habits, causality for hierarchy, and the objective for the subjective.

Hence the universe of the scientist [*l'homme savant*]. Einstein's physics is its ideal representation: a universe whose fundamental equations of intelligibility are the same, no matter what the system of reference may be. Because this universe maintains a direct relation to the milieu proper to living man—albeit a relation of negation and reduction—it confers upon this proper milieu a sort of privilege over the milieus proper to other living beings. Despite finding his ordinary perceptual experience contradicted and corrected by scientific research, living man [*l'homme vivant*] draws from his relation to the scientist [*l'homme savant*] a sort of unconscious self-conceit, which makes him prefer his own milieu over the milieus of other living beings, as having more reality and not just a different value. In fact, as a proper milieu for comportment and life, the milieu of man's sensory and technical values does not in itself have more reality than the milieus proper to the woodlouse or the gray mouse. In all rigor, the qualification *real* can be applied only to the absolute universe, the universal milieu of elements and movements disclosed by science. Its recognition as real is necessarily accompanied by the disqualification, as illusions or vital errors, of all subjectively centered proper milieus, including that of man.

The claim of science to dissolve living beings, which are centers of organization, adaptation, and invention, into the anonymity of the mechanical, physical, and chemical environment must be integral—that is, it must encompass the human living himself. We know well that this project did not appear too audacious to many scientists. But we must then ask, from a philosophical point of view, whether the origin of science does not reveal its meaning better than the claims of certain scientists do. In a humanity to which, from the scientific and even the materialist point of view, innate knowledge is rightly refused, the birth, becoming, and progress of science must be understood as a sort of enterprise as adventurous as life. Otherwise, one would have to admit the absurdity that reality contains the science of

reality beforehand, as a part of itself. And we would then have to wonder to which among the needs of reality this ambition to determine reality scientifically could correspond.

But if science is the work of a humanity rooted in life before being enlightened by knowledge, if science is a fact in the world at the same time as it is a vision of the world, then it maintains a permanent and obligatory relation with perception. And thus the milieu proper to men is not situated within the universal milieu as contents in a container. A center does not resolve into its environment. A living being is not reducible to a crossroads of influences. From this stems the insufficiency of any biology that, in complete submission to the spirit of the physico-chemical sciences, would seek to eliminate all consideration of sense from its domain. From the biological and psychological point of view, a sense is an appreciation of values in relation to a need. And for the one who experiences and lives it, a need is an irreducible, and thereby absolute, system of reference.

SIX

The Normal and the Pathological

A physician's thought and activity are incomprehensible without the concepts of the normal and the pathological. Yet a great deal is needed in order for these concepts to become as clear to medical judgment as they are indispensable to it. Is "pathological" the same concept as "abnormal"? Is it the contrary to or the contradictory of "normal"? Is "normal" the same as "healthy"? Is "anomaly" the same thing as "abnormality"? And what are we to think of monsters? Supposing that the concept of the pathological could be adequately delineated from its related concepts, would one consider daltonism to be a pathological situation on a level with angina pectoris, or blue baby syndrome with malaria? Would one believe that, other than the mere identity of the adjective that qualifies them in human language, there exists an identity between an infirmity within the order of the life of relation and a permanent threat to vegetative life? Human life can have a biological meaning, a social meaning, and an existential meaning. In an assessment of the modifications that disease inflicts on the living human

being, all these meanings can equally be retained. A man does not live only like a tree or a rabbit.

The ambiguity of the term *normal* has often been noted. Sometimes it designates a fact that can be described through statistical sampling; it refers to the mean of measurements made of a trait displayed by a species and to the plurality of individuals displaying this trait—either in accordance with the mean or with certain divergences considered insignificant. And yet it also sometimes designates an ideal, a positive principle of evaluation, in the sense of a prototype or a perfect form. The fact that these two meanings are always linked, so that the term *normal* is always unclear, comes out even in the advice we are given to help us avoid this ambiguity.[1] Nonetheless, it is perhaps more urgent to look for the causes of this ambiguity in order to understand its renewed vitality and to take from it lessons rather than advice.

What is fundamentally at stake is as much the object of biology as of the art of medicine. In his *Recherches sur la vie et la mort* (1800), Bichat locates the distinctive characteristic of organisms in the instability of vital forces, in the irregularity of vital phenomena—in contrast to the uniformity of physical phenomena.[2] In his *Anatomie générale* (1801), he remarks that there is no pathological astronomy, dynamics, or hydraulics, because physical properties never diverge from their "natural type" and thus do not need to be restored to it.[3] The essentials of Bichat's vitalism lie in these two remarks. But since for the last hundred years or so to call a medical theory vitalist has been to disparage it, these remarks have not been given the attention they deserve. However, it is time to be done with the accusation of metaphysics (hence of fantasy, if not worse) that still pursues the vitalist biologists of the eighteenth century. In fact—and we could easily show this on another occasion—vitalism rejected two metaphysical interpretations of the causes of organic phenomena: animism and mechanism. All the eighteenth-century vitalists were Newtonians, men who resisted hypotheses about the essences of phenomena and thought they had only to describe and coordinate effects as they perceived them, directly and without bias. Vitalism simply recognizes the original aspect of the vital fact. In this sense, Bichat's remarks linking the two characteristics of irregularity and pathological alteration to vital organization as a specific fact appear to us worthy of careful reconsideration.

In essence, the question is whether, when considering the living being, we should treat it as a system of laws or as an organization of properties, whether we should speak of the laws of life or of an order of life. Too often, scientists hold the laws of nature to be essentially invariant. They treat singular phenomena as approximate copies, which fail to reproduce these laws' supposed lawful reality in its entirety. From this perspective, the singular—that is, the divergence, the variation—appears to be a failure, a defect, an impurity. The singular is thus always irregular, but that is at the same time perfectly absurd, for no one can understand how a law whose reality is guaranteed by its invariance or self-identity could be at once verified by diverse examples and powerless to reduce their variety, that is, their infidelity. This is because, despite modern science's substitution of the notion of law for that of genus, the first of these concepts carries over from the second (and from the philosophy in which the latter held an eminent place) the meaning of an immutable and real type, such that the relationship of law to phenomenon (the law of gravity and the falling shard that killed Pyrrhus) is always conceived on the model of the relation between genus and individual (Man and Pyrrhus). We thus see, without any intentional paradox or irony, the reappearance of a famous problem of the Middle Ages, the problem of the nature of Universals.

This did not escape Claude Bernard's attention. In his *Principes de médecine expérimentale*, Bernard dedicates to the problem of the reality of the type and the relations of the individual to the type (as a function of the problem of the individual relativity of pathological facts) some pages richer in invitations to reflection than in responses proper.[4] We intentionally invoke Claude Bernard, rather than anyone else, because we know how much effort, in the *Introduction à l'étude de la médecine expérimentale* as well as in the *Principes de médecine expérimentale*,[5] he put into affirming the legality of vital phenomena, their consistency as being as inflexible, under defined conditions, as that of physical phenomena: in short, the effort he put into thus refuting Bichat's vitalism, which he considered an indeterminism. Well, precisely in the *Principes* Bernard observes that if "truth is in the type, reality is always outside this type and constantly differs from it. To the physician, this is very important, for he always deals with the individual. There is no medicine of the human type, of the human species." The theoretical and practical issue thus becomes to study "the relations between the individual and the type." This relation appears to be as follows: "Nature has an

ideal type for all things, this is certain; yet this type is never realized. If it were realized, then there would be no individuals, and everyone would resemble one another." The relation that constitutes the particularity of each being, each physiological or pathological state, is "the key to the idiosyncrasy upon which all medicine rests."[6] But at the same time as it is a key, this relation is an obstacle. The obstacle to biology and experimental medicine resides in individuality: one does not encounter this sort of difficulty when experimenting on purely physical entities. For this reason, Claude Bernard tried to enumerate all the causes that are linked to the fact of individuality and that alter, in space and time, the reactions of apparently similar living beings to apparently identical conditions of existence.

Despite Bernard's prestige among physicians and physiologists,[7] we will not hesitate to formulate certain limitations in the aforecited reflections. The recognition of individual, atypical, irregular existents as the basis of the pathological case is, all in all, a fine if involuntary homage to Bichat's perspicacity. But this homage could never be total, on account of Bernard's belief in a fundamental lawfulness of life, analogous to that of matter. This belief does not necessarily bear witness to all the sagacity for which he is usually recognized. After all, to affirm that truth is in the type but reality outside of it, that nature has types but that they are not realized—is this not to render knowledge powerless to grasp the real? Doesn't it justify Aristotle's objection to Plato—namely, that if one separates Ideas from Things, one cannot account for the existence of things or for the science of Ideas? What's more, to see individuality as "one of the most considerable obstacles to biology and experimental medicine"—isn't this a somewhat naïve misunderstanding of the fact that science's obstacles and objects are one and the same? If the object of science is not an obstacle to overcome, a "difficulty" in the Cartesian sense, a problem to solve, then what is it? We might as well say that the discontinuity between whole numbers is an obstacle to arithmetic. The truth is that Bernard's biology includes a fully Platonic conception of laws, coupled with a deep sense of individuality. Since this sense does not accord with that conception, we have reason to wonder whether the famous "experimental method" is not merely an avatar of traditional metaphysics. And we could find an argument in support of this proposition in Bernard's well-known aversion to statistical calculations, which, as we know, have long played an important role in biology. This aversion is a symptom of his inability to conceive the relation of the individual to the

type as anything other than the alteration of an ideal perfection, posited as a fully realized [*achevée*] essence prior to any attempt at production by reproduction.

We will now inquire whether by considering life as an order of properties we might not come closer to understanding certain difficulties that cannot be solved from within the other perspective. By "order of properties," we mean an organization of forces and a hierarchy of functions whose stability is necessarily precarious, for it is the solution to a problem of equilibrium, compensation, and compromise between different and competing powers. From such a perspective, irregularity and anomaly are conceived not as accidents affecting an individual but as its very existence. Leibniz baptized this fact—without really explaining it—the "principle of the identity of indiscernibles," affirming that no two individuals are completely alike and differ *solo numero*.[8] From this, we understand that, if individuals of the same species remain distinct and not interchangeable, this is because they are so de jure. Only within a hypothesis that conceives the laws of nature to be generic, eternal essences is the individual a provisional and regrettable irrationality. That hypothesis presents divergence as an "aberration" that human calculation cannot reduce to the strict identity of a simple formula; its explanation makes of divergence the error, failure, or prodigality of a nature considered at once intelligent enough to proceed in simple ways and too rich to resolve to conform to its own economy. However, for us a living species is viable only to the extent that it shows itself to be fecund, that is, productive of novelties, however imperceptible these may be at first sight. It is well known that species near their end once they have committed themselves to irreversible and inflexible directions and have presented themselves in rigid forms. In short, individual singularity can be interpreted either as a failure or as an attempt, as a fault or as an adventure. In the latter hypothesis, the human mind makes no negative value judgment, precisely because, as attempts or adventures, living forms are considered not beings referable to a real, pre-established type but organizations whose validity (that is, value) must be referred to the eventual success of their life. It is because value is in the living being that no value judgment is made on it. Therein lies the profound meaning of the identity between value and health, to which language attests: *valere*, in Latin, means "to be well." At this point the term *anomaly* takes back the same, nonpejorative meaning as the corresponding (and no longer in use) adjective *anomal*, which was frequently

utilized in the eighteenth century by naturalists, notably Buffon, and even late into the nineteenth century, by Cournot.[9] Etymologically, an anomaly is an inequality, a difference in degree. The anomal is simply the different.

In support of the preceding analysis, we would like to invoke two interesting orientations in contemporary biology. We know that today experimental embryology and teratology consider the production and study of monstrosities to offer insight into the mechanisms of egg development.[10] Here we find ourselves at the true antipodes of the Aristotelian theory of monstrosity, which is fixist and ontological. Aristotle would not have sought a law of nature in what he considered failures of living organization; for a conception of nature as a hierarchy of eternal forms, this is logical. Inversely, however, if we hold the living world to be an attempt at the hierarchization of possible forms, then there is no in itself a priori difference between a successful form and a failed form [*forme manquée*]. Properly speaking, there are no failed forms. Nothing can be lacking [*manque*] to a living being once we accept that there are a thousand and one different ways of living. Just as in war and politics there is no definitive victory, but only a relative and precarious superiority or equilibrium, so in the order of life there are no successes that radically devalorize other attempts and make them appear failed. All successes are threatened, since individuals and even species die. Successes are delayed failures; failures are aborted successes. What decides the value of a form is what becomes of it.[11] All living forms are, to use Louis Roule's expression in *Les poissons*, "normalized monsters."[12] Or, as Gabriel Tarde puts it in *L'opposition universelle*, "the normal is the zero of monstrosity," with zero here meaning the vanishing point.[13] The terms of the classical relation of reference are thus inverted.

It is in the same spirit that we should understand the relationship established by certain contemporary biologists between the appearance of mutations and the mechanism of the genesis of species. Genetics, which originally served to refute Darwinism, is today widely used to confirm and renew it. According to Georges Teissier, every species, even in the wild, includes, along with "normal" individuals, some original or eccentric ones, carriers of certain mutant genes.[14] Within any given species, we must allow for a certain gene fluctuation, on which depends the plasticity of the species' adaptation, that is, its evolutionary power. Without being able to decide whether there exist mutation genes, whose presence would multiply other

genes' latitude for mutation (as some have thought can be identified in certain plants), we must note that different genotypes—the lineages of a given species—present different "values" in relation to ambient circumstances. Selection, that is, screening by the milieu, is sometimes conservative in stable circumstances and sometimes innovative in critical circumstances. At certain times, "the riskiest attempts are possible and licit." Taking into consideration novelty and unforeseen circumstances—and the tasks they impose—an animal may inherit apparatuses that support henceforth indispensable functions, or it may inherit organs that have become devoid of value. "Animals and plants merit admiration as much as criticism." But they live and reproduce, and this alone matters. In this way we understand how it is that many species have become extinct, while others "that were possible were never realized."

We can therefore conclude that the term *normal* has no properly absolute or essential meaning. In an earlier work, we proposed that neither the living being nor the milieu can be called "normal" if we consider them separately.[15] Only by considering them in relation can we maintain the guiding thread without which we would necessarily have to treat as abnormal (that is to say, we believe, pathological) every anomal individual, every carrier of anomalies—every individual aberrant in relation to a specific, statistically defined type. Insofar as the anomal living being ultimately reveals itself to have been a mutant at first tolerated and then invasive, the exception becomes the rule, in the statistical sense of the word. But even as biological invention appears to be an exception to the current statistical norm, this invention must be normal in a different, though unknown sense. Otherwise, one would arrive at the biological contradiction that the pathological could engender the normal through reproduction.

Through the conjunction of genetic fluctuations with oscillations in quantitative and qualitative conditions of existence or their geographic distribution, we can grasp that the normal sometimes signifies an average trait, from which any divergence will be rarer the more perceptible it is, and sometimes a trait whose vital importance and value will be revealed by reproduction, the maintenance and multiplication of beings. In the latter sense, the normal must be called an institutor of the norm, or normative: it is prototypical and no longer simply archetypal. And this second sense must normally underlie the first.

We are not losing sight here of the fact that what interests a physician is man. We know that the problems of anomaly, monstrosity, and mutation are posed in man in the same terms as in the animal. It is enough to mention some of the most common cases: albinism, syndactylia, hemophilia, daltonism. We also know that the majority of these anomalies are regarded as inferior, and we might be surprised at not seeing them eliminated by selection if we did not know, on the one hand, that mutation incessantly renews them, and, on the other (and above all), that the human milieu always somehow shelters them and compensates, with its artifices, for the manifest deficit these anomalies represent with respect to their corresponding "normal" forms. Indeed, it should not be forgotten that, in human conditions of life, social norms of custom are substituted for biological norms of practice. Already the consideration of domestication as a biological milieu, as Edmond Dechambre calls it, shows us that the life of domestic animals tolerates anomalies that would have been pitilessly eliminated in the wild. Most domesticated species—the dog, for example—are remarkably unstable. This has made some authors wonder whether this instability might not be the sign of something that causes these species' domestication: the sign, for example, of a hidden lower resistance that would explain the elective success of domestication for these species as opposed to others, at least as well as would man's pragmatic aims. If, then, it is true that anomaly, an individual variation on a specific theme, becomes pathological only in relation to a milieu of life and a kind of life, then the problem of the pathological in man cannot remain strictly biological, for human activity, work, and culture have the immediate effect of constantly altering the milieu of human life. The history proper to man modifies problems. In a sense, there is no natural selection in the human species, to the extent that man can create new milieus instead of passively submitting to changes in the old ones. And in another sense, selection in man has reached the limit of its perfection, to the extent that man is the living being capable of existence, resistance, as well as technical and cultural activity, in all milieus.

We do not think that the form of this problem changes when we go from morphological anomaly to functional disease, for example, from daltonism to asthma, for it is possible to find multiple intermediaries between the two.[16] In particular, one can find cases of constitutional or essential diseases (e.g., hypertension) for which a possible relation to certain as yet undiscovered "microanomalies" cannot a priori be denied and which may one day

reveal a link between teratology and pathology. Just as a morphological anomaly (a simple factual difference) can become pathological—that is to say, can take on a negative vital value when its effects are assessed in relation to a defined milieu in which certain tasks have become unavoidable for the living being—so the divergence of a physiological constant (e.g., cardiac pulsations, arterial tension, basal metabolic rate, nycthemeral temperature rhythm) does not in itself constitute a pathological fact. But it becomes one at a moment that is very difficult to determine objectively and in advance. This is why authors as different from one another as Henri Laugier, Henry Sigerist, and Kurt Goldstein think we cannot determine the normal by simple reference to a statistic mean but only by comparing the individual to itself, either in identical successive situations or in varied situations.[17] On this point, no author seems as instructive as Goldstein. A norm, he tells us, must help us understand concrete individual cases. It is thus worth less for its descriptive content—as a summary of phenomena, symptoms on which a diagnosis is founded—than for its revelation of the total comportment of an organism, which has been modified in the sense of a disorder, in the sense of the appearance of catastrophic reactions. An alteration in the symptomatic content does not appear to be a disease until the moment when the being's existence, hitherto in equilibrium with its milieu, becomes dangerously troubled. What was adequate for the normal organism, in its relations to the environment, becomes inadequate or perilous for the modified organism. It is the totality of the organism that reacts "catastrophically" to the milieu, as it becomes henceforth incapable of actualizing the possibilities of activity essentially belonging to it. Adaptation to a personal milieu is one of the fundamental presuppositions of health.[18]

Such a conception may appear paradoxical, since it tends to direct the physician's attention to facts subjectively experienced by the patient or to events (such as disturbance, inadequacy, catastrophe, or danger) more apt to be appreciated than measured or objectively disclosed. According to René Leriche, who defines health as "life lived in the silence of organs," it does not suffice to define disease as that which impedes men in their occupations. And doubtless we could think that his formula "to define disease we must dehumanize it" constitutes a refutation of Goldstein's theses. Yet it is hardly so simple—Leriche also writes that "Under the same anatomical exterior one may either be sick or not. . . . In itself, a lesion does not constitute a

clinical disease, a disease of the patient." This is an affirmation of the primacy of the physiological over the anatomical. But it is not a physiology that takes the rabbit or the dog as its object; it is a physiology of the total man, who suffers, for example, in "the conflict between a stimulant and the entire individual," a physiology that necessarily leads to a consideration of man's overall comportment in the world.[19]

A possible mediation between Goldstein's and Leriche's theses can be found in the works of Hans Selye.[20] Selye observes that when failures and deregulations of comportment (e.g., emotion or fatigue) repeatedly engender states of organic tension, they provoke a structural modification in the suprarenal cortex. This modification is analogous to the one caused by any insertion of pure hormonal substances in massive doses or of impure or toxic substances into the interior milieu. Every organic state of stress or unordered tension provokes this suprarenal reaction. If it is normal, given the role of corticosterone in the organism, that every situation of stress causes a suprarenal reaction, it is conceivable that every prolonged catastrophic comportment could result first in functional disease (e.g., hypertension), and then in a morphological lesion (e.g., a stomach ulcer). From Goldstein's point of view, disease lies in the catastrophic comportment; from Leriche's point of view, it lies in the production of a histological anomaly by a physiological disorder. These two points of view are by no means exclusive—quite the contrary. It is no use appealing to a reciprocal causality here, for we have no clear knowledge of the effect of the psychic on the functional and the morphological, or vice versa; we simultaneously observe two sorts of perturbation.

In any case, when we individualize the norm and the normal, we seem to erase the boundaries between the normal and the pathological. In so doing, we seem to be strengthening a commonplace that is frequently invoked because it has the invaluable advantage of actually suppressing the problem in the guise of finding a solution to it. If what is normal here can be pathological there, it is tempting to conclude that there is no boundary between the normal and the pathological. Fine—if by this we mean that from one individual to the next the relativity of the normal is the rule. But this does not mean that for a given individual the distinction is not absolute. When an individual begins to feel sick, to call himself sick, to comport himself as a sick man, he has passed into a different universe and become a different man. The relativity of the normal must in no way encourage the physician,

in confusion, to nullify the distinction between the normal and the pathological. This confusion is often decked out with the prestige of a thesis essential to Bernard's thought, according to which the pathological state is homogeneous with the normal state and differs from it only as a quantitative variation. This positivist thesis, whose roots go back beyond the eighteenth century and Scottish physician John Brown to Francis Glisson and the first sketches of the theory of irritability, was popularized before Bernard by François Broussais and Auguste Comte. In fact, if one examines pathological facts in the detail of symptoms and anatomo-physiological mechanisms, there indeed exist numerous cases where the normal and the pathological appear to be simple quantitative variations on a phenomenon that is homogeneous in the two forms (e.g., glycemia in diabetes). Yet this atomistic pathology, though perhaps pedagogically inevitable, remains theoretically and practically contestable.[21] Considered in its entirety, an organism is "other" when it is diseased and not the same save for certain dimensions (e.g., diabetes must be thought of as a nutritional disease, in which glucid metabolism depends on multiple factors coordinated by the indivisible action of the endocrinal system—and, in general, nutritional diseases are functional diseases related to deficiencies in dietary regimes). This is what Leriche recognizes when he writes: "In man, disease is always an ensemble. . . . What produces it touches the ordinary forces [*ressorts*] of life within us in such a subtle fashion that their responses are less a deviated physiology than a new one."

It now appears possible to respond with some hope of clarity to the questions posed at the beginning of these considerations. We cannot say that the concept of the "pathological" is the logical contradictory of the concept "normal," for life in the pathological state is not the absence of norms but the presence of other norms. Rigorously speaking, "pathological" is the vital contrary of "healthy" and not the logical contradictory of "normal."[22] In the French word *abnormal*, the prefix *ab-* usually indicates distortion. To be convinced of this, it is enough to relate the French term to the respective terms in other languages: in Latin, *abnormis*, *abnormitas*; in German, *abnorm*, *Abnormität*; or in English, *abnormal*, *abnormality*. Disease—the pathological state—is not the loss of a norm but the aspect of a life regulated by norms that are vitally inferior or depreciated, insofar as they prevent the living being from an active and comfortable participation, generative of confidence and assurance, in the kind of life previously belonging to it and still

permitted to others. One could object, as has been done, that by speaking of inferiority and depreciation we are bringing in purely subjective notions. Yet this is a matter not of individual but of universal subjectivity. If there is any objective sign of this universal subjective reaction to divergence, that is, to vital depreciation in disease, it is precisely the existence, coextensive in space and time with humanity, of medicine as a more or less scientific technique for healing diseases.

As Goldstein puts it, the norms of pathological life are those that oblige the organism to henceforth live in a "shrunken" milieu, which differs qualitatively, structurally, from its former milieu of life; the organism is obliged by its incapacity to confront the demands of new milieus (in the form of reactions or undertakings dictated by new situations) to live exclusively in this shrunken milieu. Now, to live, already for animals and even more so for man, is not merely to vegetate and conserve oneself. It is to confront risks and to triumph over them. Especially in man, health is precisely a certain latitude, a certain play in the norms of life and behavior. What characterizes health is a capacity to tolerate variations in norms on which only the stability of situations and milieus—seemingly guaranteed yet in fact always necessarily precarious—confers a deceptive value of definitive normalcy. Man is truly healthy only when he is capable of several norms, when he is more than normal. The measure of health is a certain capacity to overcome organic crises and to establish a new physiological order, different from the old. Health is the luxury of being able to fall ill and recover. Every disease is, by contrast, a reduction of the power to overcome others. The economic success of life-insurance policies depends fundamentally on the fact that health is, biologically speaking, insurance in life—which usually remains within its range of possibilities but is potentially superior to its "normal" capacities.[23]

We do not think that these views on the problem of physiopathology are refuted when confronted with the problem of psychopathology. On the contrary—it is a fact that psychiatrists have better reflected on the problem of the normal than physicians have. Among them, many have recognized that a mentally ill person is an "other" person, not merely a person whose disturbance is an extension or enlargement of the normal psyche.[24] In this domain, the abnormal is truly in possession of other norms. But most of the time, when speaking of abnormal directions or representations, the psychologist or psychiatrist has in mind, as "normal," a certain form of adaptation

to the real or to life, one that has no absolute meaning—except, that is, for those who have never had an inkling of the relativity of technical, economic, or cultural values, who adhere without reservation to the value of these values, and who, in the end, forgetting their own conditioning by their surroundings and by the history of these surroundings, and thinking in too good faith that they themselves incarnate the norm of these norms, show themselves to any thinking even a bit critical to be the victims of an illusion very near to what they denounce as madness. And just as in biology one sometimes loses the guiding thread that allows one to distinguish between progressive anomaly and regressive disease in the case of a somatic or functional singularity, so it also often happens in psychology that one loses the guiding thread that allows one to distinguish between madness and genius in the case of inadaptations to a given milieu of culture. Thus, just as it has seemed necessary to recognize in health the normative power to question the usual physiological norms by seeking a debate between the living and the milieu—a search that implies a normal acceptance of the risk of illness—so it seems to us that the norm in matters of the human psyche is the reclamation and use of freedom as a power of revision and institution of norms—a reclamation that normally implies the risk of madness.[25] Who would argue, in questions of human psychology, that the abnormal does not obey norms? It is perhaps abnormal only because it is too obedient to such norms. Thomas Mann writes that "it is not so easy to decide when madness and disease begin. The man on the street is the last to be able to decide on this."[26] Too often, physicians' lack of personal reflection on these questions, which give meaning to their activity, means that they are hardly better equipped than the man on the street. How much more perspicacious seems Mann, when, doubtless via an intentional encounter with Nietzsche, the hero of his book pronounces that: "Never have I heard anything more stupid than that only sick can come from sick. Life is not squeamish, and cares not a fig for morality. It grasps the bold product of disease, devours, digests it, and no sooner takes it to itself than it is health. Before the fact of life's efficacy . . . all distinction of disease and health is undone."[27]

In conclusion, we hold that human biology and medicine are, and always have been, necessary parts of an "anthropology." But we also hold that there is no anthropology that does not presuppose a morality, such that the concept of the "normal," when considered within the human order, always remains a normative concept of properly philosophical scope.

SEVEN

Monstrosity and the Monstrous

The existence of monsters calls into question the capacity of life to teach us order. This calling into question is immediate—so comprehensive was our prior confidence, so firmly accustomed had we been to seeing wild roses blooming on rosebushes, tadpoles turning into frogs, mares suckling foals, and, in general, the same engender the same. A breach in this confidence, a morphological divergence, an appearance equivocal as to its species is enough for us to be gripped by radical fear. Very well for fear, one might say. But why radical fear? Because we are living beings, real effects of the laws of life, and ourselves possible sources of life in our turn. A failure of life is of double concern to us, for such a failure could touch us or could come from us. It is only because we humans are living beings that a morphological failure is, to our living eyes, a monster. If we were beings of pure reason, pure intellectual machines of observation, calculation, and explanation, and thus inert and indifferent to the occasions of our thinking, then the monster would be merely what is other than the same, an order other than the most probable order.

We must reserve the qualification "monster" for organic beings. There are no mineral monsters. There are no mechanical monsters. Something with no rule of internal cohesion, something whose form and dimensions cannot be seen as divergences from a module that can be expressed in terms of a measure, mold, or model, cannot be called monstrous. One could say that a rock is enormous, but not that a mountain is monstrous, except in a universe of mythical discourse in which it happens that the mountain gives birth to a mouse.[1] There is a clarification to be made regarding the relation between the enormous and the monstrous. Both are, indeed, outside the norm. The enormous escapes a norm that is only metric. But in that case, why does the enormous refer only to enlargement?[2] Doubtless because, beyond a certain degree of growth, quantity calls quality into question. Enormity stretches toward monstrosity. Hence the ambiguity of gigantism: Is a giant enormous or is it a monster? The mythological giant is a prodigy, which is to say, its size "annihilates the end that constitutes its concept."[3] If man is defined by a certain limitation of forces and functions, then the man who, by his size, escapes these limitations is no longer a man. To say that he is no longer one is also to say he still is one. Smallness, on the other hand, seems to enclose the quality of a thing in intimacy and secrecy. Quality is better preserved the less it is exposed.

We must thus include in the definition of the monster its nature as living being. The monster is a living being with negative value. Here we can borrow some of the fundamental concepts of Eugène Dupréel's original and profound theory of values.[4] What makes the value of living beings, or more exactly, what makes living beings valorized in relation to the mode of being of their physical milieu is their consistency as a species. Slicing through the vicissitudes of the material environment, consistency expresses itself through resistance to deformation and a struggle for the integrity of form—by the regeneration of mutilated organs in some species, and by reproduction in all. Now, the monster is not only a living being of reduced value, it is a living being whose value is to be a counterpoint. By revealing the precariousness of the stability to which life has habituated us—yes, merely habituated, even though we have turned this habit into a law—the monster bestows upon the repetition of species, upon morphological regularity, and upon successful structuration a value all the more eminent in that we can now grasp their contingency. The vital counter-value is thus not death but monstrosity. Death is the permanent and unconditional threat of the organism's decomposition, the limitation from without, the negation of

the living by the nonliving. Monstrosity is the accidental and conditional threat of incompleteness or distortion in the formation of the form; it is the limitation from within, the negation of the living by the nonviable.

The ambivalent attitude of human consciousness toward the monster is certainly grounded in a confused sense of the importance of monsters for a correct and complete appreciation of the values of life. On the one hand, there is fear, as we have said, and even panicked terror—but also, on the other hand, curiosity, even fascination. The monstrous is the marvelous inverted, but it is marvelous nonetheless. On the one hand, it disconcerts: life is less sure of itself than we thought. On the other, it valorizes: since life is capable of failures, all its successes are failures avoided. That these successes are not necessary depreciates them en bloc while enhancing each one in particular. When we approach the philosophy of values from the angle of negative values, we have no difficulty saying, with Gaston Bachelard, that the true is the limit of lost illusions, and, for the problem that concerns us here, we have no more difficulty saying, with Gabriel Tarde, that the normal type is the degree zero of monstrosity.[5]

But as soon as consciousness has been led to suspect the eccentricity of life, to dissociate the concepts of reproduction and repetition, what would prevent it from supposing life to be even more alive—that is to say, capable of the greatest freedom of exercise, from supposing life capable not only of provoked exceptions but also of spontaneous transgressions of its own habits? When faced with a bird with three legs, should we be more sensitive to the fact that it has one leg too many or to the fact that it has *only* one more? To judge life to be timid or frugal is to sense in oneself a movement to go even further than it will. And where does this movement come from, leading the minds of men to juxtapose to life's monstrous products, like so many projects to tempt it, *grylli* with multiple heads, perfect men, or emblems in the shape of monsters? Does this movement come from life's inscription (in the geometrical sense of the term) within the arc of a poetic élan made conscious by the imagination and revealed by it to be infinite? Or is it rather that the little follies of life incite imitation in human fantasy, which returns to life what life had lent to it? There is, however, so great a difference between loan and restitution here that it may seem unreasonable to accept such a virtuously rationalist explanation. Life is poor in monsters. The fantastic is a world.

It is here that the thorny question of the relation between monstrosity and the monstrous arises. They are two concepts from the same etymological stock. They are in the service of two forms of normative judgment—the medical and the juridical—which were initially confounded rather than combined in religious thought, and then progressively abstracted and secularized.

There is no doubt that Classical Antiquity and the Middle Ages considered monstrosity an effect of the monstrous. The very term *hybrid*, seemingly so positive and descriptive, attests to this in its etymology.[6] Interspecies animal offspring are the result of crossbreedings that violate the rules of endogomy, unions without observance of similitude. The passage from hybridization to monstrosity is easy. The Middle Ages retains the identification of the monstrous with the criminal but also enriches it with a reference to the diabolical. The monster is at once the effect of an infraction of the rule of the sexual segregation of species and the sign of a will to perversion in the table of creatures. Monstrosity is a consequence less of the contingency of life than of the licentiousness of the living. Why, asks Scipion du Pleix, does Africa produce more monsters than other regions? "Because, all sorts of animals finding themselves together by the waters to drink, they ordinarily mate without discretion as to species."[7] One sees monstrosity arising unexpectedly out of a lack of discretion—an ambiguous term that here is full of meaning. Monstrosity, the consequence of a carnival of animals after drinking!

When it comes to man, the appearance of monstrosity is even more of a signature than in the case of animals: the question of the illicit eclipses that of the irregular; responsibility eclipses causality. If the Orient deifies monsters, Greece and Rome sacrifice them. Moreover, in Sparta, the monster's mother is stoned; in Rome, she is expelled and reintegrated into the city only after purification. Such a difference in attitude between Egypt and Rome stems first of all from different theories concerning nature's possibilities. To accept metempsychosis and metamorphoses, as the Egyptians did, is to admit to a kinship between species—including man—that institutes their interfecundity. Yet as soon as one singles out, in nature, divinities' zones of influence or fundamental alliances (Lucretius), as soon as one sketches a classification of species based on their mode of generation and applies oneself to observing conditions and circumstances of impregnation (Aristotle), nature is defined as much by impossibilities as by possibilities.

Zoomorphic monstrosity, if one accepts its existence, must be treated as the consequence of a deliberate attempt to infringe the order of things (an order congruent with their perfection); it is the consequence of abandonment to the vertiginous fascination of the undefined, of chaos, of the anticosmos. As Ernest Martin pointed out in his *History of Monsters*, during the Middle Ages the connection of teratology to demonology appears to have been the result of a persistent dualism in Christian theology.[8] The literature on this question is abundant. We allude to it only to the extent that it permits us to understand that the monstrous, initially a juridical concept, was gradually made into a category of the imagination. It is a matter, in short, of a displacement of responsibility. Theologians, judges or philosophers who could not accept the possibility of direct commerce between women and incubi or succubi did not hesitate to accept that the sight of a demonic apparition could lead to an alteration in the development of a human embryo. The theory of birthmarks,[9] still alive in the popular mind, was first elaborated by Hippocrates in the treatise *Epikyesis* (*On Superfetation*).[10] This prince of medicine reportedly applied that theory to exonerate a noble Athenian woman, explaining that her contemplation of the portrait of an Ethiopian sufficed to account for the appearance of her child. In sum, long before Pascal denounced the imagination as the mistress of errors and falsehood, it had been credited with the physical power to falsify the ordinary operations of nature. Ambroise Paré counts the power of the imagination among the causes of monstrosity. Following the principles of Cartesian mechanism, Nicolas Malebranche proposes a strictly physiological explanation of this. The imagination is here nothing but a physical function of imitation, according to which objects perceived by the mother have a "repercussion" on the fetus. Like Hippocrates, Malebranche acknowledges that the perception of a simulacrum induces the same effects as the perception of the object itself. He affirms that the passions, desire, and a disordering of the imagination have similar effects.[11] In a rationalized and hence weakened form, we find here yet again the monstrous at the origin of monstrosities. The advantage of this theory for Malebranche, a partisan of preformation and of the encasement of germ seeds, is that it exculpates God from the grievance of having created monstrous seeds. One is tempted to object that, although such a theory is perhaps appropriate in the case of human monstrosity, it could not be generalized. But it was. Johann Theodore Eller (1689–1760), director of the Royal Academy of Prussia, published in 1756, in the annals

of that academy, a dissertation that credits animals with the power of engendering noteworthy monstrosities via their imagination. Eller describes a dog, which he himself had observed, that was brought into the world with a head that "resembled quite closely that of a turkey cock." When the dog's mother was pregnant, she had habitually walked in the farmyard, where she was chased and beaked by an irascible turkey cock. On the basis of this, Eller could write: "Women should not boast of being the only ones to possess the prerogative of producing monsters by the force of their imagination; we are convinced by the preceding story that beasts can do so just as well."[12] One finds the imagination credited with the power of imprinting upon living beings in gestation the traits of a perceived object, an effigy, a simulacrum; the inconsistent contours of a desire—that is to say, of a dream. If we observe that, in the seventeenth and eighteenth centuries, this much is granted to the imagination—and with the intent of giving a rational explanation—how, then, could we be astonished by the familiarity with which men lived with monsters? They blended legends of monsters with history, and were insouciant about separating reality from fiction—so ready were they to believe that monsters exist because they are imagined and that they exist once they are imagined—in other words, that fiction molds reality and reality authenticates fiction.

The teratology of the Middle Ages and the Renaissance is hardly a census of monstrosities; it is, rather, a celebration of the monstrous. It is an accumulation of themes of legends and schemes of figures in which animal forms play, so to speak, at exchanging their organs and varying the combinations of these organs, in which tools and even machines are treated as organs and are composed of the parts of living beings. In Hieronymus Bosch's *grylles*, there is no demarcating line between organisms and utensils, no frontier between the monstrous and the absurd. Jurgis Baltrusaïtis's recent works *Le Moyen Âge fantastique* and *Réveils et prodiges* contribute decisively to our knowledge of the origins and signification of monstrous themes: monsters are constant motifs in the bas-reliefs of cathedrals, in illustrations of Apocalypses, bestiaries, and cosmographies, in comic prints, in anthologies of omens, and in prognostications.[13] The same schema of monsters, the same composite beings, are sometimes symbolic, sometimes documentary, sometimes didactic. The different countries of Europe circulate, exchange, and compare them. The Low Countries and Switzerland, Antwerp and Basel, are particularly flourishing homelands for this. The first teratological works

of etiological intent, by surgeons or physicians like Paré or Fortunio Liceti, can hardly be distinguished from the chronicles of prodigies by Julius Obsequens (fourth century) and Conrad Lycosthenes (1557).[14] Their iconography juxtaposes monstrosity and the monstrous: for example, a two-headed child, a furry child, and a child with a rat's tail coming out of its head; a magpie-woman and a donkey-legged girl; a pig with a human head and a bovine monster with seven heads (like the monster of the Apocalypse); and many others. But it seems the moment has come when rational thought would triumph over monstrosity, just as the imagination had taken pleasure in believing that heroes and saints could triumph over monsters.

"The necessary complement to the monster is a child's brain," said Paul Valéry.[15] Valéry judges as uniformly ridiculous the role that the arts grant to painted, sung, or sculpted monsters and confesses to being able to respond only with laughter to the sight of the bizarre and misshapen compositions offered in paleontological anthologies. Valéry's remark could be taken as the epitome of the rationalist attitude toward the monstrous in the age of positive teratology. Once monstrosity has become a biological concept, once monstrosities have been divided into classes based on invariable relations, once one prides oneself on being able to bring them about experimentally, the monster is naturalized, the irregular is brought back to the rule and the prodigy to predictability. It then goes without saying that the scientific spirit would find it monstrous that man could have once believed in so many monstrous animals. Back in the age of fables, monstrosity exposed the monstrous power of the imagination. In the age of experiments, the monster is taken to be a symptom of puerility or mental malady; it indicates debility or a breakdown of reason. One repeats, following Goya, that "The sleep of reason begets monsters." But one doesn't ask oneself (keeping in mind Goya's oeuvre in particular) whether "begetting" here means engendering monsters or merely giving birth to them: put differently, whether the sleep of reason might not be a liberator rather than a generator of monsters. The same historical epoch that, according to Foucault, naturalized madness occupied itself with naturalizing monsters.[16] The Middle Ages (which is not so named because it allowed the coexistence of extremes) is the age in which one sees the mad living in society with the sane and monsters with the normal. In the nineteenth century, the madman is in the asylum, where he serves to teach reason, and the monster is in the embryologist's glass jar, where it serves to teach the norm.

The eighteenth century was not too hard on monsters. Even though its *lumières* chased many of them away, just as they chased away many witches—"If day breaks, let us leave," say the witches in one of Goya's *Caprichos*—the century espoused the paradox of looking to aberrant organisms for entryways to an understanding of regular phenomena of organization. Monsters were treated as substitutes for crucial experiments to decide between two possible systems of the generation and development of plants and animals: preformation and epigenesis. They were also used to provide the theory of the continuous ladder of beings with the argument of transitional forms, or, as Leibniz called them, intermediate species.[17] Because they appear equivocal as to species, monsters ensure the passage from one species to another. Their existence facilitates the mind's conception of continuity. *Natura non facit saltus, non datur hiatus formarum* ("Nature makes no leaps, there is no gap between the forms"): that is why monsters exist, albeit on a purely comparative basis. Benoît de Maillet and Jean-Baptiste Robinet evoked all the monsters they needed, without having to invent them; and one sees all the flying fish, all the mermen, all the sirens spring back up out of the bestiaries of the Renaissance. They reappear, furthermore, in a context and following an intuition that recall the spirit of the Renaissance: an insurrection against the strict legality imposed on nature by mechanistic physics and philosophy, a nostalgia for the nondistinction of forms, for panpsychism, for pansexualism. Monsters are called upon to legitimate an intuitive vision of life, in which fecunity effaces order. *Telliamed, entretiens d'un philosophe indien avec un missionnaire français* (*Telliamed; or, Conversations Between an Indian Philosopher and a French Missionary on the Diminution of the Sea*, 1748) is Oriental mythology resuscitated in the service of antitheology.[18] And in the *Considérations philosophiques de la gradation naturelle des formes de l'être* (*Philosophical Considerations on the Natural Gradation of Forms of Being*, 1768), we read: "We believe that the forms most bizarre in appearance . . . serve as passage to neighboring forms; that they prepare and bring about the combinations that follow them, just as they have been brought about by those that precede them; that, far from troubling the order of things, they contribute to it."[19] The same theses and similar arguments are taken up again in *D'Alembert's Dream* and in the *Letter Concerning the Blind*.[20] Moreover, by calling the blind-born Saunderson a monster—Saunderson, the professor of physical optics whose lesson he presents on the occasion of the visit of the blind-born du Puisaux—Diderot means, in

this letter, to demonstrate his method of the systematic employment of monstrosity as an instrument for analysis and decomposition in the domain of the genesis of ideas and ideals. In sum, whether in embryology, classification, or physiology, the eighteenth century made the monster not only an object but an instrument of science.

It is truly in the nineteenth century that the scientific explanation of monstrosity and the correlative reduction of the monstrous are elaborated. Teratology is born out of the encounter of comparative anatomy with an embryology transformed by the adoption of the theory of epigenesis. Johann Friedrich Meckel the Younger explains certain simple monstrosities, notably what were called monstrosities by default, like arrested development (as had already been suggested by C. F. Wolff).[21] Étienne Geoffroy Saint-Hilaire substitutes the notion of delay for that of arrest. Monstrosity is the fixation of one organ's development at a stage surpassed by the others. It is the survival of a transitory embryonic form. For an organism of a given species, the monstrosity of today is the normal state of the day before yesterday. And in the comparative series of species, a monstrous form of one can be a normal form for another. In his *Histoire des anomalies de l'organisation* (1837), Isidore Geoffroy Saint-Hilaire (son of Étienne) achieves—in a definitive fashion, in some respects—the domestication of monstrosities, ordering them among anomalies, classifying them according to the rules of the natural method, applying to them a methodical nomenclature still in use today, and, above all, naturalizing the composite monster, that is, the one in which we find complete or incomplete elements of two or more organisms united. Previously, the composite monster was held to be the monster's monster, because it was compared to the norm of a single individual. But if one refers the composite monster to two or more normal individuals, the composite type of monstrosity is no more monstrous than a simple monstrosity. Isidore Geoffroy Saint-Hilaire's very pertinent reflections on the existence of anomalies are summarized in one of his formulas: "There are no exceptions to the laws of nature, only exceptions to the laws of naturalists."[22] Finally, no less interesting is his linking of the concepts of anomaly and variety, which would acquire great importance toward the end of the century in the context of theories of evolution.

From this point on, constituted by descriptions, definitions, and classifications, teratology became a natural science. But in a century hardly two years older than the term and concept *biology*, all natural history tended to become an experimental science. In mid-century, Camille Dareste (1822–99) founded teratogeny, the experimental study of the conditions for the artificial production of monstrosities. In the Middle Ages, the artist represented imaginary monsters; the scientist of the nineteenth century claimed to fabricate real monsters. Echoing Marcelin Berthelot, who said that chemistry creates its object, Dareste proclaimed that teratogeny must create its own objects. He boasted of having successfully produced many simple monstrosities (as classified by Isidore Geoffroy Saint-Hilaire) on a chicken embryo, and he hoped to be able to produce hereditary varieties. Encouraged by Darwin's appreciation of his experiments—"full of promises for the future"—Dareste resolved to employ the resources of experimentation to elucidate the origin of species.[23]

From then on, monstrosity appears to have revealed the secret of its causes and laws, while anomaly appears called upon to explicate the formation of the normal, not because the normal is an attenuated form of the pathological, but because the pathological is the normal impeded or deviated. Remove the impediment and you obtain the norm. Henceforth, the transparency of monstrosity to scientific thought cuts monstrosity off from any relation to the monstrous. Realism in art systematically condemns the monstrous to being no more than the carbon copy of monstrosity. In an epoch when Gustave Courbet grumbled, "if you want me to paint goddesses, show me some!" one had to be Japanese still to paint dragons. To the extent that the monstrous persisted in Europe, it became well behaved and unexciting. For an occasion to paint a monster, Ingres borrows from *Orlando Furioso* the theme of Ruggiero saving Angelica—with the double result of being forced to tell the Goncourts that the only monster known to French art comes from Theramenes' story, and of later arousing Valéry's laughter.[24] At the same time, positivist anthropology set out to depreciate religious myths and their artistic representations. In 1878, Joseph Marie Jules Parrot tried to establish, before the members of the French Society for Anthropology, that the dwarf-god Ptah, worshipped by the Egyptians, displayed the characteristics of an achondroplasic monster.[25]

We would have liked to show how, from this period on, the monstrous seeks refuge in poetry, and we would take pleasure in following the sulfurous trail that leads from Baudelaire to the surrealists by way of Rimbaud and Lautréamont. But how can we resist the temptation to find the monstrous once again at the very heart of the scientific universe from which it

was believed expelled—to find the biologist himself partaking, *in flagrante delicto*, in surrealism? Haven't we heard Dareste claim for teratology the glory of creating its object? Haven't we seen Isidore Geoffroy Saint-Hilaire and Dareste link, the former with timidity, the latter with confidence, the two questions of monstrosity and of the creation of races? The submission of the scientific spirit to the reality of laws—might this be nothing more than a ruse of the Will to Power?

In 1826, in Auteuil, Étienne Geoffroy Saint-Hilaire reprised experiments in artificial incubation he had undertaken in Egypt, imitating then-current techniques used in the famous chicken-egg incubators. These experiments aimed to define embryonic anomalies. In 1829, drawing a lesson from the relation of these investigations to the question posed by Lamarck's thesis on the modifications of animal types,[26] Étienne Geoffroy Saint-Hilaire writes: "I sought to lead organization down unusual paths."[27] Without a doubt, this decision, insofar as it leads to operations on bird eggs, does not arise from any unconscious inclination toward the fabulous. But would we say the same of Réaumur when, having recounted at length what he calls the loves of a chicken and a rabbit, he expresses his disappointment that this strange union did not procure him "chickens covered in fur or rabbits covered in feathers"? What will we say the day we learn that teratogenic experiments have been performed on man? From the curious to the scabrous, and from the scabrous to the monstrous, the road is straight, if not short. If inscribed in the code of experimentation is a trying out of all possibilities with a view toward revealing the real, there is a risk that the boundary between the experimental and the monstrous will not be perceived at first sight. For the monstrous is one of these possibilities. We would like here to be referring to the monstrous only as *imaginary*, but we are conscious of its ambiguity. There is a gap between biologists who create their own object and fabricators of human monsters destined to be buffoons—such as those described by Victor Hugo in *L'homme qui rit* (*The Laughing Man*).[28] We must want this gap to remain as it is, but we cannot affirm that it will.

The ignorance of the ancients held monsters to be games of nature, while the science of our contemporaries turns them into the games of scientists. Let us play at fabricating cyclopean chickens, five-legged frogs, Siamese newts, while we are waiting, as some think, to be able to play at fabricating, not sirens or centaurs, but perhaps a primitive man. Had it not been coined

by a known author, the expression "to seek to lead organization down unusual paths" could pass for the announcement of a diabolical project. Here once again we find the monstrous at the origin of monstrosities—only this time authentic ones. It would thus be the century of positivism that would have realized—thinking it was abolishing it—what the Middle Ages had dreamt.

We have just used the conditional because, if it is true that the monstrous is at work, in its own way, in experimental teratology, it is just as certain that the monstrous does not surpass, in the intensity of its effects, what life obtains without it. Today's teratologist is less ambitious and more measured than Étienne Geoffroy Saint-Hilaire or Dareste. In a recent lecture, Étienne Wolff remarked that the experimental teratologist limits his intervention to the perturbation of a process that has begun without him and whose initial, elementary conditions he disregards. After which, he leaves living matter to itself; he waits and watches for what may come. In short, says Wolff, "the experimenter has the feeling of being no more than a prop master."[29] His power is narrowly limited: first, by the fact that embryonic plasticity is of short duration, and second, by the fact that monstrosities do not transgress the order of species. Not only does the biologist of today create nothing really new, he also understands why. He has a better understanding of the merit of the two Geoffroy Saint-Hilaires' insight—that there exist teratological types of organization and that these are dominated by the laws of this organization. Thus, all cyclops, from fish to man, are similarly organized. Nature, says Wolff, always pulls the same strings.[30] The experimenter cannot pull more strings than nature.

We have said that life is poor in monsters, while the fantastic is a world.

We can now understand why life is relatively poor in monsters: organisms are incapable of structural eccentricities except during a short moment at the beginning of their development. But why say of the fantastic that it is a world, if it is true that a world, a cosmos, is an *order*? Is it because there are types (some would even say archetypes) of the fantastic? What we mean is that the fantastic is capable of populating a world. The power of imagination is inexhaustible, indefatigable. How could it not be? The imagination is a function without an organ. It is not one of those functions that cease functioning to recuperate their functional power. It feeds only on its own activity. As Bachelard teaches us, the imagination incessantly deforms or

reforms old images to form new ones. We thus see that the monstrous proliferates insofar as it is imaginary. Poverty on the one hand, prodigality on the other—this is the first reason for maintaining the duality of monstrosity and the monstrous.

The second reason is situated at the level of the principle of the first. Life transgresses neither its laws nor its structural framework. Accidents are no exception to this, and there is nothing monstrous about monstrosities. "There are no exceptions in nature," says the teratologist, in the positive age of teratology. Yet this positivist formula, which defines a world as a system of laws, ignores the fact that it acquires its concrete signification through its relation to the signification of an opposite maxim, one that science excludes but the imagination applies. This maxim gives birth to an anticosmos, to a chaos of exceptions without laws. When seen from the perspective of those who haunt it after having created it, believing everything to be exceptionally possible in it, and who forget that only laws permit exceptions, this antiworld is the imaginary, murky, and vertiginous world of the monstrous.[31]

Reference Matter