The Living and Its Milieu

GEORGES CANGUILHEM
TRANSLATED BY JOHN SAVAGE

The notion of milieu is in the process of becoming a universal and obligatory means of registering the experience and existence of living things, and one could almost speak of its constitution as a basic category of contemporary thought.[1] But until now, the historical stages of the formation of the concept, its diverse uses, as well as the successive reconfigurations of the relationships in which it takes part, whether in geography, biology, psychology, technology, or social and economic history, all make it rather difficult to make out a coherent whole. For this reason philosophy must, here, initiate a synoptic study of the meaning and value of the concept. By "initiate" I do not simply mean the pretense of an initiative that would consist in taking a series of scientific investigations for reality and then confronting expectations with results. Rather, it is a question of using several approaches and engaging them in a critical confrontation with each other to locate, if possible, their common point of departure and to explore its potential richness for a philosophy of nature that focuses on the problem of individuality. It is therefore appropriate to examine the simultaneous and successive elements of the notion of milieu each in turn, the various usages of this notion from 1800 to the present, the many inversions of the relationship between organism and milieu, and finally the general philosophical impact of these inversions.

Historically considered, the notion and the term "milieu" are imported from mechanics to biology in the second half of the eighteenth century. The mechanical idea, but not the term, appears with Newton, and the word "milieu" is present in d'Alembert and Diderot's *Encyclopedia* with its mechanical meaning, in the article of the same name. It is introduced to biology by Lamarck, who was himself inspired by Buffon, though he never used the term other than in the plural. De Blainville seals this usage. Etienne Geoffroy Saint-Hilaire in 1831 and Comte in 1838 use the term in the singular, in an abstract sense. Balzac opens the gates to literature in 1842, in the preface of the *Comédie Humaine,* and it is Taine who first uses it as one of the three analytical principles used to explain history, the two others being race and event, as is well known. It is more due to Taine than Lamarck himself that neo-Lamarckian biologists in post-1870 France, such as Giard, Le Dantec, Houssay, Costantin, Gaston Bonnier, and Roule, use this term. They get the idea, in a sense, from Lamarck, but the

Grey Room 03, Spring 2001, pp. 7–31.

term as an abstract and universal one comes to them from Taine.

French mechanists of the eighteenth century called milieu what Newton meant when he said "fluid." The model for this, if not the sole archetype in Newton's physics, was ether. In Newton's day, the problem facing mechanics was that of the action of distinct physical bodies at a distance. This was the fundamental problem of the physics of central forces. It was a problem that had not existed for Descartes. For him, there was only one mode of physical action, impact, in only one possible physical situation, that of contact. This is why we can say that in Cartesian physics the notion of milieu has no place. Subtle matter is not in any way a milieu. But it was difficult to extend the Cartesian theory of impact and contact to the case of separate point particles, since in this case they could not act without being confounded by this action. As a result, we can see that Newton was led to pose the problem of the means of the action. Luminous ether was for him the fluid that served as the vehicle of action at a distance. This explains the passage from the notion of fluid as a vehicle to its designation as a medium *[milieu]*. The fluid is the intermediary between two bodies; it is their milieu; and to the extent that it penetrates these bodies, they are situated within it. According to Newton and to the physics of central forces, it is only because there are centers of force that we can speak of environment, that we can speak of a milieu. The notion of milieu is a fundamentally relative notion. To the extent that we consider separately the body on which the action, transmitted through the medium, is exercised, we may forget that the milieu is *a between two centers* and remember only its function of centripetal transmission, and one might say its ambient situation. In this way the milieu tends to lose its relative meaning and takes on an absolute one. It becomes a reality in itself.

It was perhaps Newton who was responsible for importing the term from physics to biology. Ether helped him not only resolve the problem of illumination, but also explain the physiological phenomenon of vision and even explain the physiological effects of luminous sensation, in other words, explain muscular reactions. In his *Optics,* Newton considered ether to be continuous with air, something found in the eye, in the nerves, even in muscles. It was therefore the action of a milieu that ensured the dependent connection between the spark of the perceived luminous source and the movement of muscles by which man reacts to this sensation. This, it would seem, was the first example of an explanation of an organic reaction by the action of a milieu, that is, of a fluid strictly defined by physical properties.[2] Indeed, the article in the *Encyclopedia* cited above confirmed this way of seeing things. All of the examples of milieus given in the article were drawn from Newton's physics.

And it is in a purely mechanical sense that one says that water is a milieu for the fish who move around in it. It is also primarily in this mechanical sense that Lamarck understood it.

Lamarck always speaks of milieus in the plural, and by this he specifically means fluids like water, air, and light. When Lamarck wants to designate the whole set of outside actions that are exercised on a living thing, in other words what we call today the "milieu," he never says "milieu" but always "influential circumstances." As a result, circumstance is a genus within which climate, place, and milieu are species. And this is why Léon Brunschvicg, in *Les Etapes de la philosophie mathématique,* wrote that Lamarck borrowed from Newton the physicomathematical model of explaining the living through a system of connections with its environment.[3] The relationship between Lamarck and Newton is intellectually direct and historically indirect, as they are linked through Buffon. We can, for example, recall that Lamarck was Buffon's pupil and his son's tutor.

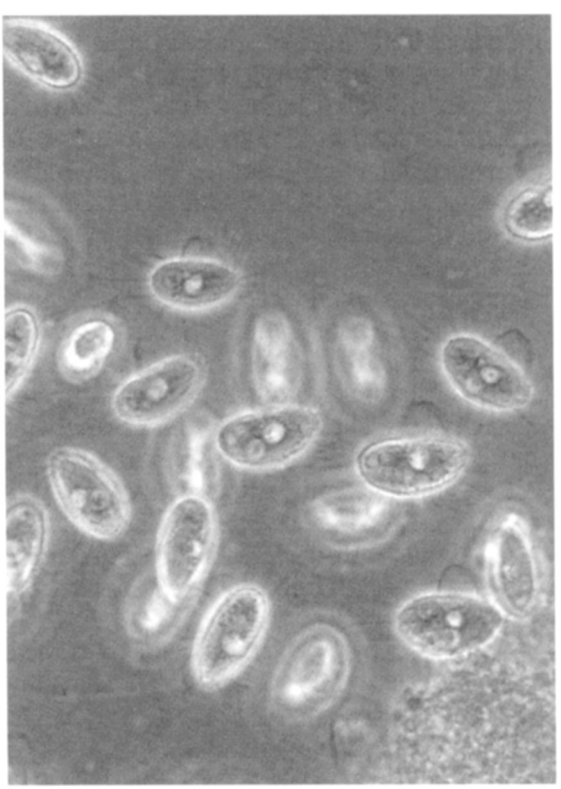
Buffon, in fact, combines two influences in his conception of the relationship between organism and milieu. The first is precisely Newton's cosmology, of which Buffon was a lifelong admirer.[4] The second influence is the tradition of anthropogeography, which had been kept alive in France by Montesquieu before him,[5] following Bodin, Machiavelli, and Arbuthnot. The Hippocratic treatise *On Airs Waters and Places* can be considered the first work that gave philosophical form to this idea. These are the components that Buffon brought together in his principles of animal ethology, to the extent that animal mores are of a distinct and specific character and that these mores can be explained by the same method that allows geographers to explain the diversity of the earth's men, races, and peoples.[6]

Therefore, as Lamarck's teacher and precursor in his theory of milieu, Buffon is positioned at the convergence of the theory's two components, the mechanical component and the anthropogeographic one. At this point, we are faced with a problem of epistemology and historical psychology of knowledge that is far more involved than the specific example that raised it. Shouldn't the fact that two or more guiding ideas come together at a given time to form the same theory be interpreted as a sign that, as different as they may seem when first used in the analysis, they have a common origin whose meaning and very existence is forgotten when one considers the different pieces separately? This is the problem we will come back to in the end.

The Newtonian origins of the notion of milieu are enough to account for the initial mechanical meaning of this notion and the use that was first made of it. The origin determines the meaning, and the meaning determines the usage. This is so true

that in 1838, in proposing a general biological theory of the milieu in the fortieth lesson of his *Cours de Philosophie positive,* Auguste Comte believed that he was using "milieu" as a neologism and claimed the credit for introducing it as a universal and abstract explanatory concept in biology. And Comte says that from this point on he would understand the term to mean not only the "fluid in which a body is immersed" (which clearly confirms the mechanical origins of the notion), but "the sum total of outside circumstances necessary to the existence of each organism."[7] However, with Comte (who has a perfectly clear idea of the origins of the notion, as well as the new meaning he wishes to give it in biology) we also observe that its use will remain dominated by the mechanical origins of the notion, if not of the term.

In fact, it is quite interesting to note that Auguste Comte was on the verge of creating a dialectical conception of the relationship between organism and milieu. I am referring to passages in which he defines the relationship between "the adapted organism" and the "favorable milieu" as a "conflict of forces" in which action is constituted by function. He posits that "the ambient system cannot modify the organism without the latter in turn exercising a corresponding influence." But, except in the case of the human species, Auguste Comte believes this action of the organism on the milieu to be negligible. As for the case of the human species, true to his philosophical conception of history, Comte allows that through the intermediary of collective action humanity modifies its milieu. However, for the living in general, Comte refuses to consider this action of the organism on the milieu seriously, reckoning that it is simply negligible. This is because he is looking for a very explicit guarantee of a dialectical connection, of a reciprocal relationship between milieu and organism, that would follow the Newtonian principle of action and reaction. It is in fact clear, from a mechanical point of view, that the action of the living on the milieu is practically negligible. And Comte ends up posing the biological problem of the relationship between organism and milieu as a mathematical one: "In a given milieu, given the organ, find the function, and vice versa." The connection of organism and milieu is therefore that of a function to a set of variables, an equal relationship that allows us to determine the function using the variables, and the variables separately starting with the function,



"all other things being equal."[8]

The analysis of variables for which the milieu turns out to be the function is conducted by Comte in lesson 43 of the *Cours de Philosophie positive.* These variables are weight, air and water pressure, movement, heat, electricity, and chemical elements, all factors capable of being studied experimentally and measured quantitatively. The quality of an organism finds itself reduced to a set of quantities, despite the skepticism Comte professes elsewhere toward the practice of treating biological problems mathematically, a skepticism that, as we know, comes to him from Bichat.

In short, even a summary history of the importation of the term "milieu" to biology in the first years of the nineteenth century brings out the initial, strictly mechanistic use of the term. If the hint of an authentically biological acceptation and a more flexible usage appears with Comte, it immediately succumbs to the prestige of mechanics, an exact science that bases predictions on calculations. The theory of milieu appears clearly to Comte as a variant of the fundamental project that the *Cours de Philosophie positive* seeks to fulfill: the world first, then man; to go from the world to man. If the idea of the subordination of the mechanical to the vital is assumed, as *Le Système de Politique positive* and *La Synthèse subjective* later suggest, it is nevertheless formally rejected.

But there is still another lesson to get out of the use of the term "milieu" that is, beyond any question, definitively consecrated by Comte. The equivalent of what this term designates would be "circumstances" in the work of Lamarck. Etienne Geoffroy Saint-Hilaire, in his report to the Academy of Sciences in 1831, spoke of "surroundings." These terms of "circumstance" and "surroundings" come from a certain intuition of a centered formation. In the success of the term "milieu," the metaphor of the line or the indefinitely extendable plane, being both continuous and homogeneous, with no definite shape or privileged position, wins out over the metaphor of the sphere or circle, shapes that are still defined qualitatively and, we might even say, attached to a fixed central reference point. Circumstances and surroundings still retain a symbolic value, but milieu abandons any evocation other than a position indefinitely denied by exteriority. The now refers to the future, the here refers to its beyond, and so forth always ad infinitum. The milieu is really a pure system of relationships without supports.

From this point we may understand the prestige of the notion of milieu for analytical scientific thought. The milieu becomes a universal instrument of the dissolution of individualized organic synthesis in the anonymity of elements and universal movements. When the French neo-Lamarckians borrow from Lamarck—if not the term in the absolute sense and in the

Cyclidium.

singular, at least the idea—they keep only the formation by outside conditioning and, so to speak, the deformation of the morphological character and functions of the living. It is enough to recall Costantin's experiments on the shapes of sagittate leaves and Houssay's experiments on the shape, fins, and metamerism of fish. In a little book entitled *La Vie des Rivières,* Louis Roule was capable of writing, "Fish don't lead their lives themselves, it is the river that makes them lead it, they are persons without will." [9] We have here an example of what a strictly mechanistic use of the notion of milieu must lead to.[10] We have returned to the idea of animal-machines. In the end, Descartes was saying the same thing when he said of animals, "It is nature that acts in them through the medium of their organs."

Starting in 1859, in other words with the publication of Darwin's *Origin of Species,* the problem of the relationship between organism and milieu is dominated by the polemical opposition between Lamarckians and Darwinians. It seems necessary to recall the originality of these respective starting points to understand the meaning and importance of the polemic.

Lamarck wrote in his *Philosophie zoologique* (1809) that if, by action of circumstance or action of milieus, we understand a direct action of the external milieu on the living, we are imposing a meaning that is unwarranted.[11] It is due to a need, a subjective notion that implies a reference to a positive pole of life values, that the milieu dominates and commands the evolution of living things. Changes in circumstance bring about changes in needs; changes in needs bring about changes in actions. As long as these actions last, the use or nonuse of certain organs causes them to strengthen or atrophy, and these morphological losses and gains acquired by individual habit are preserved by the mechanism of heredity whenever the new morphological character is common to the two parents.

According to Lamarck, the situation of the living in the milieu is a situation that we can call both distressful and distressed. The life and the milieu that is unaware of it are two asynchronous series of events. The change of circumstances comes first, but it is the living itself that, in the end, initiates the effort to not be let go by its milieu. Adaptation is a repeated effort on the part of life to continue to "stick" to an indifferent milieu. Adaptation as the result of an effort is therefore neither harmonious nor providential; it is earned and never guaranteed. Lamarckism is not mechanism, and it would be inexact to call it finalism. In reality, it is a naked vitalism. There is an originality of life that the milieu cannot render, that it does not know. The milieu is in this case really external in the proper

sense of the word. It is foreign; it does nothing for life. This is truly vitalism because it depends on this dichotomy. Life, said Bichat, is the collection of functions that resist death. In Lamarck's conception, life resists only by transforming in order to outlive itself. To my knowledge, no portrait of Lamarck, no summary of his doctrine, is better than the one given by Sainte-Beuve in his novel *Volupté.*[12] Here we can see how much distance lies between Lamarckian vitalism and the mechanicism of the French neo-Lamarckians. Cope, an American neo-Lamarckian, was truer to the spirit of the doctrine.

Darwin has a totally different explanation of the environment of the living, as well as the appearance of new forms. In the introduction to *Origin of Species,* he writes, "Naturalists are always referring to external conditions like climate and food as the only possible cause of variations; they are only right in a very narrow sense."[13] It seems that Darwin later regretted having attributed only a minor role to the direct action of physical forces on the living. This is manifest in his correspondence. On this point, in the introduction he wrote for selected texts of Darwin, Marcel Prenant published a certain number of particularly interesting passages.[14] Darwin was looking for the appearance of new forms in the interplay of two mechanisms: a mechanism of production of differences that is variation, and a mechanism of reduction and criticism of the differences produced, that is, the struggle for existence *[la concurrence vitale]* and natural selection. The fundamental biological relationship, in Darwin's eyes, is a relationship between living things and other living things. It trumps the relationship between living and milieu, conceived of as a collection of physical forces. The primary milieu an organism lives in is the set of living things around it that are enemies or allies, prey or predators. Among the living, relationships of use, destruction, and defense are established. In this test of strength, accidental variations of morphology play out as advantages or disadvantages. In fact, variation, that is to say the appearance of slight morphological differences by which a descendant does not look exactly like his ancestors, emerges from a complex process: the use or nonuse of organs (the Lamarckian factor concerns only adults), correlations or compensations of growth (for the young), or even the direct action of the milieu (on the germ).

In this sense we can therefore say that according to Darwin, unlike Lamarck, the initiative of variation sometimes, but only sometimes, comes from the milieu. According to whether we emphasize or play down this action, whether we limit ourselves to his classic works or on the contrary to the whole of his thought in the way it is revealed by his correspondence, we get a slightly different idea of Darwin's thought. At any rate, for Darwin, to live is to submit individual difference to the judgment of all

of the living. This judgment has only two outcomes: either death or one's recruitment in turn, for a time, to the jury. But as long as we live, we are always judged and judging. We can see, as a result, that in the body of work Darwin left us, the thread that ties the formation of living things to the physicochemical milieu seems quite tenuous. And the day a new explanation of the evolution of the species, mutationism, was combined with an explanation that suddenly saw the appearance of specific variations as hereditary (an explanation that Darwin was aware of but that he underestimated) was the day that the milieu was reduced to the role of eliminating the worst without being involved in the production of new beings, normalized by their nonpremeditated adaptation to new conditions of existence, with monstrosity becoming the rule and uniqueness a fleeting banality.

In the polemic that pitted Lamarckians against Darwinians, it is useful to note that the arguments and objections came under two categories and had two sets of implications. Finalism was denounced and mechanicism celebrated, first on one side, then on the other. This is a clear sign that the issue was poorly framed. Darwin, we can say, uses the language rather than the substance of finalism (he has been sufficiently reproached for using the term "selection"). With Lamarck, there is less finalism than vitalism. Both of these men were true biologists, who take life as a piece of data that they attempt to characterize without taking too much time to come to terms with it analytically. In fact, these two genuine biologists complement one another. Lamarck thinks of life in terms of duration, and Darwin more according to interdependence. One life-form implies a plurality of other forms with which it is in contact. The synoptic vision that makes up the core of Darwin's genius underscores Lamarck's weaknesses. Darwin is more closely related to geographers, and we know what he drew from his voyages and explorations. The milieu in which Darwin imagined the life of the living is a biogeographical milieu.

||||||

At the beginning of the nineteenth century, two names sum up the emergence of geography as a science newly cognizant of both its status and its method: Ritter and Humboldt.

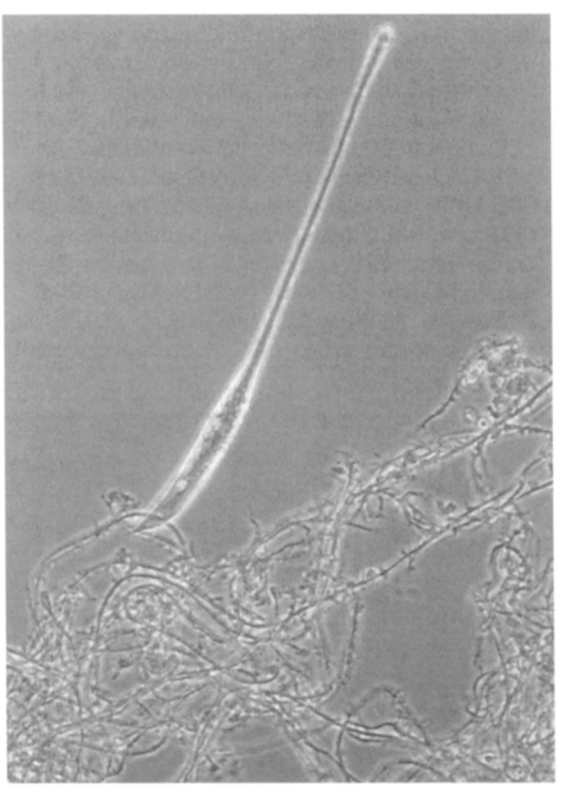
In 1817, Carl Ritter published his *Geographie générale comparée ou Science de la Terre dans ses rapports avec la nature et l'histoire de l'homme*. Starting in 1845, over the course of ten years Alexander von Humboldt published a book whose spirit is precisely captured in the title *Kosmos*. These two authors brought together the traditions of Greek geography, that is, of Aristotle and Strabo's science of the human ecumene, and the

science of the coordination of human space in relation to celestial configurations and movements, that is, the mathematical geography whose founders we consider to be Eratosthenes, Hipparchus, and Ptolemy.

According to Ritter, human history is unintelligible without understanding the connection of humanity to the land and to the whole earth. The terrestrial globe, considered as a whole, is the stable support for the vicissitudes of history. As a result, terrestrial space and its configuration are the object not only of geometric or geological knowledge, but also sociology and biology.

Humboldt was a naturalist and voyager who traveled several times over what one could travel of the world of his time and who applied a whole system of barometric, thermometric, and other measurements in his investigations. Humboldt was especially interested in the distribution of plants according to climate: he was the founder of botanical geography and zoological geography. *Kosmos* is a synthesis of learning that focuses on life on earth and the relations between life and physical milieu. This synthesis is not an attempt to be encyclopedic, but is rather a step toward an intuition of the universe. It begins with a history of *Weltanschauung* through a history of the cosmos whose equivalent could not easily be found in a work of philosophy. It is a critical commentary that is nothing short of remarkable.

It is essential to note that Ritter and Humboldt applied the category of totality to their object: the relationship between historical man and milieu. Their object is all of humanity over the whole world. As a result of their work, the idea of a historical relationship determined by environment was consolidated in geography, leading first to Ratzel and anthropogeography in Germany, then to geopolitics, and spreading to history through Michelet. One has only to recall *Le Tableau de la France.*[15] And finally Taine, as I have already mentioned, contributes to the spread of the idea in all fields *[milieux],* including the literary. One can summarize the spirit of this theory of the relationship between man and his geographic milieu by saying that doing history consists of reading a map, if we understand by map the configuration of a set of metric, geodesic, geological, climatological, and descriptive biogeographical data.



The approach to problems in anthropology and human ethology (an approach that is more and more deterministic, or more precisely mechanistic, as we get further from the spirit of the founders) is coupled with a

parallel, if not exactly contemporaneous, methodology in the area of animal ethology. A mechanistic explanation of the organism's movement within the milieu succeeds the mechanistic interpretation of the development of organic forms. Let us simply recall the work of Jacques Loeb and that of Watson. Generalizing the conclusions of his studies of phototropism in animals, Loeb considers all movement of the organism in the milieu as a movement that is forced upon the organism by the milieu. The reflex, considered the elementary response of a part of the body to an elementary physical stimulus, is the simple mechanism whose constitution allows us to explain all behavior of the living. There is no question that such exorbitant Cartesianism lies, along with Darwinism, at the origin of the postulates of behaviorist psychology.[16]

Watson assigned the analytical study of the conditions of adaptation of the living to the milieu as a program for psychology by experimenting with the production of relations of excitation and response (the coupling of stimulus-response). The determinism of the relationship between excitation and response is physical. The biology of behavior is reduced to neurology, and the latter is reduced to an energetics. Watson's ideas led him from a conception in which he simply neglected consciousness because he saw it as unuseful, to a conception in which he rejected it as outright illusory. The milieu finds itself invested with all powers with respect to individuals; its power dominates and even does away with the influence of heredity and genetic makeup. Once given a milieu, the organism itself gives nothing that, in reality, it doesn't receive. The situation of the living, its being in the world, is thus its condition, or more precisely its conditioning.

Albert Weiss wished to construct biology as a deductive physics, and he proposed an electronic theory of behavior. It was left to psychotechnicians, who extended Taylorist techniques of time and motion studies by means of the analysis of human reactions, to perfect the work of behavioral psychology and to ingeniously constitute man as a machine reacting to other machines, an organism determined by the "new milieu" (Friedmann).

In short, as a result of its origins, the notion of milieu first developed and spread in a perfectly predictable manner; and thus we may say, applying to it the methodological approach that it implies, that its intellectual power was a function of the intellectual milieu in which it was formed. The theory of milieu was the positive and apparently verifiable translation of Condillac's fable of the statue: "To us it is a statue smelling a rose, to itself it is smell of rose."[17] Similarly, in the physical milieu, the living simply is light and heat; it is carbon and oxygen, calcium, and heaviness. It responds by muscular contractions to

sensory stimuli, from scratching to tickling, from leaking to bursting. But we may, and we must, ask where the living is to be found? We can clearly see individuals, but they are objects; we see gestures, but they are displacements; centers, but they are environments; machine operators, but they are machines. The behavioral milieu coincides with the geographic milieu, the geographic milieu with the physical milieu.

IIIII

It was normal, in the strong sense of that word, for this methodological norm to be both pushed to its limits and ultimately overturned in geography. Geography deals with complexes, complexes of elements whose actions limit each other reciprocally and for which the effects of causes in turn become causes, modifying the causes that brought them into being. For this reason, trade winds provide a prototypical example of a complex. Trade winds displace surface seawater warmed through contact with the air, deeper cold waters rise to the surface and cool the atmosphere, the low temperatures lead to low pressures, which give rise to winds, and the cycle is closed and begins again. This is a type of complex that we might also observe in plant geography. Vegetation is spread out in natural groups within which different species limit each other reciprocally and in which, as a result, each one contributes to creating an equilibrium for the others. The whole set of these plant species ends up constituting its own milieu. In this way exchanges between plants and the atmosphere end up creating a sort of screen of water vapor around the plant kingdom that ends up limiting the effects of radiation, and the cause leads to the effect that it in turn attenuates, etc.[18]

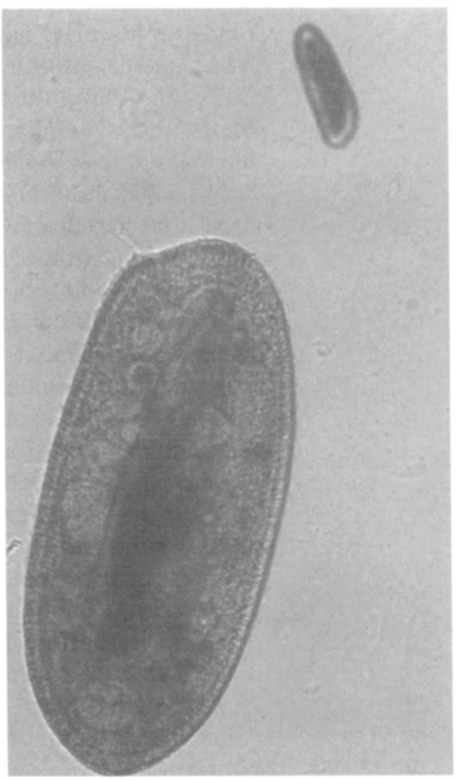
The same approach should be applied to animals and to man, although we find that human response to the stimulus of the milieu is varied. Man can find several solutions to the same problem posed by the milieu. The milieu proposes without ever imposing a solution. Of course the possibilities are not endless within a given state of civilization and culture. But the fact of seeing something as an obstacle at one time that later can become a tool is clearly tied to the idea, to the representation, that man (I am speaking of humanity as a whole, of course) makes of his own possibilities and needs. In short, it relies on what he sees as desirable, and that is something that cannot be separated from the whole of his value system.[19]

In this way, we end up inverting the relationship between milieu and living thing. At this point, to the extent that he exists in history, man becomes a creator of the geographical configuration; he is a geographical factor. We may here simply recall that the work of Vidal-Lablache, Brunhes, Demangeon,

and Lucien Febvre and his school showed that man has no pure physical milieu. In a human milieu, man is obviously subject to a determinism, but it is the determinism of artificial constructions. The spirit of invention that brought them into existence has been alienated from him. In the same line of thinking, the work of Friedmann shows how, in the new milieu that machines create for man, the same reversal has already occurred. Pushed to the extreme limits of its ambition, the psychotechnique of engineers that grew out of Taylorist philosophy has succeeded in locating an irreducible center of resistance, the presence of man's true originality in the form of his sense of values. Man, even when subordinated to machines, cannot conceive of himself as a machine. His productive efficiency increases the more he is aware of his centrality in relation to the mechanisms that serve him.

Well before this, the same reversal of the relationship between organism and milieu had occurred in matters of animal psychology and behavioral studies. Loeb led to Jennings, and Watson led to Kantor and Tolmann.

At this point, the influence of pragmatism is clear and well established. If, in one sense, pragmatism served as an intermediary between Darwinism and behaviorism by extending the idea of adaptation to a general theory of knowledge and, in another sense, by putting the accent on the role of values in relation to the interests of action, Dewey was to lead behaviorists to regard the connection between organic movements and the organism itself as essential. The organism was considered as a being on which not everything could be imposed, because its existence as an organism consists in presenting itself to things, according to certain orientations that are specific to it. First explored by Kantor, Tolmann's teleological behaviorism consists of researching and recognizing the meaning and intention of animal movement. It seems essential to the movement of response to persist in a set of phases that can be mistakes or unfulfilled acts, up until the moment when the reaction puts an end to the stimulus and reestablishes a state of rest or leads to a new series of actions that is totally different from the ones that were closed unto themselves.



Before him Jennings had shown, in his theory of trial and error, contra Loeb, that the animal does not react by the sum of molecular reactions to a stimulus that can be broken down into units of stimulation, but rather that it reacts as a whole to total objects and that these reactions regulate the needs that command them. Naturally, one must recognize here the considerable contribution of *Gestalttheorie,* especially the distinction

between behavioral milieu and geographical milieu that we owe to Koffka.[20]

Finally, the organism-milieu relationship finds itself reversed in von Uexküll's studies of animal psychology and Goldstein's studies of human pathology. Each of these illustrate the reversal with a clarity that comes from a completely philosophical approach to the problem. Uexküll and Goldstein agree on this fundamental point: that to study a living thing under experimentally constructed conditions is to create a milieu for it, to impose a milieu upon it. In fact, it is a fundamental characteristic of the living thing that it makes its own milieu; it builds one for itself. Of course, even from a materialist point of view we can speak of the interaction between the living and the milieu, between the physicochemical system interspersed within a larger whole and its environment. But talk of interaction is not enough to offset the difference that exists between a relationship of a physical type and one of a biological type.

From the biological point of view, one must understand that between organism and environment there is the same relationship that exists between the parts and the whole within the organism itself. The individuality of the living does not come to an end at its ectodermal boundaries, no more than it begins at the level of the cell. The biological relationship between the being and its milieu is a functional one, and as a result it changes as the variables successively exchange roles. The cell is a milieu for intracellular elements; it lives in an interior milieu that is either on the scale of the organ or the organism, which organism itself lives in a milieu that is for it, in a sense, what the organism is for its component parts. We can therefore move toward using a biological reasoning to evaluate biological problems. A reading of Uexküll and Goldstein can contribute a great deal to mapping out this reasoning.[21]

Let us take the terms *Umwelt, Umgebung,* and *Welt.* Uexküll distinguishes between them with great care. *Umwelt* designates the behavioral milieu that is proper to a given organism; *Umgebung* is the simple geographical environment; and *Welt* is the scientific universe. For the living, the specific behavioral milieu *(Umwelt)* is a set of stimuli that have the value and significance of signals. To act on a living thing, it is not enough that physical stimuli be produced; they must also be noticed. As a result, to the extent that a stimulus acts on the living, it presupposes an orientation of its interest. The stimulus does not proceed from the object, but from this interest. It is necessary, in other words, for the stimulus to be effective, that it be anticipated by the subject's attitude. If the living does not go looking for something, it gets nothing. A living thing is not a machine that responds by movement to stimuli, it is a machinist who responds to signals by operations. Naturally, this does

Neobursaridium.

not mean that one should call into question the fact that there are reflexes whose mechanism is physicochemical. For the biologist, the problem is elsewhere. The question is rather to be found in the fact that out of the exuberance of the physical milieu, as a producer of stimuli whose number is theoretically unlimited, the animal retains only a few signals *(Merkmale).* Its biorhythm orders the temporality of this *Umwelt,* just as it orders its space. Along with Buffon, Lamarck said: time and favorable circumstances constitute the living little by little. Uexküll reverses the relationship and says: time and favorable circumstances exist only in relation to a specific living thing.

Umwelt is therefore a voluntary sample drawn from the *Umgebung,* the geographical environment. But the environment is precisely nothing other than man's *Umwelt,* that is, the usual world of his practical perspective and experience. Like this *Umgebung,* this geographical environment that is external to the animal is, in a sense, centered, ordered, and oriented by a human subject (that is to say a creator of techniques and values). Similarly, the animal's *Umwelt* is nothing other than a milieu centered around the subject of life values that makes up the essential part of what constitutes the living. At the root of this organization of the *Umwelt* we must conceive of a subjectivity that is analogous to the one we are bound to think of as being at the root of the human *Umwelt.* One of the most compelling examples cited by Uexküll is the *Umwelt* of the tick.

Ticks grow by imbibing the warm blood of mammals. After coupling, the adult female climbs to the end of a tree branch and waits. It can wait eighteen years. At the Institute of Zoology in Rostock, ticks have stayed alive, closed up, in a state of inanition, for eighteen years. When a mammal passes under the tree, under the tick's hunting and trapping post, it lets itself fall. What guides it is the odor of rancid butter that emanates from the animal's cutaneous glands. This is the only stimulus that can set off the falling motion. This is the first step. Once the tick has fallen on the animal, it attaches itself to it. If the odor of rancid butter has been produced artificially, on a table, for example, the tick does not attach itself, but climbs back up to its observation post. The only reason it attaches to the animal is its blood temperature. It attaches to the animal because of its sense of heat; and guided by its sense of touch, it looks preferably for areas of the skin that are hairless, it digs in just beyond the head, and sucks the blood. It is only at the moment when the mammal's blood enters its stomach that the tick's eggs (encapsulated since the moment of coupling and able to remain encapsulated for eighteen years) open up, mature, and grow. The tick can live eighteen years to complete its reproductive function in a few hours. It should be noted that, for a considerable amount of time, the tick can remain totally indifferent,

insensitive to all stimuli coming from a milieu like the forest, and that the only stimulus capable of setting off its movement, to the exclusion of all others, is the odor of rancid butter.[22]

A confrontation with the work of Goldstein was inevitable, since his theory is based on a critique of the mechanical theory of reflexes. The reflex is not an isolated or gratuitous reaction. The reaction is always a function of the opening of the senses to stimuli and its orientation relative to them. This orientation depends on the meaning of a situation as it is perceived in its entirety. Separate stimuli may have meaning in the social sciences, but they mean nothing when it comes to the senses of a living thing. An animal in an experimental setting is in an abnormal situation that is imposed upon it; it is neither necessary nor of its own choosing. An organism is therefore never equal to the theoretical sum of its possibilities. We cannot understand its action without thinking of it in terms of a privileged form of behavior. "Privileged" does not mean objectively simpler in this case; it is rather the opposite. The animal finds it easier to do what it favors: it follows its own norms of living.

The relationship established between the living and the milieu is like a debate *(Auseinandersetzung)* in which the living brings its own norms of appreciating the situation, where it is in command of the milieu and accommodates itself to it. This relationship does not consist primarily, as one might think, of a struggle or a confrontation. Those are things that characterize the pathological state. A life that affirms itself in opposition is already a life threatened. Movements involving strength, as for example extensive muscular reactions, translate the domination of the exterior onto the organism.[23] A healthy life, a life that is confident in its existence and in its values, is a life that extends itself yet that is also almost gentle in its flexibility. The situation of the living demanded by the milieu from the outside is what Goldstein holds up as the prototype of a catastrophic situation. This is the situation of the living in the laboratory. The relations between the living and the milieu as they are studied experimentally and objectively are of all possible relations those that have the least biological significance: they are pathological relations. Goldstein says that "the meaning of an organism is its being"; we may say that the being of the organism is its meaning. Of course, the physicochemical analysis of the living can and should be undertaken. It has a theoretical and practical interest. But this constitutes a chapter of physics. Everything remains to be done in biology. Biology must therefore first consider the living as a meaningful being, and its individuality not as an object, but as a term within the order of values. To live is to spread out; it is to organize a milieu starting from a central reference point that cannot itself be referred to without losing its original meaning.

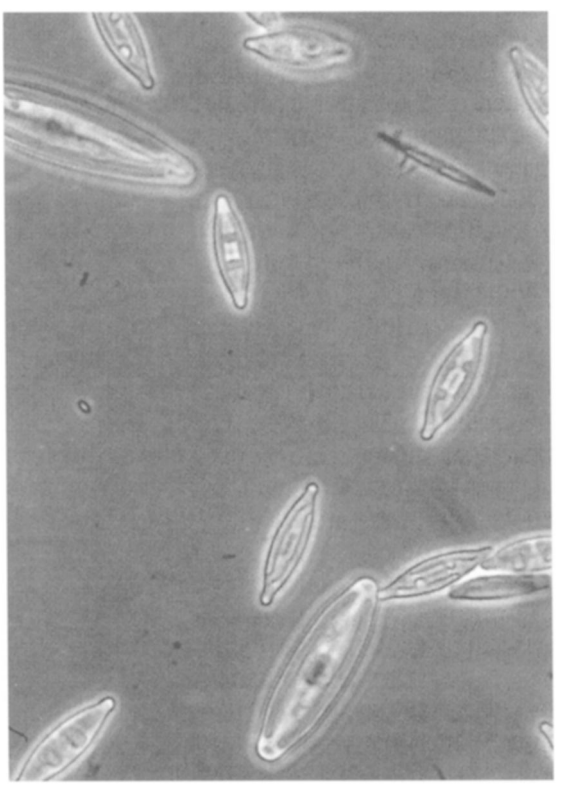
While the reversal of the organism-milieu relationship was being completed in animal ethology and in behavioral studies, a revolution was occurring in the way that morphological characteristics were being used to explain the autonomy of the living relative to the milieu. I am alluding here to the now very well known work of Bateson, Cuénot, Thomas Morgan, H. Müller, and their collaborators, who took up and extended Gregor Mendel's research on hybridization and heredity. In the process of creating the science of genetics, these thinkers ended up claiming that in a given milieu the acquisition of the form, and therefore the function, of the living depends on its particular hereditary potential and that the action of the milieu on phenotype leaves genotype unchanged. The genetic explanation of heredity and evolution (i.e., the theory of mutation) converged with Weissman's theory. The precocious isolation of a germinating plasma in the course of ontogenesis would nullify the influence of somatic modifications determined by the milieu on the evolution of the species. In his book *La Vie créatrice des Formes,* Albert Brachet wrote that "the milieu is not, properly speaking, an agent of formation, but in fact of realization," by invoking the multiformity of sea creatures within an identical milieu in support of his argument.[24] And Caullery concluded his study of *The Present State of the Problem of Evolution*[25] by recognizing that evolution depends much more on the intrinsic properties of organisms than on the surrounding milieu.[26]

Yet we know that the idea of the total autonomy of hereditary genetic assortment did not go without criticism. At first critics emphasized the fact that nucleoplasmatic disharmony tends to limit the hereditary omnipotence of genes. In sexual reproduction, if it is true that the two parents each provide half of the genes, the mother provides cytoplasm for the egg. Given that the mixed offspring of two different species are not the same, depending on whether one or the other species is represented by the father or the mother, we are led to suppose that the power of genes differs as a function of the cytoplasmic milieu. In addition to this, H. Müller's experiments (1927) provoking mutations in *Drosophila* by the action of a milieu of penetrating radiation (X rays) seemed to shed some light on the external conditioning of an organic phenomenon, perhaps too easily underscoring the distinction between organism and environment.

Finally, Lamarckism has become topical once again thanks to the ideological, as much as scientific, polemics around the indignant repudiation of genetic "pseudo-science" by the Russian biologists that Lysenko had brought back to the "healthy method" of Mitchourine (1855–1935). Experiments on the vernalization of cultivated plants like wheat and rye led Lysenko to claim that hereditary modifications can be obtained

Pennate diatoms.

and consolidated by variations in feeding, upkeep, and climatic conditions, leading to the dislocation or rupture of the hereditary constitution of the organism that geneticists had falsely imagined to be stable. To the extent that we can summarize complex experimental findings, it should be said that according to Lysenko, heredity is dependent on metabolism, and the latter is dependent on the conditions of existence. Heredity is to be seen here as the assimilation of outside conditions by the living over successive generations. Remarks of an ideological nature concerning these facts and this theory actually help clarify its meaning, regardless of their authors' inability to accept, let alone tolerate, the counterexperiments and criticisms that are the norm in matters of scientific discussion; all of which things lie, of course, outside of my realm of competence.[27] It seems that the technical, that is to say agronomic, aspect of the problem is crucial. In justifying the spontaneous character of mutations, Mendelian theories of heredity tend to moderate human, and specifically Soviet, ambitions to completely dominate nature and the possibility of intentionally altering living species. Finally and above all, the recognition of the determining influence of the milieu has a political and social impact in that it authorizes man's unlimited action upon himself through the medium of the milieu. It justifies hope in an experimental renewal of human nature. In this way, it appears, at first sight, to be progressive. Theory and praxis are indissociable, as is required by Marxist-Leninist dialectics. As a result, we can see how genetics could be charged with all of the sins of racism and slavery and how Mendel was presented as the leading spokesman for a retrograde, capitalist, and even idealist biology.



It is clear that the return to legitimacy of theories of the heredity of acquired characteristics does not in itself authorize us to unreservedly qualify the recent Soviet biological theories as Lamarckian. This is because the essence of Lamarck's ideas, as we have seen, consists in attributing the organism's adaptation to the milieu to its own initiative, needs, and continuous reactions. The milieu provokes the organism to orient its own development. Biological response far outweighs physical stimulation. By rooting adaptive phenomena in necessity, which means both pain and impatience, Lamarck was focusing on the point where life coincides with its own meaning, where through its sensory experience, the living situates itself absolutely, for better or worse, in

existence: the indivisible totality of organism and milieu.

With Lamarck, as is the case among the first theorists of milieu, the notions of "circumstances" and "surroundings" have an altogether different meaning than they have in normal language. These words genuinely evoke a spherical, centered disposition. The terms "influences" and "influential circumstances," used by Lamarck, take their meaning from astrological concepts. When Buffon, in *La Dégénération des Animaux,* speaks of the "tint" of the sky that takes man so long to perceive, he is using, no doubt unconsciously, a term borrowed from Paracelsus. Even the notion of "climate" in the eighteenth[28] and early nineteenth centuries is a unified notion common to geography, astronomy, and astrology. Climate is the change in appearance of the sky, degree by degree, from equator to pole; it is also the influence exercised by the sky on the earth.

I have already indicated that the biological notion of milieu at first brought together an anthropogeographic component and a mechanical one. The anthropogeographic component could even be considered to make up the whole idea, since it included in itself the astronomical component, the one Newton had converted to a theory of celestial mechanics. For in the beginning geography was for the Greeks the projection of the sky onto the earth, the coming together of earth and sky, a correspondence that went in two directions at the same time: a topographical correspondence (geometry and cosmography) and a hierarchical correspondence (physics and astrology). The mapping of parts of the earth and the subordination of a mapped area to the sky were understood in the astrobiological intuition of the cosmos. Greek geography had its own philosophy, that of the Stoics.[29] The intellectual relations between Posidonius on one hand, and Hipparchus, Strabo, and Ptolemy on the other, are undeniable. It is the theory of universal sympathy, a vitalist intuition of universal determinism, that gives its meaning to the geographical theory of the milieu. This theory supposes the assimilation 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 thing: man. This biocentric conception of the cosmos carried over from the Middle Ages to blossom in the Renaissance.

We know what happened to the notion of cosmos with the appearance of Copernicus, Kepler, and Galileo, as well as how dramatic the conflict was between the organic conception of the world and the conception of a universe that was decentered relative to the center privileged in the classical world, the earth of the living and of man. With Galileo and also Descartes it became necessary to choose between two theories of milieu, that is, in the final analysis, theories of space: a centered space, defined as being where the mi-*lieu* is a center; a decentered

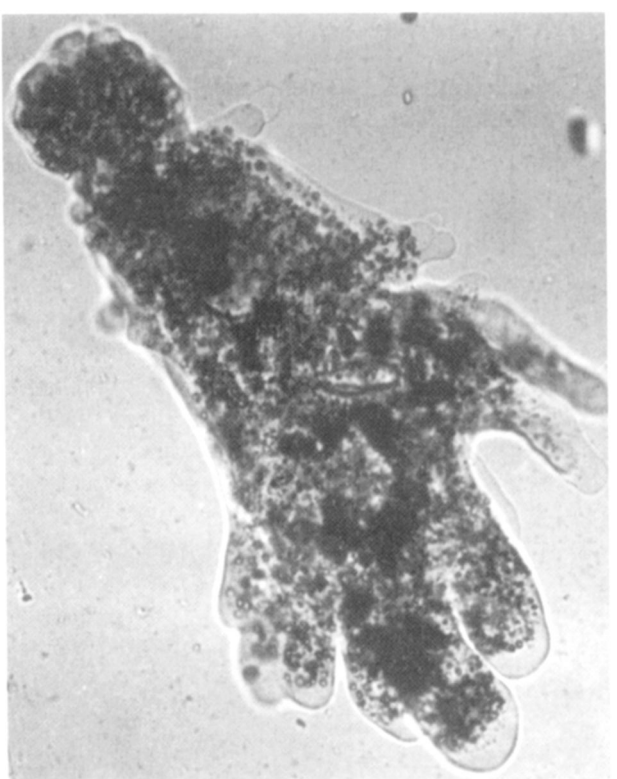
space, defined as being where the *mi*-lieu is an intermediary field. Pascal's famous text, *Disproportion de l'Homme,* shows the ambiguity of the term well in a spirit that cannot or will not choose between its existential security and the demands of scientific knowledge.[30] Pascal knew that the cosmos had shattered into pieces, but the eternal silence of infinite spaces frightened him. Man was no longer at the center *[au milieu]* of the world, but *he is a milieu* (a milieu between two infinites, a milieu between nothing and everything, a milieu between two extremes); the milieu is *the state in which nature placed us; we are floating on a vast milieu; man is in proportion with the parts of the world; he relates to all that he knows:* "He needs a place to contain him, time in which to endure, movement to live, elements to make him up, heat and food to nourish him, air to breath . . . and in the end, everything is his ally." We may observe that three meanings of the word "milieu" come into play here: a median situation, a fluid of suspension, a life environment. It was in developing this last meaning that Pascal revealed his organic conception of the world, a return to stoicism that went both beyond and against Descartes: "All things being caused and causal, helped and helping, mediated and immediate, and all intertwined by a natural and insentient connection that links the most distant and different among them, I hold that it is impossible to know the parts without knowing the whole, any more than we can know the whole without particularly knowing the parts." And when he defines the universe as "an infinite sphere in which the center is everywhere, the circumference nowhere," Pascal is paradoxically using an image borrowed from the theosophic tradition to try to reconcile the new scientific conception that sees the universe as an infinite and undifferentiated milieu and the ancient cosmological vision that sees the world as a finite whole connecting to its center. It has been established that the image used here by Pascal is a permanent myth of mystic thought of neo-Platonic origin in which an intuition of the spherical world centered in and by the living and the already heliocentric cosmology of the Pythagoreans are reconciled.[31]

Before Newton, the symbolic representation of the potential ubiquitousness of a spreading action starting from a central point described in the neo-Platonic cosmology of Jacob Boehme and Henry More, "the Cambridge Platonist," was universally recognized. Newtonian space and ether, the first as a means for the omnipresence of God, the second as a medium and vehicle of forces, both retain, as we know, an absolute character that eighteenth- and nineteenth-century scholars failed to remark upon. Newtonian science, which was to anchor so many empiricist and relativist professions of faith, is itself founded on metaphysics. Empiricism masks its theological foundations.

And in this way the natural philosophy or the positivist and mechanistic conception of milieu has as its source, finds itself anchored by in fact, the mystical intuition of a sphere of energy in which the central action is uniformly present and efficient at every point.[32]

IIIII

If today it seems normal to anyone trained in the mathematical and physical disciplines that the objectivity of knowledge requires a decentering of perspective, the moment also finally seems to have arrived where, from the perspective of biology, according to the formulation of J. S. Haldane in *The Philosophy of a Biologist,* "it is physics that is not an exact science." Indeed, as Claparède wrote, "What distinguishes the animal is the fact that he is a *center* relative to surrounding forces that are no longer, relative to it, anything but signals or stimuli; a center, in other words an internally regulated system in which reactions are controlled by an internal cause: immediate necessity."[33] In this sense, the milieu on which the organism depends is structured and organized by the organism itself. What the milieu gives to the living is a function of its demand. This is why within what appears to man to be a unique milieu, several living things draw their own specific and singular milieu. For that matter, as a living thing, man does not escape the general law of the living. The milieu that is proper to man is the world of his perception, that is to say the field of his practical experience in which his actions, oriented and regulated by values that are immanent to his tendencies, carve out certain objects, situate them relative to each other and all of them in relation to himself. This occurs in such a way that the environment he is supposed to be reacting to finds itself originally centered in and by him.



But man the scholar constructs a universe of phenomena and laws that he holds up as absolute. The essential function of science is to devalue the qualities of objects that make up the milieu proper, by offering itself as a general theory of the real, that is to say nonhuman, milieu. Sensory data are disqualified, quantified, and identified. That which is imperceptible is first placed under suspicion, then exposed and avowed. Measurements are substituted

for appreciations, laws for habits, causality for hierarchy, and the objective for the subjective.

In fact, this universe of man the scholar, of which Einstein's physics is the ultimate representation (a universe in which fundamental equations of intelligibility are the same regardless of the system of reference) because it maintains a direct, if negating and reductive, relationship with the living man's proper milieu, endows this milieu with a sort of privilege over the milieus that are proper to *other* living things. Living man takes from his relationship with man the scholar, in whose work ordinary perceptive experience finds itself contradicted and corrected, a sort of unconscious fatuousness that leads him to prefer his own milieu to that of other living things as having not only a different value, but a higher degree of reality. In fact, as a proper milieu of behavior and life, the milieu of man's sensory and technical values does not in itself have more reality than the milieu proper to a wood louse or a grey mouse. The qualification of "real" can only be applied rigorously to an absolute universe, to the universal milieu made up of elements and movements authenticated by science, in which this recognition is as such necessarily accompanied by the disqualification of *all* subjective understandings of milieu as illusions or errors of life, including those of man.

The pretension of science to dissolve these centers of organization, adaptation, and invention that are living things into the anonymity of the mechanical, physical, and chemical environment must be complete, that is to say that it must include the living human himself. And as is well known, this project has not seemed too audacious to many thinkers. But we must then ask ourselves from a philosophical point of view if the origins of science do not better reveal its meaning than the pretensions of a few scholars. For the birth, development, and progress of science must be seen as a remarkably audacious enterprise if we are rightfully to deny the innate genius of humanity, from the point of view of scientism and even materialism. If we do not, it would be necessary to admit the absurd proposition according to which reality contains the science of reality within itself a priori. And we would then have to ask what need that has its origins in reality is truly being served by the ambition to scientifically determine that same reality.

But if science is the work of a humanity that is rooted in life before being enlightened by knowledge, if it is a fact in the world while also being a vision of the world, then it perpetuates a permanent and necessary relationship with perception. And therefore man's proper milieu is *not* situated in the universal milieu like a thing contained within its container. A center does not dissolve into its environment. A living thing does not reduce itself to an intersection of influences. These ideas

Amoeba proteus.

point to the inadequacy of any biology that would eliminate any consideration of meaning from its domain out of an utter submissiveness to the spirit of the physicochemical sciences. A meaning, from the biological and psychological point of view, is an appreciation of values in relation to a need. And a need is, for whoever feels it and lives it, an irreducible system of reference, and for that reason it is absolute.

Notes

"Le Vivant et son milieu" was originally presented as a lecture at the Collège philosophique in Paris in 1946–47 and was subsequently published in *La Conaissance de la vie* in 1952. It is translated and published here with permission from Librairie Philosophique J. Vrin, Paris.

1. I have chosen to translate the author's *le vivant* as "the living," despite its apparent awkwardness. The French original is similar in this regard, and other formulations such as "living thing," "life-form," and "organism" place too much emphasis on the definite boundary between these entities and their surrounding environment, a distinction that the author clearly wishes to interrogate. I have also kept the term *milieu,* though its English usage is more limited than in French. I have used brackets in the text to note those places where the French use of *milieu* required a different translation. Along with the editors, I would like to acknowledge the numerous invaluable suggestions received from Warwick Anderson, in particular with regard to scientific terminology. *Trans.*

2. On all these points, see Léon Bloch, *Les Origines de la Théorie de l'ether et la physique de Newton* (1908).

3. Léon Brunschvicg, *Les Etapes de la philosophie mathématique* (Paris: Alcan, 1912), 508.

4. See Georges Canguilhem, "La Théorie Cellulaire," in *La Connaissance de la Vie* (Paris: J. Vrin, 1992), 54.

5. See *Esprit des Lois,* books XIV–XIX, on the relationship between laws and climate.

6. The chapter on "the degeneration of animals" in the *Histoire naturelle des animaux* (Paris, 1786–1791) examines the effects of habitat and food on the animal organism.

7. I have translated these and other quotations myself, unless otherwise indicated. The translation of Comte by Harriet Martineau is extremely loose: see *The Positivist Philosophy of Auguste Comte,* vol. 2 (New York: D. Appleton, 2 vols., 1853), 364. *Trans.*

8. Tolman's behavioral psychology also conceives of the relationship between organism and milieu in the form of the relation of a function to a variable. Compare André Tilquin, *Le Behaviorisme* (Paris: J. Vrin, 1944), 439.

9. Louis Roule, *La Vie des Rivières* (Paris: Stock, 1930), 61.

10. A striking summary of this thesis can be found in Houssay's *Force et Cause* (Paris: Flammarion, 1920), in which the author describes "certain types of units that we call living things, that we set apart as if they had an independent and separate existence, when in fact they have no isolated reality and they cannot be, but for an absolute and permanent linkage with the surrounding milieu in which they are but a simple local and momentary concentration."

11. These comments especially concern animals. Lamarck is more reserved on the subject of plants.

12. "Several times each month *[décade]* I frequented M. de Lamarck's Natural History course at the Jardin des Plantes. . . . At that time, M. de Lamarck was perhaps the last representative of that great school of physicists and general observers who had reigned from Thales and Democritus to Buffon. . . . He presented his ideas quite nakedly, with great simplicity and much sadness. He constructed a world with the fewest possible elements, the lowest number of crises and the greatest possible duration. A long, blind patience, that was his idea of the genius of the Universe. . . . In the same way, in the organic order of things, once he recognized this mysterious power of life, as small and elementary as it is, Lamarck imagined it developing, building itself up over time, little by little; deaf necessity, habit alone, gave birth to

organs within a diverse range of milieux, in opposition to the relentless power of nature that set out to destroy them; for M. de Lamarck distinguished between nature and life. In his eyes, nature was stone and ash, a granite tomb, death. Life came into play only as a strange and singularly productive accident, a prolonged struggle with here or there more or less balance or success, but always defeated in the end; cold motionlessness reigned afterwards as before." Sainte-Beuve, *Volupté.*

13. Here I have translated Canguilhem's version of Darwin directly. The original passage is as follows: "Naturalists continually refer to external conditions, such as climate, food, &c., as the only possible cause of variation. In one limited sense, as we shall hereafter see, this may be true." Charles Darwin, *On the Origin of Species: A Facsimile of the First Edition* (Cambridge: Harvard University Press, 1964), 3. *Trans.*

14. Marcel Prenant, *Darwin* (Paris: Editions Sociales Internationales, 1938), 145–49.

15. See Lucien Febvre's *La Terre et l'Evolution humaine* for a historical description of the evolution of the idea and a critique of its exaggerations.

16. André Tilquin, *Le Behaviorisme* (Paris: J. Vrin, 1942), 34–35. It is of course from this well-documented work that I have borrowed much of the information that follows.

17. Condillac, *Treatise on the Sensations,* trans. Geraldine Carr (London: Favil Press, 1930), 3.

18. Compare Henri Baulig, "La Géographie est-elle une science?" *Annales de Géographie* 57 (January–March 1948); and "Causalité et Finalité en Géomorphologie," *Geografiska Annaler* (winter 1949): 1–2.

19. A fascinating consideration of this inversion of perspective in human geography is found in an article by L. Poirier, "L'Evolution de la Géographie humaine," which appeared in *Critique* 8–9 (January–February 1947).

20. On this point, compare Paul Gillaume, *Psychologie de la Forme* (Paris: Flammarion, 1937), and Maurice Merleau-Ponty, *Structure du Comportement* (Paris: Presses Universitaires de France, 1942), translated by Alden L. Fisher as *Structure of Behavior* (Boston: Beacon Press, 1963).

21. Jakob von Uexküll, *Umwelt und Innenwelt der Tiere,* 2d ed. (Berlin, 1921); and *Theoretische Biologie,* 2d ed. (Berlin, 1928); von Uexküll and Georg Kriszat, *Streifzüge durch die Umwelten von Tieren und Menschen* (Berlin, 1934). Goldstein, however, accepts von Uexküll's views only with important reservations. By not differentiating the living from its environment, any research on their relationship becomes, in a sense, impossible. In this perspective, determinism disappears in favor of reciprocal penetration, and taking into consideration the whole effectively stifles knowledge. For knowledge to remain possible, it is necessary that a nonconventional center from which a range of relations can emerge appears within this organism-environment totality. Compare *La Structure de l'Organisme,* 75–76, a critique of any exclusively environmental theory.

22. According to von Uexküll, the example of the tick is taken up by Louis Bounoure in his book *L'Autonomie de l'Etre vivant* (Paris: Presses Universitaires de France, 1949), 143.

23. For a discussion of this argument of Goldstein's, compare the conclusion of François Dagognet's *Philosophie biologique* (Paris: Presses Universitaires de France, 1955).

24. Albert Brachet, *La Vie créatrice des Formes* (Paris: Alcan, 1927), 171.

25. Maurice Caullery, *The Present State of the Problem of Evolution* (Washington, 1917).

26. One can find an anticipation of these ideas in Nietzsche's *Will to Power.*

To be honest, the criticism that Nietzsche addresses to Darwin would be more appropriately applied to the Neo-Lamarckians.

27. For an examination of the subject, see "Une Discussion scientifique en U.R.S.S.," *Europe* 33–34 (1948); and also Claude-Charles Mathon, "Quelques Aspects du Mitchourinisme," etc., in *Revue générale des Sciences pures et appliquées* 3–4 (1951). On the ideological dimensions of the controversy, compare Julian Huxley. Jean Rostand has written a good historical and critical study on the question, "L'Offensive des Mitchouriniens contre la Génétique mendelienne," in *Les Grands Courants de la Biologie* (Paris: Gallimard, 1951), which is followed by a bibliography. Finally, see the work of Hovasse, *Adaptation et Evolution* (Hermann, 1951).

28. See the article on "climate" in the *Encyclopédie*.

29. See the excellent abridged history of Greek geography in Theodor Breiter's introduction to volume 2 (commentaries) of the *Astronomica* by Manilus (Leipzig, 1908).

30. *Pascal's Pensées,* trans. Martin Turnell (New York: Harper and Brothers, 1962), 215–20.

31. Dietrich Mahnke, *Unendliche Sphäre und Allmittelpunkt* (Niemeyer: Halle, 1937); the author devotes several very interesting pages to the usage and meaning of the expression in Leibniz and Pascal. According to Havet, Pascal supposedly borrowed the expression from Mademoiselle de Gournay (see the 1595 preface to Montaigne's *Essays*) or from Rabelais (*Tiers livre,* chapter 13).

32. Compare Alexandre Koyré, *La Philosophie de Jacob Boehme,* 378–379, 504; and "The Significance of the Newtonian Synthesis," *Archives internationales d'Histoire de Sciences* 11 (1950).

33. Preface to F. J. J. Buytendijk's *Psychologie des Animaux* (Paris: Payot, 1928).

on the former's example of the tick—which, although it lives in the same environment as us, only responds to two stimuli, which thereby effectively define its milieu (the smell of an animal's cutaneous gland and the warmth of blood)—Canguilhem proposes a view of the multiplicity of milieus that inhere within a single environment or space. Although Canguilhem's study is more of a disarticulation of historical notions than the proposition of a new theorization of space, his questioning of the residual anthropocentrism of the space defined by physics—which charts the human milieu (as that which responds to a human need) but sees it as reality entire—and his description of multiplicitous milieus open onto a theorization of space as inscribed with singularity and difference.

—Branden W. Joseph, for the editors

Navicula cuspidata.