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CYBERNETICS AND MARXISM-LENINISM

BY MAXIM W. MIKULAK

In the course of the nineteenth century it became clear that the unfettered speculation obtaining in philosophy frequently could not be useful in science. However, in the Soviet Union it is asserted that natural science can draw its correct "theoretical conclusions" only by relying upon the philosophic and the methodological teachings of dialectical materialism. Certain Soviet Marxists have, on allegedly philosophic grounds, rejected Western genetics, the resonance theory of the chemical bond, the principle of uncertainty of quantum mechanics, relativist cosmology, the relativization of space, time, and matter, probability theory, and symbolic logic. The intriguing question then remains whether Soviet dialectical materialists determine the validity of scientific theories and accomplishments on the basis of *a priori* judgments derived from philosophic analysis or whether the Soviet attacks on Western scientific thought are, rather, political and ideological in nature.

The Soviet treatment of cybernetics, which was not immediately accepted by Soviet authorities in philosophy and science as a legitimate area of scientific inquiry, provides us with an insight into the working relationship between a given science and the *Weltanschauung* of dialectical materialism. In 1948 Norbert Wiener published his groundbreaking *Cybernetics, or Control and Communication in the Animal and the Machine,* and two years later *The* Human *Use of Human Beings,* stressing the social consequences of cybernetics, but it was only in 1958 that these two works were translated into Russian and made generally available to the Soviet scientific and philosophic communities. In 1953 the editors of the second edition of the *Bol'shaia sovetskaia entsiklopediia* failed to take cognizance of the existence of cybernetics. This omission was rectified on April 29, 1958, with the publication of a supplementary volume to the Soviet encyclopedia carrying A. N. Kolmogorov's factual presentation of the development of cybernetics. Whether by coincidence or design, it was also in 1958 that the first Soviet technical journal devoted exclusively to cybernetics, *Problemy kibernetiki,* made its debut. It required an additional two years, however, before the well-known and highly respected

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Doklady (Papers) of the USSR Academy of Sciences listed for the first time the topic heading "Cybernetics and the Theory of Regulation."[1] Why the Soviet delay in accepting cybernetics as a *bona fide* science?

The postwar Soviet hostility toward Western science in general is readily traceable to the ideological policy adopted by the Central Committee of the All-Union Communist Party. In 1945 the theoretical and political journal of the Party, *Bol'shevik,* noted that "socialist" and "bourgeois" science had little in common.[2] The following year a leading article in the same publication stated that all forms of Soviet social consciousness—science, art, philosophy, law, and so forth—must be geared to the building of communism and acknowledge the correct version of Soviet reality.[3] A member of the Politburo, Andrei A. Zhdanov, was assigned the task of translating the Party line on ideological questions into a program of action. He was most instrumental in purging Soviet artistic and intellectual life of "capitalist" survivals and of safeguarding Marxism-Leninism-Stalinism from subversion. In June 1947 his crude assault on bourgeois science signaled a broad campaign for the ideological purification of Soviet science, the high point being the well publicized suppression of Western genetics and Soviet geneticists. Thus the Soviet atmosphere that first greeted Wiener's cybernetics was most unreceptive to Western theoretical developments.

From 1950 to 1953 at least three pieces that encouraged Soviet antagonism respecting cybernetic theory were published. The first, "Against Idealism in Mathematical Logic," by V. P. Tugarinov and L. E. Maistrov, was, in the subsequent judgment of some Soviet writers, directly detrimental to the advancement of mathematical logic and indirectly harmful to the progress of information theory. Essentially these two authors attacked a Russian translation of a German text on the fundamentals of theoretical logic by D. Hilbert and W. Ackerman, chided the Soviet historian and philosopher of mathematics S. A. Ianovskaia for her academic sterility, and vilified the "idealist" views of Bertrand Russell and Alfred North Whitehead, which had supposedly led mathematical logic to a cul-de-sac.[4] The criticisms of Tugarinov and Maistrov have all the earmarks of being a formalistic ideological exercise instead of a serious analysis of mathematical logic proper. In the second piece, which appeared in the widely circulated newspaper, *Literaturnaia gazeta,* the writer, M. Iareshevsky, con-

[1] Two comprehensive bibliographies of Soviet publications on cybernetics are available in D. D. Comey, "Soviet Publications on Cybernetics," *Studies in Soviet Thought,* No. 2, 1964, pp. 142-61; and L. R. Kerschner, "Western Translations of Soviet Publications on Cybernetics," *ibid.,* pp. 162-77.

[2] *Большевик,* No. 11-12, 1945, p. 2.

[3] *Ibid.,* No. 9, 1946, p. 5.

[4] *Вопросы философии* (hereafter *ВФ*), No. 3, 1950, pp. 331 ff.

demned cybernetics as a science of obscurantists and a pseudoscience wedded to idealist epistemology.[5] The most vituperative diatribe on cybernetics was produced by a writer signing himself "Materialist," who considered Wiener's brainchild a form of "atomic sociology" surrounded by "mysterious forces" of imperialist technology. He could not comprehend how one scientific discipline could cut across remote control, self-regulation, and servo-mechanization as well as biology, physiology, psychology, psychopathology, sociology, and political economics. This anonymous writer believed that the process of applying cybernetics to living organisms and to human society smacked of pure mysticism.[6]

At first appearance the Soviet philosophers and ideologues seem to have been responsible for creating Soviet resistance to Wiener's theory of communication and control. The Soviet scientists S. L. Sobolev, A. I. Kitov, and A. A. Liapunov definitely contributed to this impression when they disclosed that it was primarily Soviet philosophers who insisted on labeling cybernetics an idealistic pseudoscience. These three scientists were convinced that some thinkers rejected cybernetics because they were unaware of its scientific core and because the philosophers equated Wiener's theory with popularized Western versions of cybernation that indulged in sensationalism and speculation. This in turn led Marxist-Leninist writers to misinterpret cybernetics, to greet its progress with silence, and to neglect its remarkable achievements.[7] Years later the internationally renowned Russian physicist P. L. Kapitsa underscored the role of the philosophers in respect to the theory of control and communication by pointing out the pejorative definition of cybernetics in the 1954 Soviet *Filosofskii slovar':* "a form of reactionary pseudoscience originating in the United States after World War II and now widely employed in other capitalist countries; a form of contemporary mechanization." Academician Kapitsa made the point that, if the scientists had taken the Soviet philosophers' view on cybernetics at face value, the Soviet Union would never have been in a position to conquer space.[8]

G. V. Platonov acknowledged that Soviet scientists were just as guilty as the philosophers in approaching modern science, including cybernetics, with a "nihilistic" outlook.[9] D. N. Menitsky explicitly stated that Soviet biologists had opposed cybernetics because of the extravagant claims made for this new science in Western publications and because they were simply ignorant of the revolutionary contributions of mathematics, physics, and chemistry to biological cybernetics.[10]

[5] April 5, 1952.
[6] *ВФ*, No. 5, 1953, pp. 210 ff.
[7] *Ibid.*, No. 4, 1955, pp. 147 ff.
[8] *Экономическая газета*, March 26, 1962.
[9] In *Диалектический материализм и современное естествознание* (Moscow, 1957), p. 22.
[10] *Biophysics* (USSR), No. 2, 1957, pp. 134 ff.

Ernest Kolman, himself a philosopher of science, confirmed the nihilistic state of mind of some of his colleagues toward Wiener's theory and other branches of Western science and revealed the continuing Soviet antagonism to cybernetics; its opponents no longer referred to the theory of control and communication in the machine and living organism as pseudoscience but now argued that it was identical with automation and therefore deserved no separate title to existence. It was apparent to Kolman from the sessions on automation sponsored by the Soviet Academy of Sciences in October 1956 and from the discussions held by the Moscow Mathematical Society in April 1957 that the very same engineers, technicians, and mathematicians who were furthering automation opposed Wiener's cybernetics and that the narrow specialists in biology, physiology, psychology, and linguistics could not reconcile themselves to cybernetics because it represented a "misalliance" of incongruous disciplines.[11]

In 1954 a new Party line was promulgated for Soviet philosophy and science. The Party publication *Kommunist* emphasized that practice must serve as the highest and most reliable criterion for evaluating the truth of scientific propositions. As its plenary sessions of February and March 1954 the Party Central Committee sharply criticized dogmatism in the agricultural sciences—an allusion to the 1948 genetics controversy. The Marxist-Leninist philosophers, so often coddled by the Party leadership, were castigated for being unproductive in the area of philosophy and science.[12] The able Soviet physicist, S. L. Sobolev, backing the Central Committee's position, remarked that a clash of opinions and freedom of criticism were vital to the progress of the sciences. He saw in dogmatism the true enemy of science, especially in Soviet genetics.[13] It was obvious that the ideological policy associated with Andrei Zhdanov had run its course.

There was no intention of severing dialectical materialist philosophy from the Soviet natural sciences. That the Party opposed dogmatism in the sciences is unquestioned, but it also opposed any manifestations of philosophic neutralism. Party spokesmen made it abundantly clear that dialectical materialism was absolutely indispensable for Soviet scientists; it would save them from making idealistic interpretations of scientific data and of reality and keep them from undue deference to bourgeois science. But a nihilistic outlook that found nothing of value in capitalistic science was repudiated as anti-Leninist. The Party leadership made it plain that Soviet science was to grow and prosper on the granite foundation of Marxism-Leninism and that Soviet scientists were

[11] Э. Кольман, *Кибернетика* (Moscow, 1956), pp. 29-30; and Кольман in *Философские вопросы кибернетики* (hereafter *ФВК*) (Moscow, 1961), p. 90.

[12] *Коммунист*, No. 5, 1954, pp. 3 ff.

[13] *Правда*, July 2, 1954.

to struggle against indifference to its "principles on the scientific front."

What impact did the new Party line have on cybernetics? Although it is possible to find in Soviet literature mention of the rationalization of mental labor and of thinking machines as early as 1926,[14] the first significant Soviet defense of cybernetics was made by Kolman in November 1954 at the Academy of Social Sciences attached to the Party's Central Committee. This Czech-born Soviet philosopher, who throughout his long career managed to avoid extremist stands on the philosophic issues of modern science, was competent to judge the worth of cybernetics.[15] In his lecture before the Academy, "What Is Cybernetics?" Kolman belittled the detractors of cybernetics, noted the preparatory role played by Russian and Soviet scientists (Chernyshev, Shorin, Andronov, Kulebakin, Pavlov, Kolmogorov, Krylov, Bogoliubov, Markov, Novikov, and Shanin) in laying the foundation for cybernetics, and stressed the value of cybernetics for advancement of human thought.[16] Soon thereafter Sobolev, Kitov, and Liapunov published their paper presenting in favorable light the basic concepts underlying Wiener's cybernetics.[17] Cybernetics had finally found its champions in the Soviet Union.

Despite the Party's stand on dogmatism in science and despite the Central Committee declaration at its 1955 plenary session on the necessity of utilizing automation and cybernetic technology, the immediate response of Soviet intellectuals to Wiener's theory was less than enthusiastic. A few articles and pamphlets in popular vein were published. Some excellent work on information theory was carried out by A. Ia. Khinchin, A. N. Kolmogorov, and A. A. Liapunov. Some of the philosophical and physiological aspects of cybernetics were studied by P. K. Anokhin, B. Kh. Gurevich, and G. K. Khilme. Studies of the practical application of self-regulating and control methods were most numerous. But in general these contributions to the theory of information, control, and communication pursued lines of research characteristic of the pre-Wiener era—they did not advance the science of cybernetics but rather the separate disciplines of mathematics, physics, biology, physiology, and economics. Consequently, before 1958 cybernetics was not handled by most Soviet scientists as a distinct science having its own unique structure, methodology, and solutions. The practical problem of determining the relation of cybernetics to the other disciplines had to be solved first. Nevertheless, after 1954 no malicious attacks on cybernetics appeared in popular Soviet publications.

By 1958 cybernetics had been accepted as an area of scientific knowledge in the Soviet Union. Not only did the technical journal *Problemy*

[14] *Под знаменем марксизма*, No. 12, 1926, pp. 72 ff.

[15] In his *Kriticky nýklad symbolické metody moderni logiky* (Prague, 1948) Kolman displayed a critical acquaintance with Western literature on symbolic logic.

[16] *ВФ*, No. 4, 1955, pp. 148 ff.

[17] See note 7, above.

kibernetiki make its first appearance in 1958 under the editorship of Liapunov, but in April of that year the Scientific Council on Cybernetics was established by the Soviet Academy of Sciences and headed by Academician A. I. Berg. Thereafter Soviet publications were inundated with pieces on the theory of communication, control, and information. The outstanding Western developers of cybernetics, W. R. Ashby, R. V. Z. Hartley, J. von Neumann, C. E. Shannon, Wiener, and many others had also found acceptance by Soviet authorities. In the case of Wiener the popular Soviet magazine *Ogonëk* virtually stated that it was criminal for Soviet philosophers to denounce the founder of cybernetics as an "obscurantist."[18] Subsequently Wiener was sought out by Soviet scholars for his opinions on the relation of cybernetics to man and philosophy.[19] In 1961 a collection of essays entitled *Cybernetics in the Service of Communism* appeared, a marked contrast in tone and purpose to "Materialist's" article "Whom Cybernetics Serves," published eight years earlier in *Voprosy filosofii* (see page 452 above). And in 1963 I. B. Novik was able to write that cybernetics was not an accidental occurrence but a "result of the progress of social practice and theory."[20]

Thus, in a display of decisiveness unusual in matters of scientific theory, the responsible leadership of the Party endorsed the development of cybernetics in connection with automation. The Party, of course, saw in automation and cybernation the means of attaining an economy of abundance. At the Twentieth Congress (1956) a directive was issued for a program to complete the automation of Soviet plants.[21] The same line was taken three years later by the Twenty-first Congress. And at the Twenty-second Congress, held in 1961, the need was voiced for expanding cybernetic studies in order to create the material-technical base for Communism.[22] Khrushchev personally advanced this line at all of these congresses. As a matter of fact, the president of the Ukrainian Academy of Sciences, B. Paton, stated that the Academy's Cybernetic Institute was following Khrushchev's advice, given at a meeting in December 1962 of the Kiev Communist Party attended mainly by economists, stressing the "necessity for developing research in cybernetics and for using computers in accounting and planning in the national economy."[23] At the same time, however, the Party was demanding that Western science be examined in the light of dialectical materialism. What were the consequences?

[18] *Огонёк*, No. 16, 1959, p. 23.
[19] *Природа*, No. 8, 1960, p. 68; *ВФ*, No. 9, 1960, pp. 164 ff.
[20] И. Новик, *Кибернетика: Философские и социологические проблемы* (Moscow, 1963), p. 34.
[21] *ВФ*, No. 6, 1959, p. 148.
[22] *Ibid.*, No. 11, 1962, p. 153.
[23] *Известия*, April 2, 1963.

Even though the scientific principles of Wiener's cybernetics achieved an aura of respectability in the Soviet Union, its ideological and philosophic content, as expounded by Western writers, was not completely acceptable to Soviet dialectical materialists. The philosophers and scientists who backed cybernetics in Soviet Russia were among the first to condemn some of the philosophic views of Western cyberneticians. Wiener was variously accused of pragmatism,[24] antiscientism,[25] vulgar materialism,[26] natural-history materialism,[27] positivism, and idealistic eclecticism.[28] The neurophysicist Grey W. Walter was labeled a mechanist.[29] W. Ross Ashby's interpretation of cybernetics was stigmatized as mechanistic materialism bordering on idealism, irrationalism, and indeterminism.[30] To make matters more confusing, S. Anisimov and A. Vislobokov asserted that cybernetics became a disreputable subject in the hands of bourgeois spiritualists, who used it to prove the existence of God and the immortality of the soul.[31] On the other hand, Kolman mentioned on several occasions that Western ecclesiastics spurned cybernetic theory because they believed that inherent in its teachings was the idea that machines could be created having some of the attributes of living organisms.[32] Other criticisms were that the capitalist view of cybernetics led to reactionary philosophic and sociological conclusions and that automation played an exploitative role in the class struggle existing in bourgeois society.[33] Despite the fact that Wiener, Ashby, and other Western cyberneticians lacked a consistent philosophic outlook, Soviet Marxists were not to discard cybernetics for its inadequate methodological and philosophic development. On the contrary, Soviet Marxist philosophers were urged to provide the proper dialectical materialist interpretation for cybernetics so that it could rest securely on a scientific base.[34]

One of the main problems facing Soviet philosophers was to define the function and scope of cybernetics. The possibility that it represented a serious challenge to the monopolistic position of dialectical materialism in the Soviet Union was studied. Soviet writers were aware that some Western authors had made fantastic claims, in effect describing cybernetics as a new philosophy of universal application in solving problems stemming from the world of nature and from human society.

[24] *ВФ*, No. 4, 1955, p. 149.
[25] *Ibid.*, No. 3, 1957, p. 157.
[26] *Философские вопросы физики и химии*, No. 1, 1959, p. 67.
[27] *Вестник Ленинградского Университета, Серия экономики, философии и права*, No. 17, 1960, p. 76.
[28] *ФВК*, pp. 97-98.
[29] *ВФ*, No. 3, 1957, p. 156.
[30] *Ibid.*, p. 157.
[31] *Коммунист*, No. 2, 1960, p. 109.
[32] Кольман, *Кибернетика*, p. 3; Кольман in *ФВК*, p. 86.
[33] *ВФ*, No. 4, 1955, p. 147; *Автоматика и телемеханика*, No. 7, 1959, p. 999; *ФВК*, p. 86.
[34] *ФВК*, p. 227.

According to Soviet Marxists only dialectical materialism can provide the most general laws of development of the natural world and the human social order, and this assertion is in harmony with Engels' definition of dialectics as "the science of the most general laws of *all* motion." These general laws of motion are the triadic Hegelian laws of thought: the law of the transformation of quantity into quality and vice versa, the law of the unity and the struggle of opposites, and the law of the negation of the negation. The Hegelian laws are supposed to be abstracted from nature, human society, and thought and to reflect the most general interconnections found in nature, society, and thinking.[35] As a result, in respect to cybernetics Soviet Marxists were forced to conclude that at best it was much more narrow in its spectrum of applicability than dialectical materialism. Furthermore, it was agreed that the theory of control and communication could not be construed as a form of materialist philosophy although it might have implications for philosophy.[36]

Having thus decided that cybernetics was not a philosophy, Soviet Marxists proceeded to explore the uniqueness of Wiener's new and burgeoning science in order to determine whether or not it merited a title to separate existence. Undoubtedly many Soviet scientists saw in cybernetics and the traditional theory of control and communication a duplication of effort since the traditional theory was well established before Wiener's entrance into this area. Nonetheless, Z. Rovensky, A. I. Uemov, and E. K. Uemova admitted that, although cybernetics included the fields of physics, biology, mathematics, electronics, and sociology, its uniqueness lay in the fact that it was not a part of any of these branches of science.[37] B. S. Ukraintsev also recognized that cybernetics impinged on several areas of science, yet agreed in principle that cybernetics had its own subject matter.[38] Iu. I. Sokolovsky believed it wiser to discuss the sphere of influence of cybernetics rather than its content.[39] In the opinion of Anisimov and Vislobokov cybernetics achieved the status of a special science when Wiener compared electronic networks with nervous systems; they stated that the real problem of cybernetics arose not in relation to automation but in relation to physiology, psychology, linguistics, and economics.[40] But the consensus among Soviet scholars now is that cybernetics is a separate science primarily concerned with the processes of controlling and directing the

[35] F. Engels, *Dialectics of Nature* (Moscow, 1954), p. 353; Engels, *Anti-Dühring* (Moscow, 1954), pp. 195, 510; В. М. Ковалгин, *Диалектический материализм о законах науки* (Minsk, 1958), pp. 88 ff.; М. Н. Руткевич, *Диалектический материализм* (Moscow, 1959), p. 280.

[36] *ВФ*, No. 5, 1960, p. 54; *ФВК*, pp. 25, 169, 231.

[37] З. Ровенский *et al.*, *Машина и мысль (Философский очерк о кибернетике)* (Moscow, 1960), p. 56.

[38] In *ФВК*, p. 111.

[39] Ю. И. Соколовский, *Кибернетика настоящего и будущего* (Kharkov, 1959), p. 21.

[40] *Коммунист*, No. 2, 1960, p. 108.

storage, transmission, and reworking of information in the machine and the biological organism.[41]

Soviet philosophers have not as yet established to their own satisfaction any clear relationship between Wiener's theory and the other sciences, nor have they sharply delineated the area of operation for cybernetics.[42] Part of the difficulty in ascertaining the scientific status of cybernetics is rooted in the Soviet Marxist adherence to the scheme of the classification of science devised by Engels. He divided knowledge into the three traditional spheres of the exact physical sciences, the descriptive biological sciences, and the historical social sciences. (The theory of control and communication is involved in all three areas of learning.) Engels conceived the division of the sciences in terms of the forms of motion exhibited by the objects under investigation.[43] He wrote: *"Classification of the sciences,* each of which analyzes a single form of motion, or series of forms of motion that belong together and pass into one another, is therefore the classification, the arrangement, of these forms of motion themselves according to their inherent sequence, and herein lies its importance."[44] Thus, mechanics is derived from a study of celestial and terrestrial motion, physics and chemistry from molecular motion, and the plant and animal sciences from organic activity. Cybernetics, if defined as the general laws of control and direction in machine, organism, and society, simply does not neatly fit into Engels' scheme. The Rumanian scholar I. N. Belenescu pinpointed the following characteristics of matter in motion: (1) all motion exists in time and space; (2) all forms of motion involve the interactions of things and events; and (3) all forms of motion contain within themselves contradictions and a unity of contradictions, and a unity of continuity and noncontinuity. In his estimation Wiener's cybernetics did not possess any particular form of motion of its own; therefore, it could not be treated as a science in the same sense as physics, chemistry, or biology.[45] Pursuing Belenescu's thinking to its logical conclusion, Ukraintsev, in 1961, did not anticipate that cybernetics would make any new discoveries or establish any new laws of moving matter.[46] Strictly speaking, in the Soviet Union cybernetics cannot be treated as a singular scientific discipline unless Engels' approach to the classification of the sciences is abandoned.

At the heart of the problem of classifying cybernetics is the concept of information. Wiener's statement that "information is information, not matter or energy," is categorically rejected by Soviet philosophers.

[41] *Философские проблемы современного естествознания* (Moscow, 1959), pp. 237 ff.; Кольман, *Кибернетика,* p. 13; *ФВК,* pp. 26, 97, 112 ff., 180, 182, 228.

[42] Кольман, *Кибернетика,* p. 13; *ВФ,* No. 4, 1957, p. 158.

[43] *Anti-Dühring,* pp. 123-27; *Dialectics of Nature,* pp. 326-39.

[44] *Dialectics of Nature,* p. 330.

[45] *ВФ,* No. 3, 1957, p. 161.

[46] In *ФВК,* p. 111.

For a science to be materialist in the eyes of the Marxist-Leninist dialecticians it must reveal some link with material substances or energy (and energy is presumed to be a special form of moving matter). The general Soviet position is that information is connected with material processes as thinking is connected with the brain. It is inconceivable to most Soviet Marxists that information can exist without the presence of physical activity.[47] F. P. Tarasenko has gone so far as to say that information is a property of matter and connected with matter.[48] In agreement with other Soviet authors, he believes that the signal is the material carrier of information. And P. K. Anokhin has equated the theory of information with the theory of signals.[49] I. B. Novik not only regards information as a product of matter but has attempted to link cybernetic information with Lenin's epistemological theory of reflections (sensations and concepts are "reflections" or "copies" of material objects).[50] As a consequence of the materialistic conception of information Soviet cybernetics concentrates on the physical systems of control and direction.

To complicate the situation further, information is not only a product of physical activity, but it also has a mathematically structured form. The mathematical features of the theory of information are fully recognized by Soviet scientists and philosophers.[51] Both mathematics and the theory of information are used to establish quantitative relationships of physical processes, but neither discipline per se contributes any laws governing the various forms of moving matter. Where do mathematics and the theory of information fit into Engels' classification of the sciences? Unfortunately for the Soviet philosophers, Engels offered no ready-made answers on the nexus of mathematics to the edifice of science. However, he postulated the existence of a science dealing with the laws of human thought and limited this science to logic and dialectics.[52] It can be argued that mathematics is a form of logic, and the same can be said for the theory of information. Nevertheless, Soviet Marxists seemingly eschew this issue of classifying mathematics as a science of thought. What is more, Soviet dialectical materialists refuse to concede that the theory of information is as extensive in application as dialectical thought. Despite the fact that cybernetics defies classification within the framework of Engels' dialectical materialism, its development in Soviet Russia is closely associated with the mathematicians and is considered an offspring of mathematics.

[47] *Коммунист,* No. 2, 1960, p. 116; *ФВК,* p. 115.
[48] *ВФ,* No. 4, 1963, p. 78.
[49] *ВФ,* No. 4, 1957, p. 153.
[50] Новик, *Кибернетика,* pp. 58 ff.
[51] Кольман, *Кибернетика,* p. 13; *Коммунист,* No. 2, 1960, p. 110; *Научные доклады высшей школы, Философские науки,* No. 3, 1959, p. 110; *Вестник Академии наук СССР,* No. 9, 1957, p. 39; *Философские проблемы современного естествознания,* p. 237; *ФВК,* p. 8.
[52] *Anti-Dühring,* p. 127.

The one area of philosophic inquiry that has attracted special Soviet attention concerns the similarities and differences between man and his machines, between living tissue and electronic circuitry. The question as to whether or not an electronic calculating machine can be constructed to reproduce the processes of the human brain has generated considerable discussion among Soviet scientists and philosophers. The starting point of this discussion was the imputation to man-made machines, on the part of some Western writers, of the human-like experiences of thinking, remembering, problem-solving, creating, talking, and so on. It was acknowledged that cybernetics had forced a reexamination of many concepts and definitions of human behavior. While Soviet intellectuals generally agree that some of the operational features of electronic calculating machines *simulate* human behavior, they almost invariably stress that human beings and machines are entirely dissimilar from the structural point of view, for the following reasons: man possesses consciousness, a machine does not; thinking is solely the product of the biological world and not evident in the mechanical world; organic processes differ qualitatively from machine processes; and human thinking and activity operate under social, psychological, and physiological laws, whereas the machine operates under physical laws. From the dialectical materialist position no "equals" sign can be placed between man and machine.[53]

The nearly unanimous negative stand of the Soviet cyberneticians and philosophers on the question whether or not machines think is best understood against the background of the great philosophic controversies of the 1920s between the mechanistic materialists and the Hegelian dialecticians. In 1926 at the Institute of Scientific Philosophy a discussion was held on Bergson's philosophy, vitalism, and reductionism. The Russian mechanistic materialists took the position that it was within the realm of possibility to reduce biological phenomena to the laws of chemistry and physics. The Hegelian Marxists denounced reductionism on the dialectical grounds that there are qualitative, and not merely quantitative, differences between living and nonliving matter. Engels himself wrote in *Dialectics of Nature* that the mechanical conception of nature "explains all change from change of place, all qualitative differences from quantitative ones, and overlooks that the relation of quality and quantity is reciprocal, that quality can become transformed into quantity just as much as quantity into quality, that, in fact, reciprocal action takes place."[54] And he also stated that a living organism is "*the higher unity which within itself unites mechanics,*

[53] *ВФ*, No. 3, 1956, p. 119; *Философские проблемы современного естествознания*, p. 259; *Коммунист*, No. 2, 1960, p. 111; *Наука и жизнь*, No. 2, 1960, p. 41; *ВФ*, No. 2, 1961, p. 103; No. 1, 1963, p. 36. It is interesting to note that a philosophically minded Russian chemist, I. Orlov, raised similar objections in 1926 to a "thinking" machine demonstrated by Professor Shchukarov; see *Под знаменем марксизма*, No. 12, 1926, pp. 72 ff.

[54] *Dialectics of Nature*, p. 335.

physics, and chemistry into a whole where the trinity no longer can be separated."[55] The Russian Hegelian dialecticians did not deny that biological processes contained simpler forms of motion, but they refused to assent to the notion that biological activity was the summation of chemical and physical forms of motion.[56] There is little to indicate that Soviet thinkers have deviated from the basic stand of Engels and the Russian dialecticians on reductionism. Soviet dialectical materialists of the current crop still support the conception of the unity of organic and inorganic processes whereby the more complex forms of motion have incorporated the simpler forms.[57] Although the question is seldom discussed, the Soviet Marxists apparently advocate a *hierarchic order of natural laws* in which the higher forms of moving matter are produced from lower forms with an accompanying qualitative change.

Few in the Soviet Union openly deny the validity of applying cybernetic concepts to both the physical and biological sciences. But this in turn introduces the ticklish question of explaining how cybernetics bridges the gulf between the living and the nonliving without damaging the dialectical approach to reductionism. Thus, in a 1960 paper L. A. Petrushenko acknowledged not only that cybernetic terminology is employed in describing systems of control and direction in the living organism as well as the automated device but also that the principle of feedback and the theory of information are of vital importance in comprehending the operations of both the nervous system and the cybernetic machine. He was impressed with the universal nature of the process of feedback and designated it as the "motion of regulation" having the helically cyclical direction of dialectical motion itself.[58] Inasmuch as dialectical motion is evidenced throughout the natural world, it can be presumed that the "motion of regulation" is also ubiquitous.

D. N. Menitsky presented a more orthodox dialectical analysis of cybernetics as the bond between the biological and the exact sciences.[59] He asked whether there can be principles common to physics and biology. According to dialectical materialism each science exists because it isolates a facet of nature and studies a particular form of the movement of matter, but nature itself is not composed of isolated parts. It is in the interconnectedness of natural phenomena that general principles arise—otherwise how can the fields of biomechanics, biophysics, and biochemistry be justified? As for cybernetics, Menitsky stated, "its meth-

[55] *Ibid.*, pp. 331-32.

[56] *Правда*, Aug. 1, 1926; *Под знаменем марксизма*, No. 9-10, 1926, pp. 89 ff.; А. Столяров, *Диалектический материализм и механисты (наши философские разногласия)* (Leningrad, 1930).

[57] *Коммунист*, No. 2, 1959, p. 105; *Философские вопросы физики и химии*, No. 1, 1959, p. 63; *Наука и жизнь*, No. 2, 1960, p. 41.

[58] *Вестник Ленинградского Университета, Серия экономики, философии и права*, No. 17, 1960, p. 76.

[59] *Biophysics* (USSR), No. 2, 1957, p. 143.

ods, built on mathematical logic, study only general principles without going into the qualitative characteristics of different phenomena." Consequently cybernetics was not directly identified with either the organic or the inorganic forms of matter. This thesis was shared by Academician A. I. Berg.[60] In classifying cybernetic notions under the heading of general principles, the problem of reconciling cybernetic concepts in terms of reductionism becomes irrelevant.

Another aspect of cybernetics which at first glance does not seem to conform to the dialectical attitude toward reductionism is the utilization of cybernetic physical models in explaining biological processes. The comparison of electronic systems with nervous systems is standard procedure in the Soviet Union.[61] Soviet cyberneticians and philosophers, however, severely circumscribe the applicability of physical concepts to biological phenomena. (Both Wiener and the French writer L. Couffignal have been criticized for equating the neuron with the relays of computers, and the nervous system with the diodes of electronic machines.)[62] Cybernetic models are regarded at most as analogous to, but never identical with, biological operations. The Soviet scientist I. T. Frolov has remarked that cybernetic models have heuristic value but are limited because they oversimplify complex biological systems.[63] The Marxist philosopher B. S. Ukraintsev is convinced that analogies, no matter how useful, are methodologically unreliable in scientific research.[64] E. Kolman considers cybernetic models valid only if they are treated as approximating the nervous system; the use of physical models for the biological sciences is proper, he maintains, inasmuch as biology studies a form of matter in motion and all matter is subject to *physical* laws but this in no sense implies that biology is reducible to physics.[65]

The fact that cybernetic principles and models are operative in organic and inorganic matter is attractive from the dialectical materialist point of view, for Soviet philosophers believe that Wiener's science of control has administered the *coup de grâce* to vitalism.[66] Unlike vitalism, it is argued, dialectical materialism and cybernetics reveal that the living and nonliving worlds are closely interrelated and that living matter contains within itself lower forms of motion. Furthermore, both dialectical materialism and cybernetics affirm the materiality of life processes and do not postulate any mystical *élan vital* separating the organic from the inorganic. Soviet cybernetics, then, is treated not in

[60] In *ФВК*, pp. 159 ff.

[61] *ВФ*, No. 4, 1957, p. 142; No. 8, 1958, p. 92; No. 2, 1961, p. 39; No. 10, 1961, p. 92; No. 8, 1962, p. 78; *ФВК*, pp. 123, 262-305, 338-45; *Правда*, April 6, 1962.

[62] *ВФ*, No. 3, 1957, p. 154.

[63] *ВФ*, No. 2, 1961, pp. 39-51.

[64] In *ФВК*, p. 123.

[65] Кольман, *Кибернетика*, pp. 31 ff.

[66] *Наука и жизнь*, No. 2, 1960, p. 41; *Вестник Ленинградского Университета, Серия экономики, философии и права*, No. 17, 1960, p. 86; *ВФ*, No. 2, 1963, p. 70.

terms of a triumph for either vitalism or reductionism but rather as a confirmation of the dialectical teaching of the interconnectedness and interpenetration of nature.

Too often Western observers of the Soviet scene have been inclined to regard ideological pronunciamentos hostile to a given scientific theory as amounting to a death warrant for that theory in the Soviet Union. Such a view generally overrates the role of the Marxist ideologist as an arbiter of Soviet science. Too often, also, Soviet ideologues have rejected a Western scientific theory not because of its scientific content but because of the philosophic conclusions associated with it. This view overrates the significance of the speculative, sensationalist, and often quite shallow statements appearing in the popular Western press. What *has* proved to be a source of continuing embarrassment to Soviet philosophers is that the scientific theories they have condemned as irreconcilable with dialectical materialism are subsequently accepted as confirming and enriching dialectical materialist doctrines. Such Western scientists as Einstein, Heisenberg, Pauling, Wiener, and others, who are at first censured as idealists, obscurantists, and mystics by Soviet nihilistic Marxists, are later credited by Soviet authorities with having made substantial contributions to science. These inconsistent Soviet practices respecting Western science have tended to debase dialectical materialism in Western eyes as a philosophy of science.

A major factor contributing to the ambivalent attitude of the Soviet Marxists toward science is their use of nonscientific criteria in evaluating the correctness or incorrectness of any scientific theory. Soviet philosophers and ideologues have been known to attack Western scientific theories because of a scientist's personal philosophy, his political outlook, his class background, or his lack of adherence to the dialectical propositions on nature and reality. To this day there is no definite and uniformly accepted Soviet formula on the relationship of dialectical materialism to the exact sciences, other than general statements that have little, if any, value in solving the real and practical problems of science. There is no Soviet philosophic substitute for mathematical and laboratory procedures as a means of ascertaining the validity of a scientific hypothesis. As long as Soviet Marxists employ a multiplicity of nonscientific standards in judging the truth of a scientific theory, and as long as the relationship between dialectical philosophy and the natural sciences is not elucidated concretely, there is bound to be uncertainty surrounding the application of dialectical materialism to the sciences.[67]

While cybernetics was ridiculed by some Soviet writers, work on symbolic, mathematical, and constructive (intuitional) logic continued

[67] See my "Lenin on the 'Party' Nature of Science and Philosophy," in *Essays in Russian and Soviet History* (New York, 1963), pp. 164-76; "[Soviet] Philosophy and Science," *Survey*, No. 52, 1964, pp. 147-56.

virtually unimpeded during the 1930s and 1940s, especially by Markov, Shanin, Novikov, and Kolmogorov. As early as 1934 the Soviet Academy of Sciences had organized a commission on remote control and automation. The year 1936 witnessed the introduction of the journal *Avtomatika i telemekhanika.*[68] In 1950 the Institute for Precision Mechanics and Computer Technology came into existence; its chief function was to develop the practical aspects of programming. And it took three volumes to record the reports made in 1953, at the Second All-Union Conference on the Theory of Automatic Regulation, on the progress of automation and cybernation from 1940 to 1953. Excellent textbooks on servomechanisms and control systems were written by B. S. Sotskov (1950), G. A. Shaumian (1952), and E. P. Popov (1956).[69] Thus, in fact, Soviet scientists were at work furthering automation and cybernetic technology at a time when symbolic logic and cybernetics were ostensibly under an ideological cloud.

After 1954 it was effectively argued by knowledgeable Soviet philosophers and scientists that cybernetics had never really been rejected on dialectical materialist grounds. As Soviet writers have themselves revealed, those who denied that cybernetics was a science did so out of ignorance and not out of philosophic considerations. The ideological campaign waged by Zhdanov was primarily an attempt to assert the superiority of the Soviet socialist system over the bourgeois West; it hardly merits attention as a *philosophic* campaign of profound significance for the Soviet sciences. Unless one equates Soviet ideology with dialectical materialism, there is little to support the contention that Wiener's scientific theory of control and information was rejected on strictly philosophic grounds.

What has been the result of the interaction of dialectical materialist philosophy with Soviet cybernetics? Most important philosophically is the fact that Soviet Marxists and scientists have managed to demonstrate the flexibility of dialectical materialism and its compatibility with cybernetics. Although Academician Berg assures us that "Soviet cybernetics is an independent science which rests on the philosophy of dialectical materialism,"[70] Soviet dialecticians by and large have displayed no overt or direct influence on the evolution of the theory of control, communication, and information or on the mathematical and scientific problems connected with contemporary cybernation in the Soviet Union. Most Soviet philosophic analysis has been focused on the definitional and philosophic aspects of cybernetics. Soviet dialectical

[68] *Вестник Академии наук СССР*, No. 2, 1936, p. 64; А. А. Воронов, *Элементы теории автоматического регулирования* (Moscow, 1954), pp. 6 ff.

[69] *Труды второго всесоюзного совещания по теории автоматического регулирования* (Moscow and Leningrad, 1955); В. С. Сотсков, *Элементы автоматической и телемеханической аппаратуры* (Moscow and Leningrad, 1950); Г. А. Шаумиян, *Автоматы* (Moscow, 1952); Э. П. Попов, *Динамика систем автоматического регулирования* (Moscow, 1956).

[70] In *ФВК*, pp. 178-79.

materialism is adequate for resolving certain epistemological and philosophical questions arising from the interpretations of scientific knowledge, but it is ill suited for establishing the truth of modern scientific theories. However, in the dialectical materialist storehouse there is the tenet that practice is the ultimate criterion of truth, and this tenet ultimately saves dialectical materialism from degenerating into a sterile body of first principles for weighing scientific truth.[71] Because cybernetics has proven its efficacy in actual practice, this science is assured the continued support of the Soviet Communist Party. And because of the criterion of practice Soviet Marxists had no choice but to reconcile cybernetics with dialectical materialist doctrines.

[71] Every important Soviet textbook on Marxism-Leninism has a section devoted to practice as the criterion of truth; see V. I. Lenin, *Materialism and Empirio-Criticism* (Moscow, 1952), pp. 136 ff.; Ф. В. Константинов *et al., Основы марксистской философии* (Moscow, 1960), pp. 320 ff.; *Fundamentals of Marxism-Leninism* (Moscow, 1963), pp. 109 ff.