Machines and Vitalists

Reflections on the Ideology of Cybernetics

ROBERT McCLINTOCK

"In the course of their search for the origin of things, investigators always thought that they found something which would be of the highest importance for . . . action and judgment: yea, . . . they even invariably postulated that the salvation of mankind depended upon *insight into the origin of things*. . . . On the other hand, the more we examine into origins, the less do they concern our interests." When Nietzsche wrote these words, men were flushed with the expectation that insight into the origin of species would enhance their judgment and valuations. Experience has proved that Nietzsche was correct, for the comprehension of human origins did not lessen the fallibility of man's decisions and deeds. The theory of natural selection did not give a formula for human choice; and the conviction that the fittest survived, a variation of the old sophistry that might makes right, did not make man sublime. Darwinism has passed; but the mystique of origins remains: some would equate reason with idealizations of economic interest, others would transform intellect into sublimations of sexual drives, and an increasing few would reduce mind to ingenious circuits of negative feedback. Can we expect this growing insight of cybernetics into the sources of thought to improve human valuation and judgment?

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Certain cyberneticians have been suggesting that their understanding of communication and control clarifies perennial confusions that cloud the human judgment. I do not refer to their having changed the background against which valuations and judgments are made. The artifacts of cybernetics are increasingly useful in the organization man's "decision-making process." My concern is different; besides the technical innovations, there is a conviction among cyberneticians and information theorists that their work will provide a better standard for the evaluation of human thought. By knowing how brains think, we can precisely appraise the quality of what they think. From the origin of thought, its destiny will be revealed.

Hints of this hope abound in the literature of cybernetics and information theory. The very name "cybernetics," coined from the Greek word for "steersman," portends its philosophical pretensions. For instance, one of the leading theorists in the field, W. Ross Ashby, was not content to have the word denote a group of technical problems: he made it connote normative potentials when he called his science "the art of steersmanship." Then he converted steersmanship into statesmanship by concluding that to those interested in the problems of man cybernetics "offers the hope of providing the essential methods by which to attack the ills—psychological, social, economic—which at present are defeating us by their intrinsic complexity." I have been told that one historian has already used these cybernetic methods to analyze the political machine of Boss Tweed. With more dramatic eclat, Warren S. McCulloch, a neurologist with M.I.T.'s Research Laboratory of Electronics, con-

tended that a robot of only six relays could contradict Plato. He went on to give the cybernetic version of might makes right: "Sin, in its widest sense, is but to miss a mark." Ashby and McCulloch should, however, defer to Norbert Wiener as the most persuasive proponent of "the general ideology of cybernetics."

Sociology, anthropology, economics, epistemology and the philosophy of science were all to be brought under the sway of cybernetics, Wiener wrote in his autobiography. Besides creating this constellation of inquiry, he found that through his studies of communication and control he was "able to add something positive to the pessimism of Kierkegaard and . . . the existentialists." Taking another tack in *The Human Use of Human Beings,* Wiener investigated the relevance of cybernetics for society and used the principles of his science as the basis for sensible policy proposals concerning governmental secrecy. Finally his ideology of cybernetics seems to be winning some favor with the popular tastemakers, for his *God and Golem, Inc.: A Comment on Certain Points where Cybernetics Impinges on Religion* received the National Book Award for 1964. In it Wiener's announced intentions were significant.

> I wish to take certain situations which have been discussed in religious books, and have a religious aspect, but possess a close analogy to other situations which belong to science, and in particular to the new science of cybernetics, the science of communication and control, whether in machines or in living organisms. I propose to use the limited analogies of cybernetic situations to cast a little light on the religious situations.

The hope was there: insight into the origins of communication and control may improve our moral sensibility.

These ideological aspirations are based on an attempt to develop a metaphysics of cybernetics in which it is argued that theories of communication and control will establish criteria for a materialistic conception of meaning and purpose. Cyberneticians find the materialistic basis of purpose in the phenomena of feedback. These are most familiar in the household thermostat that signals a furnace to start when the room temperature drops below the desired level and to stop when the temperature climbs above it. To the behaviorist, the thermostat acts with the purpose of keeping a room at the temperature one deems comfortable; to the cybernetician, all purposes are potentially analyzable into material feedback mechanisms similar to the thermostat.

An argument is not lacking for this belief. Norbert Wiener gave the following general description of feedback:

> When we desire a motion to follow a given pattern the difference between this pattern and the actually performed motion is used as a new input to cause the part regulated to move in such a way as to bring its motion closer to that given by the pattern.

He and others have shown that feedbacks of this kind can produce a variety of purposive behavior. The power to change a stimulus in the light of the response in a way that makes the response approximate a predetermined norm can be built into electronic circuitry, and by means of this circuitry automata have been built that behave purposively. Little motorized robots can be made to seek light or hide from it, to cuddle up to warmth, or to come wagging their tails whene'er they hear their master's voice. Several cyberneticians have argued cogently that the source of human purpose is in the neuronic feedback circuits of our nervous system; eventually, the material basis of these circuits will be understood and fully explained. Then, both simple mechanical performances and complex human aspirations will have been shown to result from a materialistic system that alters acts as they are performed in order to make them conform to a pattern. Consequently, the old inability of mechanistic materialism to explain the phenomena of purpose seems nearly overcome.

In like manner, the materialistic basis of meaning is found in electronic circuitry. The tendency of information theory, an extension of linguistic analysis, is to make meaning the equivalent of effective communication, or the reception by B of that which A sent. In both information theory and linguistic analysis the fundamental

question is what can cause something to be true and to have meaning. For instance, Ogden and Richards said that their *Meaning of Meaning* was an attempt to account for thinking "in purely causal terms." The results of information theory have arisen from the mathematical determination of what coding procedures will most probably cause B to receive that which A sent through an imperfect communications system. Theorists hope that by studying how information about reality can be coded and transmitted via various systems of communication and control they will discover standards that will distinguish sense from nonsense. Meaning will become the equivalent of that which can be encoded and programmed through electronic systems. Hence, like purpose, meaning will be founded on electronic and neuronic circuitry. In both ways, the metaphysics of cybernetics suggests a mechanistic materialism.

Cyberneticians have been quick to point out one of the implications of this materialism: it contradicts the arguments for vitalism, or the belief that in explanations of life, biologists must use more than mechanistic assertions about physicochemical causality, and that a vital principle pertinent only to living things should be introduced into science. As Wladyslaw Sluckin, a psychologist concerned with cybernetics, has indicated, the vitalists' bastion was traditionally the problem of purpose, which suddenly yielded to the cyberneticians' physicochemical explanation. Armed with their mechanistic conception of purpose, cyberneticians have been outspoken critics of vitalism. Norbert Wiener called it a "question-begging epithet," which was, for a man of his temper, a question-closing epitaph. Elsewhere, he ironically accepted a vitalistic, Bergsonian conception of time, but only to add that for vitalism "this victory is a complete defeat, for from every point of view which has the slightest relation to morality or religion, the new mechanics is fully as mechanistic as the old."

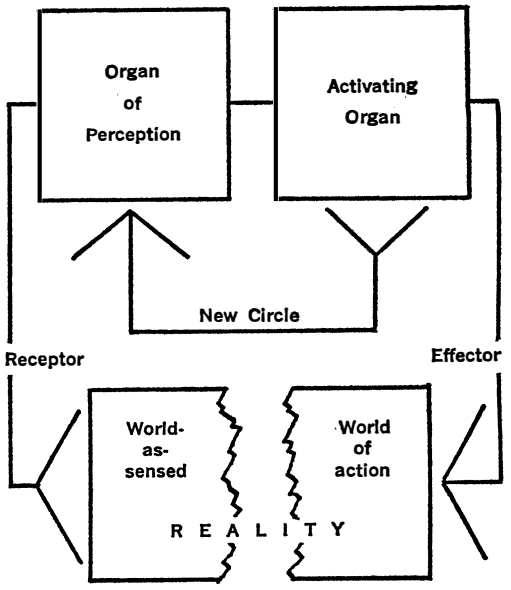
Vitalism has its defenders. Edmund W. Sinnott, Rainer Schubert-Soldern and Erwin Chargaff, all eminent biologists, have pointed out that the expected physicochemical explanation of the cell has definitely not yet been made, and Schubert-Soldern has raised epistemological doubts whether a biochemical explanation of the cell, even if attained, can be accepted as a complete explanation of living matter. These arguments, significant as they are, only defend vitalism from being overrun by a materialistic biochemistry, but they do not take up the cybernetic critique of vitalistic purposes. The materialism of cybernetics, however, should not be allowed to win its point by default. Norbert Wiener was a historian of only his own ideas, and his idea of vitalism was rather narrow, being confined to the philosophy of Henri Bergson. Perhaps, if he had a fuller knowledge of the men with whom Bergson shared the name of vitalist, he might have been more circumspect in his assertions about mechanism and vitalism.

For those who do not give it close attention, history repeats itself. For instance, the cyberneticians' discovery that purpose results from feedback circuits repeated discoveries made earlier in this century by Jacob von Uexküll, a German vitalist. Uexküll was an unique figure in the history of biology. Although along with Bergson and Hans Driesch he was a major participant in the early twentieth-century renaissance of vitalism, Uexküll, himself, had few predecessors and he left few followers. In both research and theory he was highly original, which is not necessarily a happy trait in a natural scientist. His peers, who were stimulated by Darwin to study the genesis and development of life, did not understand Uexküll well because he had departed too sharply from their dominant interests. Whereas most mechanists and vitalists were propounding their expectations about the future prospects for contending theories of development, Uexküll simply observed that there was more to life than its genesis and that in explaining the living of life a nonmechanistic theory of function was indispensable. He based this theory of function on a vitalistic conception of feedback.

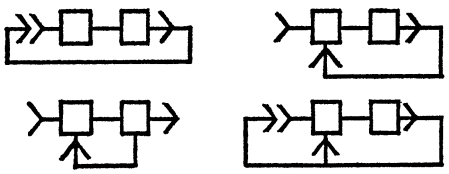
According to Uexküll, the task of biology

was twofold: to explain how a living system was generated, and to describe how various completed systems functioned. In his major study, *Theoretical Biology,* he arrived at a conception of feedback, or as he called it "the function-circle," by investigating this second problem of biology. Uexküll asserted that scientists who tried to explain the function of organisms as a process of physicochemical causality were indulging in anthropomorphic speculations. To be sure, other creatures subsisted in the world known by physics and chemistry; but they conducted their lives in a world of their own that included only those things that they could in some way perceive and act upon. The benevolent biologist had to make something of a phenomenological reduction on the part of the mute creature he studied and carefully catalog the things that entered into its sphere of activity, for these things were the functional facts that concerned the organism. Theories of physicochemical causality were insensitive to functional facts, which could be comprehended only by using the animal's vital pattern as a standard.

From empirical studies of the vital worlds inhabited by various animals, Uexküll abstracted a conceptual model of purposive behavior, the function-circle. Like a cybernetic feedback system, which has two halves, one for input and the other for output, Uexküll's function-circle had one part for perception and another for action. In the first half, a "world-as-sensed" was delimited by the capacities of an animal's sensory receptors, such as eyes or feelers, and by its organ of perception, such as the neural system that translated the stimulations received by the eye into a perceived vision of a thing. In the same way the capacities of the neural activating organ and the effectors—arms, claws or a digestive tract—defined an animal's world of action. By themselves these two halves of the function-circle amount to a simple input-output system with no feedback; but Uexküll observed that the function-circle was complicated by a "new circle," which allowed animals to act with more flexibility than a fixed response to a particular stimulus. By means of a new circle an animal could transform a preliminary response into the stimulus for a different, selective response. New circles allowed for highly selective activity in the world of action and for sharp concentration on specific features of the world-as-sensed. Uexküll diagrammed the whole system in a way similar to a cybernetic model:



There were different kinds of new circles depending on whether they began from an activating organ or an effector and ended at a receptor or an organ of perception. With an intuition similar to the cyberneticians, Uexküll called the new circles "steering mechanisms," and he gave them schematic signs that are similar to sketch diagrams of various feedback circuits used in cybernetics:



Different types of selective activity depended on the use of different steering mechanisms.

A complete function-circle, with all the relevant new circles, laid out the "plan" of

an animal's life; the plan described the limits within which the creature could perceive and act. Things within these limits took part in the creature's vital drama; things outside them were elements in the biologist's world that did not exist as far as the animal was itself concerned. To comprehend a creature as a living being one had to study its function-circle to see what its vital potential was; then one could estimate the functional significance of a particular event by observing how the occurrence contributed to the animal's success or failure in fulfilling its life plan.

Hence, more than twenty years before the cyberneticians drew the connection between the principle of feedback and purposive behavior, Uexküll derived the principle from his study of vital behavior and found that it was the basis of selective and purposive activity. Thus, the same principle is at the heart of Wiener's mechanistic cybernetics and of Uexküll's vitalistic biology. This raises several interesting problems, not the least of which is the possibility that mechanistic and vitalistic conceptions may not be mutually exclusive.

Cyberneticians claim that their technology invalidates vitalism. Most vitalistic theories introduced a nonphysical something—an *élan vital,* an entelechy, or an "impulse"—to direct the process of development. Without it, the phenomena of self-repair, self-reproduction and self-improvement would be incomprehensible. The cyberneticians' feat has been to build machines capable of repairing themselves, reproducing themselves, and improving themselves, which, they claim, proves that the vital something is not necessary to explain these phenomena among the fleshly automatons that were once called life. As far as it goes this reasoning is cogent, and it even upsets Uexküll's vitalism insofar as it was a theory of development. But almost in anticipation, it would seem, Uexküll divided his vitalism into a rule of genesis and a rule of function, devoting his important work to the latter. Rather than being upset by cybernetics, the latter part of Uexküll's vitalism anticipated it and is confirmed by it.

In this case the vitalistic and mechanistic theories are not mutually exclusive; on the contrary, Uexküll's function-circle neatly complements cybernetics by filling in some dangerous gaps in the cybernetic system. In essence, the rule of function warns cyberneticians against the mystique of origins and their "general ideology." It shows that, contrary to Wiener's belief, the new vitalism is not mechanistic as far as morality is concerned.

Information theory tells the cyberneticians how to combine electronic artifacts in ways that will create feedback systems suitable for various tasks. Information theory is quantitative and it is useful in the development of systems for communication and control. There is a tendency, however, to use the same theory to analyze how these systems function; and this second use leads to ambiguities, for it applies a quantitative conception, which describes only the production and consumption, not the content, of messages, to qualitative situations that depend on the content, not the construction, of the messages. Unfortunately, not even computers can add apples to oranges. To anticipate the argument, then: in the light of Uexküll's rule of function, information theory should have only one duty, to enter into the design of cybernetic systems; the function-circle, replete with its teleology, is the proper way to describe the functioning of brains—be they neuronic or electronic.

As a quantitative conception, information theory is based on the idea of a "message," which Norbert Wiener defined as "a discrete or continuous sequence of measurable events distributed in time." A message is measurable because it is a sequence of information units, each of which is "a simple decision between equally probable alternatives." Consequently, one can measure the magnitude of the message by counting the number of information units it contains. Information theorists prefer a binary system as the most efficient basis for the information unit; hence, the binary unit, or "bit," is a decision between only two alternatives: yes-no, plus-minus, in-out, 1-0, to be or not to be. The important point is that for the information theorist,

unlike Hamlet, it is of no interest which of the two alternatives is taken. Like the "Message Units" for which we monthly pay A.T.&T., information units are each of equal value, it matters not whether we use one to summon the doctor or the wrong number as long as we get an "answer." Therefore, to begin with, information is a quantity measured by counting decisions between alternatives; contrary to the layman's intuition, the content of the alternatives is nugatory.

Quantitative information is a useful conception, but the layman's intuition that information must be informative overpowers even the expert theorist. Norbert Wiener wrote:

> Information is a name for the content of what is exchanged with the outer world as we adjust to it, and make our adjustment felt upon it. The process of receiving and of using information is the process of our adjusting to the contingencies of the outer environment, and of living effectively within that environment.

Wiener's second conception of information is not the same as the first. Unlike the quantitative theory, in the second case each bit of information is not of equal value. In adapting to the outer world it makes a great difference whether we summon with a message unit the doctor or the wrong number. In the end, information, which strictly was a quantity, becomes a quality judged by assessing the alternatives between which we must decide.

Despite this ambiguity Wiener was correct in his intuition that feedback was connected not only with the quantitative kind of information; he was correct in quipping that "information is information, not matter or energy." Nevertheless, the quantitative conception, which merely postulates a pulse of electrical energy passing through a material switching circuit, cannot explain the informativeness of information because the content of the message was abstracted from it in order to give it mathematical precision. Instead, the vital plan marked off by Uexküll's function-circle gives a standard with which the informativeness of any bit of information can be estimated. The very language that Wiener used in his second, qualitative definition of information leads straight to Uexküll, for the "outer world" and "outer environment" are the same as the vitalist's world-as-sensed and world of action. In essence, Uexküll's function-circle was a means of specifying what was, and what was not, informative to different beings. Consequently, Uexküll's conception complements cybernetics by using the principle that it shares with the newer science to explain the qualitative phenomena of information that the quantitative theory of cybernetics cannot avoid and cannot explain.

Nevertheless, cyberneticians are a notoriously self-confident group, and they may reply that Wiener made a slip in using a qualitative conception of information and that they would rather stick to quantities than admit the sensibility of any metaphysical concept of "informativeness." To preclude such a Thrasymachian response it is wise to follow the advice of Ben Franklin, whose Poor Richard said: "Would you persuade, speak of Interest, not of Reason." Philosophers such as Ernest Nagel have condemned vitalism for scientific infertility —a venal sin according to those who account for truth by its cash value. But Uexküll's vitalism has a cash value for cyberneticians in both an economic and intellectual sense. A distinction between quantitative information and functional informativeness will help cyberneticians design better machines and it will reduce the false expectations that both cyberneticians and the public have about long-outstanding intellectual problems.

In the field of computer design the most severe lack of knowledge is not how to design and build bigger and faster machines, but how to make them function, how to integrate them into the human world, and how to make them do what we want them to do. Norbert Wiener's later writings harped upon the dangers we risk by building machines to perform functions that we do not adequately understand. The dangers are real because our ability to design machines is more fully developed than is our ability to understand the purposes to which they might be put; and we could

end by putting electronic machines to uses we would not want to put them if we really understood what the uses were. Less awesomely, this problem means that given an adequately specified purpose, computer engineers can probably design a machine to meet it; but many purposes cannot be adequately specified to the engineer.

By using Uexküll's function-circle, the elements of a purpose or function can be investigated. In *Theoretical Biology* he showed that for any particular mode of being there is a definite world-as-sensed and world of action. From this data one could work back and specify the capacities of the receptors and effectors that would correlate with the desired world-as-sensed and world of action. By knowing the capacities of the receptors and effectors that would be needed for a particular purpose, one could determine the capacities for the activating and perceiving organs that would be necessary to link the receptors and effectors together. For instance, in passing, Uexküll gave directions that would be sufficient for designing a machine that, like a bullfinch, could learn to pipe new tunes. And a hasty specification of the human function-circle suggests that confidence in the cybernetic technologists' ability to build any specifiable system may be premature and that *"l'homme machine"* is still a figment for the future. But this is not the place to put Uexküll's ideas to work analyzing the potential functions of cybernetic systems. Suffice it to observe that Uexküll's conception of the function-circle *may* increase our ability to analyze the operations of functionally complex systems of communication and control, and thus increase our ability to design more useful systems. It would be ironic if the pragmatists' animus against metaphysical constructions like "informativeness" would prevent them from testing this potential cash value.

More importantly, however, the cybernetician has a second, intellectual interest: to avoid talking nonsense. The realization that both quantitative information and functional informativeness pertain to any feedback system will prevent his falling into sophistry. For sophistry arises from the mystique of origins, the tendency to use cybernetic revelations of how we think to judge the quality of what we think. It is true that computers can be validly used as analogues to the human brain in order to explain how it processes bits of information. Consequently, there has been a useful exchange between cybernetics and psychopathology. But there is a tendency to overextend this analogy and to use the quantitative theory of information to pontificate upon its functional informativeness. This overextension results from the sophistical use of analogical reasoning. Let us take an example.

In his declamation, "Mysterium Iniquitatis," Warren S. McCulloch asserted several startling things about the power of robots. They can deduce "any conclusion that follows from a finite set of premises" or, like a Lockean slate, they can have "any general idea that can be induced from our sensations." Given the proper circuitry, robots can generate memories, general ideas, Spinozistic consciousness, and the idea of ideas. McCulloch continued, "these robots, even simple ones having but half a dozen relays, may, without inconsistency, show that circularity of preference, or of choice, called the value anomaly which—contra Plato—precludes a common measure of 'the good.' "

McCulloch found what observers of life have long known: the processes of thought are such that neither man nor machine will arrive at an eternal definition of the good. Those who have read their Plato with care know that he claimed no absolute knowledge of the good. But even if Plato had offered a universal standard, the circularity of preference in but half a dozen relays would qualify, rather than preclude, the common measure. Thus, a robot could endlessly scan the world and never find a point that fulfilled its geometrical definition of dimensionless location. That anomaly would not preclude the concept of point; it would make us qualify our idea by saying that the point is a fiction that has proved productive in geometry. In the same way, the value anomaly does not preclude a common measure of the good; it converts the idea into a useful fiction. Contra McCulloch and his robots—that is

all Plato claimed; he investigated the function that the idea of a universal good might perform in the geometry of justice.

Ideas serve a function in human life and therefore what half a dozen relays generate is not an analogous equivalent to Plato's intellection. Psychopathology is not philosophy, just as quantitative information is not functional informativeness. In order to create a mechanical analogue to social and ethical philosophy, one would need to build a system that was functionally, not merely formally, equivalent to the philosophizing brain. That would be a large order. But let us imagine that McCulloch managed to populate a world such as earth with three billion or more machines, each as functionally complex, as easily destroyed, and as difficult to reproduce as man; let us further imagine that he divided these machines into various groups, which compete for the scarce resources of mechanical sustenance. Would these robots be so quick to preclude the idea of a common good?

Formal equivalents are not necessarily functional equivalents, and any argument about the significance of cybernetic formalism for human thought that does not take this fact into account is sophistic nonsense. With their background in logical positivism and its aversion to all nonsense, cyberneticians may then find it in their intellectual interest to heed the conception of functional informativeness; for Uexküll's function-circle avoids the reductionist errors to which the cybernetic idea of feedback is susceptible and it effectively illuminates the sense of conceptions such as Plato's common measure of the good.

By analyzing the human function-circle Uexküll showed that an ethical dilemma was a significant element of the human world. He observed that the function-circles of human beings and of human societies were interdependent, yet divergent. The human individual thrived in liberty, the human society necessitated subordination. If the human species was to continue its development, he contended, neither liberty nor subordination could become dominant and suppress or exclude the other. Therefore, the task of social and ethical philosophy was to reflect upon human experience in order to reconcile the contradictory characteristics of persons and societies in a way that would enable men to profit from both individual initiative and social organization. In the tradition of which Plato is a part the conflicting imperatives of the individual and the social have been reconciled by the conception of a community of individuals held together by common ideals. The quality of Plato's contribution to this tradition should be judged not on the basis of its cybernetic thinkableness, but on the basis of its value in relation to the human situation, which Uexküll's version of the art of steersmanship helps reveal. Plato has not been precluded during the past twenty-four centuries, because his aspiration to a common measure of the good has helped ensuing communities of individuals hold themselves together through common ideals. In this way, Uexküll's use of the feedback principle helps us understand the sense of moral speculation such as that of Plato.

Consequently, Norbert Wiener was only partly right: there is a new mechanics. But he was wrong in claiming that from the point of view of morality and religion it is as mechanistic as the old. In one direction, the feedback principle shows that thought can be produced mechanistically; and in the other, it indicates that the adequacy of a thought can only be judged in view of the needs, potentials and purposes of the system that did the thinking. Therefore, man is still man's measure, and "know thyself" continues to be the way to wisdom.

With the cyberneticians' economic and intellectual interest securely engaged, it is safe to appeal to reason. Epistemology provides an explanation for the surprising discovery that cybernetic materialism needs to be complemented by a biological vitalism and that the quantitative theory of information needs to be balanced by a conception of functional informativeness.

One of the reasons that Uexküll fared poorly with his peers was that he was an outspoken Kantian and they were not. Uexküll thought that science interpreted phenomena, not reality. "In Nature everything is certain; in science everything is

problematical . . . . [Scientific theory] does not itself pertain to Nature, but is always something extraneous." Neither vitalism nor mechanism would tell us what life was in itself. Therefore, since absolute reality was beyond our ken, science had room for both mechanism and vitalism; they did not need to be mutually exclusive. Uexküll, himself, was not both a mechanist and a vitalist, but some of the distinctions he made opened the way to this dual view. Most important was his distinction between the rule of genesis and the rule of function; for it frees us to explain the development and production of things through physicochemical causalities and, at the same time, to interpret the operation and functioning of these things with a purposeful teleology.

Kant provided a basis for this distinction in his *Critique of Pure Reason*. He asserted that all phenomena were subject a priori to three rules, the principles of permanence, production and community. Here the principle of permanence may be disregarded because it pertains to both the rule of genesis and the rule of function. The principle of production is that "all alterations take place in conformity with the law of the connection of cause and effect." This principle governs the rule of genesis, and it suggests that an inquiry into how things came to be will be causal, which in our time has come to be the same as physicochemical. The principle of community is that "all substances, in so far as they can be perceived to coexist in space, are in thoroughgoing reciprocity." This principle governs the rule of function, which studies not how a system is produced, but how it works when it and all the things with which it interacts are coexisting. The principle suggests that interacting things should be conceived as wholes, or communities, in which each part has a place; and thus it leads to a purposive, teleological interpretation of the pertinent phenomena.

Hence, a Kantian might have predicted that from the phenomena of feedback two scientific systems would arise, one illuminating the law of causality and the other the law of reciprocity. Positivists should be impressed by this nice confirmation of Kant's analogies of experience. That causality and reciprocity are separate, but complementary, interpretations of the same thing generalizes the reasoning by means of which Nietzsche observed that the Darwinian insight into the origin of man would not solve man's problem of justly evaluating his own acts.

Finally, the distinction between a rule of genesis and a rule of function helps state the problem of the unity of our culture. The apparent dichotomy of the "two cultures" will not be overcome by endowing everyone with a stock of conversational tidbits about Dickens and DNA. Reestablishing the unity of intellect is, as my mentor Martin S. Dworkin teaches, a problem of reestablishing the primacy of philosophy over all its former parts. The particular achievements of inquiry have never been continuous, each with the other, and they have never been an essential part of that common sphere of discourse inhabited by educated men. Instead of cultivating the lordly banality of being at home in every group, masters of the arcane might again pay heed to philosophy, which aspires to state the conditions of thought in such a way that a desirous inquirer could relate his work to that of any other who shared his desire. Thus, the principle of production and the principle of community yield two methods that become one in the philosophic mind, for both methods pertain to all phenomena. For the man who is willing to embark upon a course of disciplined self-examination there is, in Jacques Barzun's phrase, only one mind of many modes. But in the absence of this disciplined inquiry certain scientists have become obsessed with finding laws of causality, and certain writers with comprehending the conditions of reciprocity. Both elevate their interest into the "one thing needful," and forget that production and community equally pertain to all endeavors. Remember that Pascal was writing about the philosophers when he observed:

> We do not display greatness by going to one extreme, but in touching both at once, and filling all the intervening space.
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> Pensée 353