

“Russian Scandals”: Soviet Readings of American Cybernetics in the Early Years of the Cold War

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“Russian scandal” is a parlor game in which players sitting in a circle pass a message from one to another by whisper and finally observe how it has been transformed.

In May 1913 a young British psychologist named Frederic Bartlett participated in a series of experiments on visual perception in the newly opened Laboratory of Experimental Psychology at Cambridge University. “I was fascinated,” he wrote, “by the variety of interpretations which different people then achieved, all of which they said they ‘saw,’ of the same diagrams and pictures” shown to them by the experimentalist.¹ Dissatisfied with the accepted “exact” experimental technique, which relied on recollection of lists of nonsense syllables, Bartlett was looking for a new method of studying human memory. He was convinced that memory was a social and cultural phenomenon and wanted cultural associations and behavioral patterns to play a role in the experiment. At that moment, he met Norbert Wiener, a fresh eighteen-year-old Ph.D. from Harvard, who arrived in Cambridge to study mathematical logic with Bertrand Russell. Later Bartlett recalled:

We became close friends and had tremendous arguments with one another. One day, when I had been talking about my experiments ... he said: “Couldn’t you do something with ‘Russian Scandal’ as we used to call it?” That was what led to the method I later called “The Method of Serial Reproduction,” one which, in varied form, was to contribute much to the final working out of my experiments.²

I wish to thank Loren Graham, Elizabeth Wood, the participants of the Russian/East-European History Workshop at Harvard University, and the anonymous reader of *The Russian Review* for their helpful suggestions and criticism.

¹Sir Frederic Bartlett, *Thinking: An Experimental and Social Study* (New York, 1958), 139.

²*Ibid.*, 144.

Bartlett eventually developed an experimental procedure much similar to the parlor game to which Wiener referred. The first subject would read some exotic story, and after fifteen to thirty minutes try to reproduce it as precisely as possible; then the second subject would read this reproduction and write down the next version, and so on. A chain of reproductions led to most remarkable transformations of the original story. At first Bartlett gave his subjects an Indian folk story filled with supernatural events and mysterious occurrences, which followed one another without any clear logic or causation. After a series of transformations, the story became much more coherent, the supernatural elements disappeared, and causal links were added. The story turned into an ordered, rationalized account of events, much more typical for the Western culture in which Bartlett's subjects lived.

In another set of experiments, Bartlett used a passage from Wallace's *Darwinism*, which articulated a complicated argument using special biological terminology. Bartlett discovered that

educated subjects are likely to understand and remember astonishingly little of any scientific subject concerning which they have been given no specialized training. Here ... statements are promptly converted into their opposite, the title disappears, proper names are changed. Between the original and the final reproduction there is no obvious link of connexion.³

Again, after a series of reproductions the original text was gradually transformed into something more comprehensible to the experimental subjects. They retained the details that made sense to them and omitted or distorted everything else. From his experiments with "Russian scandals," Bartlett concluded that remembering was determined by "schemes," or cultural patterns characteristic of a larger social group.

In 1947, Wiener again visited Bartlett, now one of the leading British psychologists, in his Cambridge laboratory. At that time, Wiener was actively researching a new field he named "cybernetics." Drawing upon his wartime experience with designing an anti-aircraft predictor, he established parallels between the operation of servomechanisms, analog control devices used in anti-aircraft gunnery, and purposeful behavior of pilots and gunners: in both cases, the goal was being reached via a feedback mechanism. Other wartime projects gave rise to information theory, which established an analogy between transmission of encoded signals in communication engineering and exchange of messages in human communication, and to the stored-program electronic digital computer, which was often compared to the human brain, both structurally and functionally. Synthesizing and universalizing these perspectives, Wiener postulated that control via feedback and communication via information exchange constituted universal mechanisms of purposeful behavior for both living organisms and self-regulating machines, such as servomechanisms and computers.⁴ In 1948 he published his famous book, *Cybernetics, or Control and Communication in the*

³Frederic C. Bartlett, *Remembering: A Study in Experimental and Social Psychology* (Cambridge, England, 1932), 168.

⁴On Wiener and the origins of cybernetics see Steve Heims, *John von Neumann and Norbert Wiener: From Mathematics to the Technologies of Life and Death* (Cambridge, MA, 1980); and Pesi Masani, *Norbert Wiener, 1894–1964* (Basel, 1990).

Animal and the Machine, which immediately attracted great public attention in the West. The *Saturday Review of Literature* wrote that it appeared "impossible for anyone seriously interested in our civilization to ignore this book. It is a 'must' book for those in every branch of science." Newspapers and popular magazines extolled the advent of a new age of self-regulating machines, hailing Wiener as its "prophet." Eager to apply his ideas to new fields, Wiener quickly translated Bartlett's current work into the cybernetic language, describing it as a study of "the human element in control processes."⁵ "Russian scandals" thus found a place within cybernetics.

In the Soviet Union, however, cybernetics itself became the subject of a true "Russian scandal." Literally, in Soviet public discourse in the early years of the Cold War cybernetics acquired the scandalous reputation of a "modish pseudo-science." Figuratively, the mechanism of a Soviet anticybernetics campaign resembled the "Russian scandal" game, for it involved profound discursive transformations, similar to those in Bartlett's experiments. While this campaign has been traditionally viewed as an intentional product of human agency (in this case, the party and government agencies), this article will attempt to interpret it as a sequence of events spontaneously generated by self-perpetuating Cold War propaganda discourse.

POSTWAR IDEOLOGICAL CAMPAIGNS IN THE SOVIET UNION

Soviet scientists in the early years of the Cold War faced a fundamental dilemma. On the one hand, the Soviet leadership instructed them "to overtake and surpass" Western science; on the other, party ideologues urged them to rely on distinct national scientific traditions. Western science stood as a yardstick against which their progress was measured; at the same time, Western scientific developments were portrayed in public discourse as a source of alien ideology. As David Joravsky has put it, "however inconsistently, the Stalinist mentality laid both demands on scientists, to be true to their own Russian knowledge and to surpass Westerners in universal knowledge; to take a rock-solid stand in the native monolith and to be as disputatiously creative as scientists in the West."⁶

Soviet scientists chose different strategies to overcome this impasse. Some discarded much of contemporary Western science and attempted to build a distinct, ideologically superior national approach. Others ingeniously split Western scientific theories into two parts: the "objective content" and the "philosophical interpretation." They creatively reinterpreted Western theories both scientifically and philosophically, trying to rescue the "essential" elements and sacrifice only the "dispensable" ones. They freely criticized and rejected the latter, while safely adopting and further developing the former. What gradually emerged was a popular image of Western science as a centaur with a solid body of scientific facts and an ugly bourgeois face.

American cybernetics in a Soviet context similarly split into two disconnected entities—a set of useful techniques and technologies, quickly adopted by the military, and an

⁵Norbert Wiener, *Cybernetics, or Control and Communication in the Animal and the Machine*, 2d ed. (Cambridge, MA, 1961), 23.

⁶David Joravsky, *Russian Psychology: A Critical History* (Oxford, 1989), 406.

ideological monster, pounded by the professional “soldiers of the ideological front.” The two incarnations of cybernetics lived their separate lives, almost never crossing their ways. One hid underground in the top-secret world of military computing and command-and-control systems, while the other ran freely across the pages of the central press.

A brief enumeration of public attacks on cybernetics in the Soviet press in the first half of the 1950s gives the impression of a well-orchestrated campaign. In May 1950 *Literaturnaia gazeta*, without naming cybernetics, published an article that listed Wiener among the “charlatans and obscurantists, whom capitalists substitute for genuine scientists,” and called the computer hype in the United States a “giant-scale campaign of mass delusion of ordinary people.”⁷ In a 1951 book published by the Academy of Sciences Institute of Philosophy, cybernetics was placed under the rubric of “semantic idealism,” and cyberneticians were branded “semanticists-cannibals.”⁸ In April 1952 *Literaturnaia gazeta* attacked cybernetics in a separate article, entitled unambiguously, “Cybernetics—a ‘Science’ of Obscurantists.”⁹ After that, a flood of anticybernetics articles filled newspapers, scholarly journals, and popular magazines, whose content was well reflected in their titles, such as “Cybernetics—An American Pseudo-Science,” “The Science of Modern Slaveholders,” and “Cybernetics—A Pseudo-Science of Machines, Animals, Men and Society.”¹⁰ In 1954 cybernetics was defined as a “reactionary pseudo-science” and “a form of modern mechanicism” in a new edition of the *Short Philosophical Dictionary*, a standard ideological reference for Soviet scholars.¹¹ Historians have traditionally assumed that these attacks reflected an officially sanctioned negative attitude toward cybernetics as a doctrine fundamentally incompatible with dogmatic Soviet philosophy of science.¹² I would argue, however, that the conflict between cybernetics and Soviet philosophy was a product, not the cause, of the anticybernetics campaign. The Soviet image of American cybernetics as an ideological enemy was shaped by the Cold War political context; it is in this context, rather than in any essential features of cybernetics itself, one should look for the origins of this campaign.

Cybernetics came under attack in the Soviet Union on the wave of fierce ideological disputes, which in the late 1940s and early 1950s spread across various fields of culture, as well as such academic fields as philosophy, logic, mathematics, physics, astronomy, chemistry, genetics, linguistics, political economy, and physiology.¹³ These disputes, often

⁷Boris Agapov, “Mark III, kal’kuliator,” *Literaturnaia gazeta* (4 May 1950): 2–3.

⁸Mikhail G. Iaroshevskii, “Semanticheskii idealizm—filosofiiia imperialisticheskoi reaktsii,” in *Protiv filosofsviuiushchikh oruzhenostsev amerikano-angliiskogo imperializma*, ed. Teodor I. Oizerman and Pavel S. Trofimov (Moscow, 1951), 100.

⁹Mikhail Iaroshevskii, “Kibernetika—‘nauka’ mrakobesov,” *Literaturnaia gazeta* (5 April 1952): 4.

¹⁰See Bernard E. Bykhovskii, “Kibernetika—amerikanskaia lzhenauka,” *Priroda*, 1952, no. 7:125–27; idem, “Nauka sovremennykh rabovladel’tsev,” *Nauka i zhizn’*, 1953, no. 6:42–44; and Teodor K. Gladkov, “Kibernetika—pseudonauka o mashinakh, zhivotnykh, cheloveke i obshchestve,” *Vestnik Moskovskogo Universiteta*, 1955, no. 1:57–67.

¹¹“Kibernetika,” in *Kratkii filosofskii slovar’*, ed. Mark Rozental’ and Pavel Iudin (Moscow, 1954), 236.

¹²See Richard D. Gillespie, “The Politics of Cybernetics in the Soviet Union,” in *Scientists and Public Affairs*, ed. Albert H. Teich (Cambridge, MA, 1974), 239–98; and Lee Kerschner, “Cybernetics: Key to the Future?” *Problems of Communism* 14 (November–December 1965): 56–66.

¹³For an excellent account of ideological debates in various disciplines see Loren R. Graham, *Science, Philosophy, and Human Behavior in the Soviet Union* (New York, 1987).

referred to as "ideological campaigns," followed one another with machine-like regularity, which suggested an underlying pattern. Contemporaries often took for granted that these campaigns originated at the top of the party hierarchy and then spread downwards according to a carefully planned scenario. Historical accounts not infrequently trailed such perceptions and described postwar ideological campaigns as carefully planned, directed from above, and executed in accordance with party guidelines:

Stalinist ideological campaigns usually unfolded by the same scheme. The groundwork is laid by individual remarks by the Boss and his trusted lieutenants, which signal, in a comparatively restrained form, the upcoming operation. At the second stage, meetings at the Central Committee are held, where activists assemble and listen to instructive pogrom-like speeches, initiated and occasionally personally delivered by Stalin. Then a decision follows, in the form of a resolution of the Central Committee, its Secretariat, or its Organizational Bureau, or as an editorial in *Pravda*. On this basis, a witch-hunt starts, involving vociferous denunciation in the press, a search for new enemies, administrative measures, and occasionally purges and arrests. Then follows a certain retreat, the campaign is wrapped up, and some merciful gestures ensue, which can emanate only from the Boss himself. His role as a charismatic leader is timely to step in and stand up for the unjustly persecuted; sometimes he can even punish some of the overzealous executors. A period of calm follows, preparing ground for a new campaign.¹⁴

The very regularity of campaign patterns was often taken for a sign of thorough planning, and chronological sequences of events were interpreted as causal chains. Such perceptions, based on the belief in the omnipotence of the Soviet state and the omniscience of its leaders, fit well with the "totalitarian model" of Soviet society. This model assumed a fundamental conflict between party authorities and scientists, and the campaigns, accordingly, were often interpreted as persistent attempts on the part of party authorities to subdue the intelligentsia and to place Soviet science and culture firmly under party control.¹⁵

Recent studies, based on newly available archival materials, have seriously questioned this top-down, purely confrontational model. New scholarship suggests that postwar campaigns often lacked coherence and coordination. Campaign participants displayed more independence and initiative than one would expect from mere diligent executors of the supreme will. The authorities, in turn, frequently seemed to be acting on contingency rather than executing some master plan. Instead of open conflict, party authorities and scientists were often engaged in negotiations, maneuvering, and skillful manipulation of the ongoing campaigns to their own ends. While the campaigns displayed great similarities in their ceremonies and rituals, they differed greatly in their origins, actual directions, and final outcomes.¹⁶

¹⁴Evgenii S. Gromov, *Stalin: Vlast' i iskusstvo* (Moscow, 1998), 395.

¹⁵See, for example, Alexander Vucinich, *Empire of Knowledge: The Academy of Sciences of the USSR (1917–1970)* (Berkeley, 1984).

¹⁶See Alexei Kojevnikov, "Rituals of Stalinist Culture at Work: Science and the Games of Intraparty Democracy Circa 1948," *Russian Review* 57 (January 1998): 25–52; and Nikolai Kremontsov, *Stalinist Science* (Princeton, 1997). On the role of formal rituals in Soviet political culture see J. Arch Getty, "Samokritika Rituals in the Stalinist Central Committee, 1933–38," *Russian Review* 58 (January 1999): 49–70.

The relationships between the party apparatus and the scientific community in the late Stalinist period are no longer seen as purely antagonistic; instead, some historians even describe these relationships as “symbiotic”: scientists often appealed to party authorities for support, while party leaders exploited scientific controversies to political ends.¹⁷ The most celebrated case of “party intervention” in Soviet science—the Lysenko controversy—illuminates the complexity of this issue. In July 1948, at a session of the Lenin All-Union Academy of Agricultural Sciences in Moscow, the notorious hack scientist Trofim Lysenko delivered his infamous address, “On the Situation in Biological Science,” which contrasted two “opposing and antagonistic” trends in biology—the Western-born “Weismannism-Mendelism-Morganism” and “our creative Michurinist Darwinism.” The former, the basis of modern genetics, he labeled unscientific, idealistic, metaphysical, reactionary, scholastic, feeble, and sterile; the latter, a variation on the Lamarckian idea of the inheritance of acquired characteristics, he praised as truly scientific, materialistic, creative, productive, and progressive, firmly resting on a foundation established by the Russian “founding father” Ivan Michurin. Caught in a fierce battle for the control over Soviet biological research and educational institutions, Lysenko tried to portray his opponents as enemies of Soviet ideology by stressing the Western origins of their approach and accusing the “Morganists” of philosophical and ideological deviations.¹⁸

Lysenko’s address was edited personally by Stalin, who had his own agenda in mind. While Lysenko was exploiting the rhetorical resources of party propaganda to advance his personal career, Stalin, in turn, used the genetics controversy as an occasion to bring the party line in science into accord with the unfolding Cold War. The thesis of unity of international science, popular during the wartime period of cooperation between the Allies, was dropped; instead, the idea of “two sciences” within each discipline was revived. In the 1920s and 1930s, Soviet Marxists had used the criterion of class to divide science into the “proletarian” and “bourgeois” kinds. Now a new criterion was introduced, which contrasted “progressive, socialist” science with its “reactionary, imperialist” opponent. Stalin thoroughly went over Lysenko’s manuscript and replaced the obsolete references to “bourgeois” scientific theories with the terms “idealistic” and “reactionary,” thus signaling a discursive turn from class-based analysis of science to the concept of “two worlds—two ideologies in science,” much more relevant to the tasks of Cold War propaganda.¹⁹

This major revision of ideological premises of public discourse on science in the spirit of the Cold War set an example for the rest of Soviet science. In August–December 1948 meetings discussing the new line were held in numerous research and educational institutions across all disciplines. Mathematicians and physicists, geologists and astronomers—all were now supposed to expose “idealistic and reactionary” elements in their academic fields. Campaign activists among the linguists, for example, closely imitated Lysenko by identifying “two trends in linguistics”: the late Soviet linguist Nikolai Marr was put

¹⁷Krementsov, *Stalinist Science*, 5–6.

¹⁸On the Lysenko controversy see David Joravsky, *The Lysenko Affair* (Cambridge, MA, 1970); Kremmentsov, *Stalinist Science*; Zhores A. Medvedev, *The Rise and Fall of T. D. Lysenko* (New York, 1969); and Valery N. Soyfer, *Lysenko and the Tragedy of Soviet Science*, trans. Leo Gruliov and Rebecca Gruliov (New Brunswick, 1994).

¹⁹Kirill Rossianov, “Editing Nature: Joseph Stalin and the ‘New’ Soviet Biology,” *Isis* 84 (December 1993): 728–45.

forward as the Michurin of linguistics, while Wilhelm von Humboldt and Ferdinand de Saussure were assigned the roles of Mendel and Morgan; the schools of comparative historical linguistics and structuralism were harshly condemned as "idealistic."²⁰ In 1949 these attacks were followed by a campaign against "cosmopolitanism" (a label denoting the ideological opposite of patriotism), which resulted in vicious anti-Semitic attacks and widespread expulsion of Jews, labeled as "rootless cosmopolitans," from cultural and academic institutions.²¹ As a result, a number of prominent Soviet scientists were forced out of their jobs and lost a chance to publish their works; their laboratories were often closed and research programs abandoned.²²

In June 1950, with yet another turn of the ideological screw, Stalin suddenly distanced himself from the "excesses" of policies he himself had previously actively promoted.²³ He published in *Pravda* a long article on the subject of Marxism in linguistics, severely criticizing the Marrist school and restoring the legitimacy of the internationally recognized comparative historical linguistics. Furthermore, he censured the practices of strict administrative control (the "Arakcheev regimes") in science, rejected the idea that one school could hold a monopoly on truth, and called for "freedom of criticism."²⁴ His authoritarian call for freedom, however, produced precisely the opposite: comparative linguistics immediately assumed a monopoly status, the comparativists were elevated to high positions, and a large-scale administrative persecution of the former Marrists began.²⁵

The active involvement of party organs and Stalin personally in postwar ideological campaigns in Soviet science, although quite conspicuous, was limited to a few chosen instances. Only in a handful of disciplines (biology, linguistics, political economy) did high-ranking party officials explicitly approve "ideologically correct" scientific theories. Every new campaign, however, spread quickly over the entire range of scientific disciplines, and scientists in all fields had to realign themselves in a new direction. How to apply the party line on linguistics, say, to mathematics, was by no means clear, and this left much leeway for campaign activists.

In the same way the party exploited the Lysenko affair for Cold War propaganda, campaign activists often brought into Stalinist campaigns their own agendas. National

²⁰See Ivan I. Meshchaninov, "O polozhenii v lingvisticheskoi nauke," and Fedot P. Filin, "O dvukh napravleniakh v lingvistike," both in *Izvestiia Akademii nauk SSSR. Otdelenie literatury i iazyka*, 1948, no. 6:4–16, and 488, respectively; and "O polozhenii v lingvisticheskoi nauke," *Vestnik Akademii nauk SSSR*, 1948, no. 12:71–74.

²¹See Gennadi Kostyrchenko, *Out of the Red Shadows: Anti-Semitism in Stalin's Russia* (Amherst, 1995).

²²See Vucinich, *Empire of Knowledge*, 210–47.

²³This strategy, which one might call "two steps forward, one step back," allowed Stalin to put the blame for the "excesses" on low-ranking officials and to portray himself as a savior. Compare Stalin's 1930 article, "Dizzy with Success," which condemned the "excesses" of forced collectivization, and his 1935 formula, "the son is not responsible for his father," announced after the completion of large-scale systematic deportations of "kulaks" with their entire families to Siberia.

²⁴Arakcheev supervised the introduction of military-type settlements in Russia circa 1820; his name was often associated with the idea of subjecting society to military discipline.

²⁵On the history of the Marrist school and the controversy over Marr's doctrine in Soviet linguistics see Vladimir M. Alpatov, *Istoriia odnogo mifa: Marr i marrizm* (Moscow, 1991); idem, "Marr, Marrism, and Stalinism," *Russian Studies in History* 34 (Fall 1995): 37–61; Mikhail V. Gorbanevskii, *V nachale bylo slovo: Maloizvestnye stranitsy istorii sovetskoi lingvistiki* (Moscow, 1991); and Yuri Slezkine, "N. Ia. Marr and the National Origins of Soviet Ethnogenetics," *Slavic Review* 55 (Winter 1996): 826–62.

campaigns opened a wonderful opportunity for some critics to settle scores with their personal foes and institutional rivals. The vast damage produced by these campaigns often resulted from the actions of local activists who jumped on a campaign bandwagon to reach their mundane career objectives. Campaign activists took great initiative in picking and choosing heroes and villains in their own fields, nominating candidates for the leading parts of ideologically acceptable native Russian “founding fathers” and their irreconcilable opponents, preachers of Western pseudo-science. Aiming at a particular group, critics would first trace some unfortunate Western ancestry in their opponents’ scientific ideas and label these ideas “idealistic.” They would then attack their foes for alleged philosophical errors, which in this context were virtually synonymous with political mistakes. While the critics declared that they aimed only at the adherents of “reactionary, idealistic pseudo-science,” in fact they often deliberately cast particular theories as “pseudo-scientific” to fit their targets.²⁶

Dialectical materialism, once a thriving and productive field of philosophical scholarship, under Stalin gradually “calcified” and was used as a philosophical cudgel.²⁷ The basic principles of dialectical materialism—realism, nonreductionism, the view of the material world as an infinitely complex, interconnected, and evolving whole, and the belief in the relative nature of human knowledge—were often subjected to most dogmatic interpretation.²⁸ Doctrinaire thinkers identified “the material world” with entities directly observable with contemporary scientific instruments; everything else, including genes, was labeled as the product of “idealistic” speculation. At the same time, the categories of dialectical materialism and the three laws of dialectics—the transition of quantity into quality, the unity and struggle of opposites, and the negation of the negation—acquired great “elasticity,” which made it possible to bend philosophical argument in any desired direction. After making numerous twists in attempt to catch up with the winding party line, Soviet philosophy of science finally degenerated into a complex rhetorical system, which combined ostentatious adherence to the canonical formulae of Marx and Lenin with extremely flexible techniques of cunning reinterpretation of those formulae to make them fit the political agenda of the day. Dialectical materialism became a convenient rhetorical tool for translating scholarly debates into ideological and ultimately political conflicts.

Since the conduct of postwar ideological campaigns was largely a matter of local politics, their outcome varied greatly from one discipline to another. While in biology and physiology they resulted in enormous personal and intellectual losses, in most other fields, despite much ideological noise, minimal administrative measures followed. The vociferous campaign against Pauling and Wheland’s resonance theory of valence in chemistry can serve as a telling example. Campaign activists condemned this theory on philosophical

²⁶Compare Marrists’ attacks on comparative historical linguistics, aimed largely at the leading Soviet comparativist Viktor Vinogradov, and the orthodox Pavlovians’ assault on the “deviations from the Pavlov teaching,” pointed chiefly at Leon Orbeli, Pavlov’s influential successor (Kojevnikov, “Rituals of Stalinist Culture,” 46–47; Krementsov, *Stalinist Science*, 268–74).

²⁷See Loren R. Graham, *Science in Russia and the Soviet Union: A Short History* (Cambridge, England, 1993), 121.

²⁸On the history and principal ideas of dialectical materialism see Graham, *Science, Philosophy, and Human Behavior*, chap. 2; and David Joravsky, *Soviet Marxism and Natural Science, 1917–1932* (London, 1961).

grounds as “mechanistic” for allegedly reducing chemical phenomena to physical and mathematical laws, as well as “idealistic” for its supposedly speculative character. They duly contrasted it with the homegrown structural theory of the Russian “founding father” Aleksandr Butlerov. The most boisterous critics, however, gained no personal career advantage. No significant changes occurred in the Soviet chemical establishment; several exposed adherents of the resonance theory only temporarily lost their jobs or were suspended from teaching, while one of the most prominent targets of criticism, chemist Aleksandr Nesmeianov, after admitting his “errors,” was promoted to become president of the Academy of Sciences. Aleksandr Pechenkin argues that this campaign was nothing more than a ritual fulfillment of minimal ideological obligations on the part of Soviet chemists: “The theory of resonance and its adepts among Soviet scientists ... played the role of a sacrificial lamb. Soviet scientists performed a ritual dance, sacrificed one particular theory, without which, they believed, they could manage, and returned to their daily business.”²⁹

Rather than being victimized by Bolshevik ideology, both sides in most controversies skillfully manipulated ideological discourse and appealed to party authorities for support. Nikolai Kremontsov argues, for example, that the entire campaign against “reactionary and idealistic science” that followed Lysenko’s 1948 address was “largely initiated, orchestrated, and fine-tuned by the leadership of the scientific community itself” in their effort to elude party control and maintain their own authority, while paying no more than lip service to party rhetoric.³⁰ Furthermore, some scientists even managed to turn ideological campaigns into means of extracting more funding from the authorities under the banner of strengthening the “right trend” in science. Using the same ritual dance metaphor, Kremontsov writes: “Like rain dances performed by a shaman in the desert, the ‘dances’ performed by the scientific community aimed to call forth a golden rain from above and to avoid ‘the punishing hand’ of angry gods.”³¹ Instead of uniformly strengthening party control over science, postwar ideological campaigns thus often served scientists’ own purposes, which could significantly differ from the goals of the party leadership.

As an extreme case of the local transformation of a central goal, one could imagine an inadvertent campaign, one that was never planned at the top, but emerged on a large scale as an unexpected outcome of local initiative or misinterpretation. Contemporary observers, from whom the operations of the party apparatus were safely hidden, tended to regard each campaign as directed by the authorities and thus would not be able to distinguish an epiphenomenal campaign from a “real thing.” A series of public attacks on cybernetics in the first half of the 1950s, usually listed among party-sponsored ideological campaigns, seems to fall precisely under this rubric of epiphenomena.

²⁹Aleksandr A. Pechenkin, “Antiresonansnaia kompaniia v kvantovoi khimii (1950–1951 gg.),” *Filosofskie issledovaniia*, 1993, no. 4:373. On the “anti-resonance campaign” see also Graham, *Science, Philosophy, and Human Behavior*, 294–319.

³⁰Kremontsov, *Stalinist Science*, 194.

³¹*Ibid.*, 215.

THE CYBERNETICS “SCANDAL”

Soon after the formation of NATO in April 1949 the Cold Warriors in the Soviet Union stepped up their propaganda campaign. In spring 1949 the Central Committee’s Department of Propaganda and Agitation (Agitprop) drafted a “Plan for the Intensification of Anti-American Propaganda in the Near Future,” soon approved by the Central Committee Secretariat. The plan outlined a number of measures intended “to expose the aggressive plans of American imperialism,” “to debunk the myths of American propaganda about the ‘thriving’ of America,” and “to show the decay of bourgeois culture and morals” in the United States. The plan directed all major Soviet newspapers, including *Pravda* and *Literaturnaia gazeta*, and several popular literary magazines to publish on a regular basis articles on such topics as “The Degeneration of Culture in the USA,” “Cosmopolitanism in the Service of American Reaction,” “The Crisis of Education in the USA,” and “Science in the Service of American Monopolies.” No specific scientific discipline, except economics, was mentioned; such details were left entirely to the discretion of campaign participants.³²

Soviet journalists began a frantic search for stories that could fit the assigned topics. Recent sensational reports in the American press about the advent of automatic digital computers and the impending era of “thinking machines” gave Boris Agapov, the science editor of *Literaturnaia gazeta*, an idea. On 4 May 1950 *Literaturnaia gazeta* published his article, “Mark III, a Calculator,” which thoroughly ridiculed the computer hype in the United States. One memoirist has described Agapov as a “self-educated man, without any formal background in science and technology, but with fine intuition, good literary style, and an enormous capacity for mastering tasks.”³³ All these characteristics proved very handy in this case. In his article, Agapov confessed right away that he did not know much about Norbert Wiener, “except for the fact that he is already old (although still brisk), very fleshy, and smokes cigars.” Nevertheless, this scarce information sufficed for the imaginative journalist to make up all the rest. In a good literary style, Agapov mocked American businessmen who “love information as American patients love patented pills,” and dismissed the idea of using computers for processing economic information. He scoffed at the “sweet dream” of American capitalists to replace class-conscious workers with obedient robots and also regarded as laughable the “fantasies” of the Western military about replacing soldiers in the battlefield with “thinking machines.” Commenting on a cartoon depicting a computer dressed in military uniform on the cover of *Time*, he concluded: “It becomes immediately clear in whose service is employed this ‘hero of the week,’ this sensational machine, as well as all of science and technology in America!”³⁴ Although Agapov did not use the word “cybernetics,” his article had a profound impact on the reception of cybernetics in the

³²See “Plan meropriiatii po usileniiu antiamerikanskoi propagandy na blizhaishee vremia,” 1949, Rossiiskii gosudarstvennyi arkhiv sotsial’no-politicheskoi istorii (RGASPI), f. 17, op. 132, d. 224, ll. 48–52. See also D. G. Nadzhafov, “Antiamerikanskii propagandistskie pristrastia stalinskogo rukovodstva,” in *Stalinskoe desiatiletie khodnoi voiny: Fakty i gipotezy*, ed. A. O. Chubar’ian et al. (Moscow, 1999), 134–50.

³³Mark Kuchment, “Bridging the Two Cultures: The Emergence of Scientific Prose,” in *Science and the Soviet Social Order*, ed. Loren R. Graham (Cambridge, MA, 1990), 331.

³⁴Agapov, “Mark III, kal’kulator,” 3.

Soviet Union. Following its publication, the Lenin State Library in Moscow—the largest book collection in the Soviet Union—reportedly withdrew Wiener's *Cybernetics* from circulation.³⁵ This article thus played a critical discursive role, for it was evidently taken as a "signal" of the official negative attitude toward cybernetics.

In 1951 the term "cybernetics" made its first, and rather unfortunate, appearance in Soviet public discourse. As a weighty contribution to the anti-American propaganda campaign, the Institute of Philosophy published a collection of papers under the characteristic title, *Against the Philosophizing Henchmen of American and English Imperialism*. One of the papers, authored by psychologist Mikhail Iaroshevskii, was devoted to the critique of "semantic idealism." This term acquired currency in the vociferous campaign that followed Stalin's condemnation of the Marrist school in linguistics. Among the numerous sins Stalin had ascribed to the Marrists was "the overvaluation of semantics and its misuse," which supposedly "led to idealism."³⁶ The label of "semantic idealism" quickly traveled from anti-Marrist discourse into anti-American propaganda, and Soviet critics soon attacked semantics studies in the West for their supposed idealistic philosophical errors. Party bureaucrats began listing "semanticism" in their documents among other "reactionary philosophical 'shabby schools'" that American imperialism employed to "'justify' cosmopolitanism and American aggressive plans for attaining world hegemony."³⁷ Having first learned about cybernetics from a Western journal on semantics, Iaroshevskii unhesitatingly placed cybernetics under the rubric of "semantic idealism." He charged that Wiener shared with such "semantic obscurantists" as Bertrand Russell, Alfred North Whitehead, and Rudolf Carnap the reductionist claim that "thinking is nothing else than operations with signs." Wiener's well-known remark about the market devaluation of the human brain as a result of automation, which was apparently meant as a liberal critique of market values, was interpreted by Iaroshevskii as a misanthropic escapade. "From this fantastic idea," he wrote imaginatively, "semanticists-cannibals derive the conclusion that a larger part of humanity must be exterminated."³⁸

In the meantime, trying perhaps to distance their work from the ideologically suspect speculations about "thinking machines," two Soviet computer specialists sent to *Literaturnaia gazeta* a manuscript criticizing American cybernetics. The authors, Ekaterina Shkabara and Lev Dashevskii, were part of a small group working secretly in Kiev on the construction of the Small Electronic Calculating Machine (*Malaia elektronnaia schetnaia mashina*, or MESM), the first Soviet computer. They alleged that cybernetic analogies between the human brain and the computer were "reactionary," "methodologically harmful," and "aimed at reducing people involved in conscious social activity to the status of a mechanical automaton, a 'robot.'"³⁹ Physiologist Petr Anokhin favorably reviewed their article and added criticism from a physiological perspective, suggesting the need for a comprehensive article

³⁵Gelii N. Povarov, interview with author, Moscow, 17 July 1996.

³⁶Iosif V. Stalin, "Otvét tovarishchu E. Krasheninnikovoi" (1950), in Stalin, *Sochineniia*, ed. Robert H. McNeal, vol. 3 [XVI] (Stanford, 1967), 154.

³⁷Chesnokov and Makhov to Suslov, 2 September 1952, RGASPI, f. 17, op. 133, d. 285, l. 88.

³⁸Iaroshevskii, "Semanticheskii idealizm," 100.

³⁹See Petr K. Anokhin, "Zamechaniia po povodu retsenzii E. A. Shkabara and L. N. Dashevskogo na stat'iu o 'kibernetike'" (n.d.), Rossiiskii gosudarstvennyi arkhiv literatury i iskusstva (RGALI), f. 634, op. 3, d. 206, ll. 139–40. Shkabara and Dashevskii's article, unfortunately, did not survive in the *Literaturnaia gazeta* archive.

to criticize “specific cybernetic statements that contradict the common sense and the materialist understanding of the functioning of the human brain.”⁴⁰ Shkabara and Dashevskii’s manuscript looked too technical for the general reader, and the *Literaturnaia gazeta* staff passed it to Iaroshevskii, who enjoyed the reputation of a leading critic of American psychology, asking him to write a popular critique of cybernetics.

On 5 April 1952 Iaroshevskii’s article—the first Soviet publication devoted specifically to the critique of cybernetics—appeared in *Literaturnaia gazeta*. He reiterated Agapov’s earlier criticism of Western computing, seeing behind it merely the intentions to replace a proletarian striker with a robot and to substitute a human pilot who refused to bomb civilians with an “indifferent metallic monster”—only this time placing all this under the rubric of cybernetics. Iaroshevskii also added some philosophical errors to the list of cybernetics’ sins. Since he had earlier associated cybernetics with “semantic idealism,” he easily built his critique of cybernetics into the ongoing campaign against “reactionary, idealistic trends” in Western science. As an example of “idealism,” Iaroshevskii cited the method of checking calculations by running them simultaneously on two independent computing devices—a practice which, he alleged, derived the criterion of truth from computation alone. He concluded that cybernetics was a “modish pseudo-theory,” fabricated by “philosophizing ignoramuses” and “utterly hostile to the people and to science.”⁴¹

The authors of subsequent anticybernetics publications clearly interpreted Iaroshevskii’s article as a signal to start a full-blown anticybernetics campaign. Yet far from being a trusted party spokesman carrying out the important task of articulating the official line toward cybernetics, Iaroshevskii was a persecuted scholar scrambling to rescue his reputation after serious charges of ideological deviations. A nonparty member with an ominous “spot” in his biography, Iaroshevskii was in a particularly vulnerable position and presented an easy target in the wave of postwar ideological campaigns.⁴² After the publication of Stalin’s critique of Marrism, the Institute of Philosophy was conducting an urgent search for open and hidden followers of this condemned doctrine, and in December 1950, Iaroshevskii, then a researcher at the institute, was named among the malicious adherents of Marrism.⁴³ With the start of a campaign against “cosmopolitanism,” Iaroshevskii, who was Jewish, had a strong reason to fear the worst. He decided to leave Moscow for a more quiet location, where ideological battles were not so intense, and moved to the Soviet Central Asian republic of Tadzhikistan, taking up a teaching position there.⁴⁴ Party activists at the Institute of Philosophy proudly reported his departure to be the result of their uncompromising struggle against Marrism.⁴⁵ It was in his semi-exile in Tadzhikistan that Iaroshevskii

⁴⁰Ibid., I. 140.

⁴¹Iaroshevskii, “Kibernetika—‘nauka’ mrakobesov,” 4.

⁴²In 1938, during the Great Purges, Iaroshevskii was arrested on a trumped-up charge and released a year later without trial; the charges were officially dismissed only in 1991. See S. A. Kaliadina, “Fragmentsy ‘Dela leningradskoi studencheskoi terroristicheskoi organizatsii,’” in *Repressirovannaia nauka*, ed. Mikhail G. Iaroshevskii, vol. 2 (St. Petersburg, 1994), 193–99.

⁴³See “Reshenie zakrytogo partiinogo sobraniia Instituta filosofii,” 21 December 1950, RGASPI, f. 17, op. 133, d. 8, I. 41.

⁴⁴Mikhail G. Iaroshevskii, interview with author, Moscow, 2 August 1994.

⁴⁵“Otchetnyi doklad partiinogo biuro Instituta filosofii,” July 1952, RGASPI, f. 17, op. 133, d. 286, I. 157.

wrote his anticybernetics article for *Literaturnaia gazeta*, hoping perhaps to repair his tainted image.

Iaroshevskii did not receive any benefits from his ideologically correct critique; on the contrary, he nearly ended up in jail because of this publication. His mistake was that he followed the clichés of Cold War propaganda much too closely. After castigating the military applications of computers in the West, he glorified the positive achievements of Soviet computing. On the basis of Shkabara and Dashevskii's manuscript, he concluded that Soviet computing was not falling behind the West. "Soviet scientists constantly improve mathematical machines," he wrote. "Among the greatest achievements in this field are automatic, high-speed electronic calculating machines of Soviet design."⁴⁶ Unfortunately, he was much closer to the truth than he realized. Soon after his article came out, Iaroshevskii was urgently summoned to Moscow and interrogated by the secret police about his sources of information on Soviet computing, a top state secret at that time. He was released only after declaring that his statement was "a play of imagination"; he thought it wise to withdraw information about Shkabara and Dashevskii's manuscript.⁴⁷ While Iaroshevskii was privately suffering the consequences of his careless remark, the public critique of cybernetics in *Literaturnaia gazeta* acquired a significance of its own and had a fate independent from its author's. The view of cybernetics as a "pseudo-science," reproduced in several central newspapers and magazines, became all but official.

Attacks against cybernetics fit well with Cold War propaganda, and party ideologues, by encouraging this propaganda in general, indirectly helped turn these attacks into a large-scale campaign. In September 1952 the Department of Philosophy and Legal Studies of the Central Committee submitted a report to the Secretary Mikhail Suslov which concluded that the situation on the "ideological front" remained unsatisfactory: Soviet philosophers had not managed to deliver "crashing blows to the representatives of the Anglo-American center of philosophical reaction" and to expose the links between American imperialism and such philosophical schools as pragmatism, voluntarism, irrationalism, and semanticism.⁴⁸ The department urged the journal *Voprosy filosofii* to increase the number of publications critical of Western philosophy and sociology and proposed setting up a special sector for the critique of contemporary bourgeois philosophy at the Institute of Philosophy. The institute immediately organized such sector with thirteen full-time professional critics of contemporary bourgeois philosophy and sociology.⁴⁹ The institute's academic council adopted a resolution which called upon Soviet philosophers "to criticize and destroy all reactionary philosophical trends that appear in bourgeois countries under new, modish names and spread the propaganda of a new war."⁵⁰ In neither party documents, nor the directives of the leadership of the Institute of Philosophy was cybernetics mentioned; apparently, it had not yet been viewed as a major "reactionary philosophical trend."

⁴⁶Iaroshevskii, "Kibernetika—'nauka' mrakobesov," 4.

⁴⁷Iaroshevskii, interview with author, Moscow.

⁴⁸Chesnokov and Makhov to Suslov, 2 September 1952, RGASPI, f. 17, op. 133, d. 285, l. 88.

⁴⁹Chesnokov to Suslov, 27 March 1953, *ibid.*, l. 93.

⁵⁰"Postanovlenie Uchenogo soveta Instituta filosofii," 27 May 1952, Arkhiv Rossiiskoi Akademii nauk (ARAN), f. 1922, op. 1, d. 538, l. 9. See also "Kratkii obzor deiatel'nosti zhurnala 'Voprosy filosofii,'" 12 September 1953, ARAN, f. 499, op. 2, d. 24, ll. 15–42.

Cybernetics—a new and modish name indeed—had already been linked in the press to imperialist reaction, and before long it was turned by Soviet critics into a full-fledged “philosophical trend.” When the new sector conducted a comprehensive search for appropriate targets of criticism, it soon discovered cybernetics. The sector elaborated a thorough plan aimed at exposing “the pseudoscientific and reactionary character of such trends in contemporary bourgeois philosophy as instrumentalism, semanticism, neothomism, existentialism, cybernetics, and others.”⁵¹ In particular, the sector pledged to prepare several popular brochures criticizing “phenomenalism, cybernetics, existentialism, and the like.”⁵² In the prospectus of a textbook on the critique of contemporary bourgeois philosophy and sociology, cybernetics was listed among other “idealistic schools” under number seventeen.⁵³ Cybernetics was now classified as a philosophical theory stuck firmly between phenomenism and existentialism.

Following party directives, *Voprosy filosofii* in turn opened a special rubric, “Critique of Bourgeois Ideology.” Its editor-in-chief, Fedor Konstantinov, proclaimed that “what we need is a combative spirit in order not [merely] to attack individual [Western] philosophers but also to have an organized onslaught. We must have a plan for the entire year in which it is specified whom will we attack this year, so that we do not criticize passing individuals who have no significance in the West, but instead criticize those who have influence.”⁵⁴ Among the first items to appear under the new rubric was “Whom Does Cybernetics Serve?” Published under the pseudonym “Materialist” in the October 1953 issue, this article took the philosophical critique of cybernetics to a new level. The cyberneticians were not only said to “cling to the decrepit remnants of idealistic philosophy,” but also accused of “mechanicism,” for they allegedly reduced the activity of the human brain to “mechanical connection and signalling.”⁵⁵ Cybernetics thus appeared to deviate from dialectical materialism, the official Soviet philosophy of science, in two opposite directions—toward idealism and toward mechanicism. “Materialist” resolved this seeming contradiction in a truly dialectical manner, explaining that cybernetics was based, in fact, on mechanicism “transformed into idealism.”⁵⁶ Having exhausted the available repertoire of philosophical accusations, the author turned to the clichés of anti-imperialist propaganda. From the fact that the first automatic digital computers in the United States were constructed for the Department of Defense, “Materialist” concluded: “This is the god whom cybernetics serves!”⁵⁷

After cybernetics was attacked in the main academic philosophical journal, closely supervised by the Central Committee, the critique of cybernetics became a standard element of Soviet public discourse on American science. Other journals, newspapers, and magazines hastily jumped on the anticybernetics bandwagon: they too had to fulfill their

⁵¹“Otchet o rabote sektora kritiki sovremennoi burzhuaznoi filosofii i sotsiologii Instituta filosofii,” 19 December 1953, *ibid.*, d. 22, l. 14.

⁵²*Ibid.*, l. 5. By “phenomenalism,” Soviet experts in bourgeois philosophy apparently meant phenomenology.

⁵³“Plan uchebnogo posobiia ‘Burzhuaznaia filosofii i sotsiologii epokhi imperializma’” (1955), ARAN, f. 1922, op. 1, d. 726, l. 115.

⁵⁴Stenogramma soveshchaniia po koordinatsii, 9 December 1953, *ibid.*, d. 605, ll. 2–3, 12.

⁵⁵Materialist [pseudonym], “Whom Does Cybernetics Serve?” (1953), trans. Alexander D. Paul, *Soviet Cybernetics Review* 4:2 (1974): 35, 37

⁵⁶*Ibid.*, 43.

⁵⁷*Ibid.*, 44.

quota for articles critical of American science in the service of imperialist ideology. The more anticybernetics articles were published, the more obvious it seemed that the campaign reflected an officially sanctioned attitude, and more and more critics hurried up to join the chorus. Each critic carried criticism one step further, gradually enlarging the significance of cybernetics until it reached the proportions of a full embodiment of imperialist ideology.

SERIAL REPRODUCTION OF CRITICISM

As in Bartlett’s serial reproduction experiments, Soviet critics’ account of cybernetics departed further and further from Wiener’s original and acquired more and more features introduced by the zealous critics themselves. Their knowledge of cybernetics was not very good to begin with. Agapov’s boasting of his ignorance about Wiener’s work was not bravado but a frank confession. Agapov’s case was not an exception, but the rule. Virtually all Soviet critics of cybernetics—mostly philosophers and psychologists with little mathematical or engineering training—based their critique on second- or third-hand accounts. Agapov’s critique was based almost entirely on the 23 January 1950 issue of *Time*; Iaroshevskii’s sources were limited to Shkabara and Dashevskii’s manuscript and a single article from a 1949 issue of *Etc.: A Review of General Semantics*. Dashevskii, in turn, later confessed in his letter to the leading Soviet cybernetics specialist, Aleksei Liapunov, of being an “absolute ignoramus in this field” and asked for a bibliography.⁵⁸ None of the Soviet critics, except for “Materialist,” directly quoted from Wiener’s *Cybernetics*; most common sources were Wiener’s sensationalist interviews, philosophers’ bold speculations, and journalists’ enthusiastic reports in popular Western magazines. Even “Materialist” (this pseudonym apparently belonged to psychologist Viktor Kolbanovskii) reportedly had not read *Cybernetics* and may have borrowed his only quotation from a secondary source.⁵⁹ This is not, after all, surprising: after the publication of Agapov’s article, even the opponents of cybernetics could not check out Wiener’s book from a library!

The physical or conceptual inaccessibility of primary sources did not bother Soviet critics; they extracted all the information they needed from previous critical reviews and then merely applied the general rules of ideological discourse to develop their argument. The author of an anticybernetics article in *Meditsinskii rabotnik*, for example, borrowed the entire content of his article from Agapov’s and Iaroshevskii’s publications in *Literaturnaia gazeta*, adding only a couple of general anti-imperialist invectives of his own.⁶⁰ No knowledge of cybernetics was evidently needed for participating in the anticybernetics campaign; regular reading of the Soviet press provided a sufficient repertoire of critical arguments. After the advent of Khrushchev’s political “thaw,” the leadership of the Academy of Sciences frankly admitted in its 1956 annual report to the Central Committee that Soviet philosophical discourse had perpetuated “the practice of writing books exclusively or

⁵⁸Dashevskii to Liapunov (n.d.), Liapunov Papers in Natal’ia Liapunova’s home archive.

⁵⁹See Arnost Kolman, “The Adventure of Cybernetics in the Soviet Union,” *Minerva* 3 (1978): 422.

⁶⁰Iu. Klemanov, “‘Kibernetika’ mozga,” *Meditsinskii rabotnik* (25 July 1952): 4.

almost exclusively on the basis of other books already written on the same or similar subject.”⁶¹

The anticybernetics campaign thus acquired its own dynamics, with each author adding a few new strokes to the grisly image of cybernetics. Soviet critics’ ignorance of the content of cybernetics only helped them unleash their imagination. Skillfully manipulating a handful of Wiener’s quotations taken out of context, the critics stretched cybernetics’ clothes to make them fit their ideological strawman. Lenin’s “classical” critique of the “idealistic” philosophical speculations about the alleged “disappearance of matter” in the equations of relativity physics in the early twentieth century was thoroughly imitated during the anticybernetics campaign. Soviet critics similarly claimed that cyberneticians reduced biological and sociological laws to “pure” mathematical formulas and equations, which opened a way to “idealistic speculations.”⁶² The critics “creatively” translated Wiener’s modest statement, “information is information, not matter or energy,” into a brassy claim that “‘information’ has nothing to do with matter or consciousness,” and concluded that cybernetics marched along a “straight road toward open idealism and religion.”⁶³

Another allegation of philosophical error—that of “mechanicism”—was to some extent based on the interplay of the words “mechanistic” and “mechanical.” “On the basis of mechanistic principles,” one critic wrote, “in the United States recently emerged the pseudoscience of cybernetics, which promises to build perfect mechanical robots.”⁶⁴ The critics labeled any man-machine analogies mechanistic and reductionist. “No mechanical model can be identified with any biological process, especially with higher nervous activity,” they maintained.⁶⁵ As an ideologically correct alternative, they put forward the “materialist” physiological doctrine of the Russian scientist Ivan Pavlov, totally neglecting the fact that Pavlov’s theory of conditional reflexes had been modeled on the telephone switchboard—a much more primitive mechanical metaphor than the cybernetic analogies with the servo-mechanism and the computer.⁶⁶

The critics were evidently more concerned with making a propaganda show than with conducting a serious philosophical analysis of original cybernetic works, which most of them had not even read. They took full advantage of the rhetorical “elasticity” of dialectical materialism to turn it against cybernetics. “Materialist,” for example, cited the First Law of Dialectics, which postulated the transition of quantity into quality, to argue that the cybernetic parallels between people and machines ignored “the qualitative difference between a living organism and a machine.”⁶⁷ This law, however, could in principle be interpreted in favor of cybernetics. The dialectical “qualitative leap” might be seen not as an insurmount-

⁶¹“Otchet o deiatel’nosti Akademii nauk SSSR v 1956 g.,” 1956, Rossiiskii gosudarstvennyi arkhiv noveishei istorii (RGANI), f. 5, op. 35, d. 30, l. 148–ob.

⁶²Bykhovskii, “Nauka sovremennykh rabovladel’tsev,” 44.

⁶³Wiener, *Cybernetics*, 132; Gladkov, “Kibernetika—psevdonauka,” 64.

⁶⁴Nikolai V. Medvedev, *Marksistsko-leninskaiia teoriia otrazheniia i uchenie I. P. Pavlova o vysshei nervnoi deiatel’nosti* (Moscow, 1954), 105–6.

⁶⁵Bykhovskii, “Kibernetika—amerikanskaia lzhenauka,” 126.

⁶⁶On the Pavlovian physiological school see Joravsky, *Russian Psychology*; Daniel P. Todes, “From the Machine to the Ghost Within: Pavlov’s Transition from Digestive Physiology to Conditional Reflexes,” *American Psychologist* 52 (September 1997): 947–55; and idem, “Pavlov’s Physiology Factory,” *Isis* 88 (June 1997): 205–46.

⁶⁷Materialist, “Whom Does Cybernetics Serve?” 36.

able barrier, but as a connecting ladder, not a “gap” but a “bridge.” Indeed, just a few years later, during the post-Stalinist “thaw,” other Soviet philosophers would argue that the First Law actually provided a bridge between mind and machine, since the growing complexity of computers could lead to a qualitative change in their intelligent functions. As Loren Graham has keenly observed, “the basic ‘laws’ underlying this argument—that of the transition of quantity into quality—could be used in favor of the notion of thinking machines as well as against it.”⁶⁸ The participants of the anticybernetics campaign, who had already been set to “criticize and destroy” cybernetics as a breed of bourgeois ideology, however, naturally preferred the interpretation that gave them the greater critical leverage.

Soviet critics also labeled cybernetics a “reactionary imperialist utopia” aimed at rationalization and legitimization of capitalism.⁶⁹ They constructed this “utopia” out of Wiener’s gloomy prophecy about the “second industrial revolution” produced by cybernetic automation, which would carry with it “great possibilities for good and for evil” and could result in mass unemployment. “The skilled scientist and the skilled administrator may survive” this revolution, he wrote, explaining the social dangers of automation to labor leaders, but “the average human being of mediocre attainments or less has nothing to sell that it is worth anyone’s money to buy.”⁷⁰ The critics read this passage not as a warning but as an enthusiastic proclamation of the main goal of the entire cybernetic enterprise: “The process of production realized without workers, only with machines controlled by the gigantic brain of the computer! No strikes or strike movements, and moreover no revolutionary insurrections! Machines instead of the brain, machines without people! What an enticing perspective for capitalism!”⁷¹ The critics charged that “contemporary cyberneticians go out of their way to lower man, to show that man can—and should—be completely replaced by machine.”⁷² While some critics castigated Wiener for his alleged enthusiasm, others denounced his skepticism. Ignoring his view that automation still had “great possibilities for good,” they concluded that cyberneticians served the interests of capitalists by playing down the benefits that computers and automation could bring to the entire society.

Further, Soviet critics called cybernetics a “technocratic theory” and alleged that cyberneticians had claimed that “society needs them to step in, ‘scientifically’ explain, and ‘fix’ the ‘malfunctioning’ of society.”⁷³ Cyberneticians were accused of making “a fetish of technology” and pretending that acute social problems could be “solved with exact mathematical formulas.”⁷⁴ The critics again turned Wiener’s views completely upside down. In his writings, he repeatedly attacked the “excessive optimism” among American social scientists about the prospects of applying cybernetic methods to anthropology, sociology, and economics. He argued that irregular social processes were not amenable to the same type of mathematical analysis as regular neurophysiological processes. “In the social sciences we have to deal with short statistical runs,” he explained, “[and we cannot] be sure

⁶⁸Graham, *Science, Philosophy, and Human Behavior*, 479.

⁶⁹Bykhovskii, “Kibernetika—amerikanskaia lzhenauka,” 127.

⁷⁰Wiener, *Cybernetics*, 28.

⁷¹Materialist, “Whom Does Cybernetics Serve?” 44.

⁷²Ibid., 37.

⁷³Ibid.; Gladkov, “Kibernetika—psevdonauka,” 64.

⁷⁴Materialist, “Whom Does Cybernetics Serve?” 32; Klemanov, “‘Kibernetika’ mozga,” 4.

that a considerable part of what we observe is not an artifact of our own creation.”⁷⁵ Again, while some critics denounced Wiener as a technocrat, others censured him for not extending cybernetic models into the social sciences. The latter charged that Wiener denied the objective nature of laws of social development and therefore “objectively oppose[d] any kind of social science.”⁷⁶ “The sociological theory of cyberneticians is directed against historical materialism,” they concluded.⁷⁷

Like any ideological discourse assembled from prefabricated components, the anticybernetics campaign was insensitive to its inner contradictions. Producing a typical oxymoron, the critics branded cybernetics “not only an ideological weapon of imperialist reaction but also a tool for accomplishing its aggressive military plans,” referring to the use of computers and servomechanisms in the construction of modern electronic, remotely controlled, automated weapons.⁷⁸ How a worthless pseudo-science, an expression of obscurantist, reactionary ideology, could assist in the construction of working weapons was not entirely clear. To enlarge the significance of cybernetics as a formidable ideological enemy, the critics credited it with all military applications of computing and control engineering in the West. True, cybernetics was informed by wartime research projects and embodied some elements of military thinking, patterns of encoded communication, and principles of command and control.⁷⁹ Yet cybernetics for Wiener and his associates was a civilian enterprise; their cybernetic ideas largely affected the life sciences and the social sciences, while the military benefited mostly from Wiener’s earlier mathematical work.⁸⁰ Cybernetics could be seen, therefore, as a product, rather than driving force, of American military research on control and communication. Soviet critics also ignored, or possibly were not aware of, Wiener’s open pacifist stand, which he had taken after Hiroshima.⁸¹

Soviet political discourse was gradually shaping the image of American cybernetics to incorporate the ever-growing number of anti-American propaganda clichés, and the inherent contradictions of this discourse became imprinted on that image as well. American cybernetics was portrayed as both “idealistic” and “mechanistic,” “utopian” and “dystopian,” “technocratic” and “pessimistic,” a “pseudo-science” and a dangerous weapon of military aggression. The inconsistencies of the anticybernetics discourse and the critics’ indifference toward these inconsistencies suggest that the anticybernetics campaign was not driven by some “inherent incompatibility” of cybernetics with dialectical materialism. Instead,

⁷⁵Wiener, *Cybernetics*, 164.

⁷⁶Materialist, “Whom Does Cybernetics Serve?” 42.

⁷⁷Gladkov, “Kibernetika—psevdonauka,” 64.

⁷⁸“Kibernetika,” 236.

⁷⁹On the links between cybernetics and military research in the United States see Paul Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA, 1996); Peter Galison, “The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision,” *Critical Inquiry* 21 (Autumn 1994): 228–66; and Lily E. Kay, “Cybernetics, Information, Life: The Emergence of Scriptural Representations of Heredity,” *Configurations* 5 (1997): 23–91.

⁸⁰On Wiener’s distancing from military research during his work on cybernetics see David A. Mindell, “‘Datum for Its Own Annihilation’: Feedback, Control, and Computing, 1916–1945” (Ph.D. diss., Massachusetts Institute of Technology, 1996). On the intellectual impact of cybernetics in the United States see Steve J. Heims, *Constructing a Social Science for Postwar America: The Cybernetics Group, 1946–1953* (Cambridge, MA, 1993).

⁸¹See Norbert Wiener, “A Scientist Rebels” (1947), in *Collected Works with Commentaries*, ed. Pesi Masani, vol 4 (Cambridge, MA, 1985), 748.

this conflict was rhetorically constructed after cybernetics had become a target of anti-American propaganda.

The Soviet campaign against cybernetics developed along the familiar lines of a “Russian scandal.” As in Bartlett’s experiment on serial reproduction of Wallace’s *Darwinism*, a complex scientific subject was boiled down to a set of distorted statements with missing logical links. The end product similarly conformed to a pre-established “scheme” or cultural pattern—in this case, the ideological principles of Cold War propaganda. The critics’ ignorance about cybernetics only made it easier to stick new derogatory labels on this barely known subject. Neither quantum mechanics, nor relativity theory, nor the chemical theory of resonance, nor even “formal genetics” was entitled by Soviet critics to such a rich diversity of charges. They gradually transformed the image of cybernetics into a comprehensive enemy ideology, elaborated largely by the critics themselves according to the clichés of anti-American propaganda.

The fact that Western electronic digital computing and cybernetics had originated in the military sector played a remarkable dual role in a Soviet context: on the one hand, this served as a pretext for the ideological condemnation of cybernetics as a tool of imperialism; on the other, this same fact attracted the serious attention of the Soviet military toward cybernetics and to the use of computers as control devices. As a result, the anticypernetics campaign in the open Soviet press unfolded in parallel with growing party and government support for top-secret computer and automated-control projects in the defense sector. Iurii Zhdanov, the former head of the Science Department of the Central Committee in 1951–53, recalled in his memoirs: “While Stalin spoke against modern genetics, he never opposed cybernetics. On the contrary, in connection with the space enterprise every effort was made to advance computer technology. In particular, our department had an assignment to help Academician S. A. Lebedev with the construction of the first machines of the BESM type (the High-Speed Electronic Calculating Machine [*Bystrodeistvuiushchaia elektronnaia shetnaia mashina*]). And that was done.”⁸² While the “soldiers of the ideological front” were dismissing cybernetics as a “modish pseudo-science,” the actual soldiers in uniform took Western military research on computing and control very seriously. They realized that the Soviet Union was falling behind the West in a crucially important field of military technology, and aspired to close the gap as quickly as possible.

THE MILITARY READING OF CYBERNETICS: TECHNOLOGY WITHOUT IDEOLOGY

Ironically, Iaroshevskii’s unfortunate remark in his 1952 article in *Literaturnaia gazeta* about “automatic, high-speed electronic calculating machines of Soviet design” as one of the greatest achievements in modern computing was absolutely correct. The MESM, the first stored-program electronic digital computer in Europe, was already working in Kiev,

⁸²Iurii Zhdanov, “Vo mgle protivorechii,” *Voprosy filosofii*, 1993, no. 7:89. The euphemism “space enterprise” stands for the Soviet intercontinental ballistic missile program, out of which the space program eventually developed. The term “cybernetics” is used here in the broad sense this word acquired in the Soviet Union in the 1960s and 1970s, when all computer applications fell under the rubric of cybernetics.

and two more machines were under construction in Moscow. Their very existence, however, was strictly classified, for they were developed almost exclusively for defense purposes. In January 1951, Sergei Lebedev, the chief designer of the MESM, named the calculation of guided missile trajectories the first among its potential applications.⁸³ As soon as the MESM was completed, it was immediately utilized to perform most urgent military calculations for the Applied Mathematics Division in Moscow, an institution created specifically to provide mathematical support for the design of ballistic missiles and nuclear weapons. The first problems solved on the MESM were mathematical problems of nuclear physics, missile ballistics, statistical quality analysis, and the stability of long-range high-voltage power lines.⁸⁴

On 11 January 1950, following the first successful tests of the MESM, the government authorized two independent projects to build large high-speed digital computers: one at the Institute of Precise Mechanics and Computer Technology in Moscow (the BESM), the other at the Special Design Bureau No. 245, also in Moscow (the Arrow [*Strela*]).⁸⁵ By Stalin's demand, the decree specified the names of chief designers personally responsible for each project, and Lebedev was chosen to supervise the construction of the BESM.⁸⁶ Soon the Institute of Computer Technology received funding for one hundred new positions and moved to a new, much larger facility, a rare luxury in postwar Moscow.⁸⁷ By April 1952, when Iaroshevskii's anticybernetics article appeared in *Literaturnaia gazeta*, Lebedev's laboratory in Moscow counted almost 150 people on staff.⁸⁸ While the press denounced the use of computers for military purposes in the United States, the party and the government assigned high priority to the development of Soviet military computing. In 1953, when the first *Strela* was completed, it was immediately installed at the Applied Mathematics Division and used almost exclusively for military calculations.⁸⁹ The method of running important calculations simultaneously on two independent computers, which Iaroshevskii branded as "idealistic," was routinely employed by the Soviet military in the design of nuclear weapons and ballistic missiles.⁹⁰

At the same time as noisy ideological campaigns castigated "cosmopolitanism" and "kow-towing before the West," the borrowing of Western technology seemed remarkably unimpeded by these ideological considerations. While the translation of books filled with philosophical and sociological speculations, such as Wiener's *Cybernetics*, was put off,

⁸³Boris N. Malinovskii, *Istoriia vychislitel'noi tekhniki v litsakh* (Kiev, 1995), 30–31.

⁸⁴*Ibid.*, 42. On Lebedev and his first computers see also Gregory D. Crowe and Seymour E. Goodman, "S. A. Lebedev and the Birth of Soviet Computing," *Annals of the History of Computing* 16 (Spring 1994): 4–24.

⁸⁵See Sergei A. Lebedev and Mstislav V. Keldysh, "Bol'shie schetnye matematicheskie mashiny" (1952), ARAN, f. 1939, op. 2, d. 2, ll. 55, 57.

⁸⁶Malinovskii, *Istoriia vychislitel'noi tekhniki*, 48.

⁸⁷1950 annual accounting report (p. 22), located in the archive of the Institute of Precise Mechanics and Computer Technology.

⁸⁸I. S. Mukhin, "O podbore, rasstanovke i vospitanii kadrov v institute," 10 April 1952, Tsentral'nyi arkhiv obshchestvennykh dvizhenii goroda Moskvy, f. 7341, op. 1, d. 4, l. 164.

⁸⁹Andrei P. Ershov and Mikhail R. Shura-Bura, "The Early Development of Programming in the USSR," in *A History of Computing in the Twentieth Century*, trans. Ken Kennedy, ed. N. Metropolis, J. Howlett, and Gian-Carlo Rota (New York, 1980), 150.

⁹⁰See, for example, James Harford, *Korolev: How One Man Masterminded the Soviet Drive to Beat America to the Moon* (New York, 1997), 221.

Western technical literature passed the censor relatively easily.⁹¹ Major technical publications on computing, for example, were published in the Russian translation within two years of their original publication.⁹² The editors simply cut out all suspicious philosophical and sociological passages and supplied clever introductions, condemning the author’s ideological “errors.” Dmitrii Panov, the editor of the 1952 Russian translation of *High-Speed Computing Devices*, openly stated, for example, that he had eliminated from the text all “dubious analogies between people and machines in the spirit of pseudo-scientific statements of ‘cyberneticians.’”⁹³

While Soviet “soldiers of the ideological front” read about cybernetics in popular Western magazines and developed a principled ideological critique of this “idealistic and reactionary doctrine,” Soviet military experts were reading professional literature and drawing significant conclusions about the utility of computers and automatic control devices for the construction of weapons. In July 1953, at the height of the anticybernetics campaign in the Soviet press, Panov, then director of the newly established Institute of Scientific Information, submitted to the Central Committee a secret report, “On Small-Size Electronic Computing Devices and Their Application for Control Purposes.” Here he did not talk of “pseudo-science” or “a weapon of imperialist reaction,” but instead assumed a business-like tone: “From materials published in American journals, it is clear that the USA is conducting extensive work on designing various electronic control devices.”⁹⁴ Panov cited several examples of control devices used in American aircraft and anti-aircraft gunnery and flight control; he pointed out that the greater efficiency of the F-86 aircraft over the Soviet MIG-15 demonstrated during the Korean War might be due to the F-86’s on-board automated control system.

The Soviet military took news of cybernetics very seriously. In fall 1953 deputy minister of defense Engineer Vice Admiral Aksel’ Berg asked his subordinate Anatolii Kitov to prepare a report on computers and cybernetics.⁹⁵ Kitov’s upbeat report had profound consequences. The Ministry of Defense soon organized three military computation centers—the Computation Center No. 1, the Navy Computation Center, and the Air Force Computation Center—equipped with the first serially produced Strela computers. While the Soviet press vociferously condemned the “abnormal, one-sided” development of American military computing and ridiculed the “fantasies” of robots giving out military orders, the Soviet military tried desperately to catch up with Western developments in computing and cybernetics. Following the Western lead, Soviet military specialists were looking for means of “optimal” automated remote control of weapons, as well as military units, and Center No. 1

⁹¹The first Russian edition of Wiener’s *Cybernetics* (1948) appeared in 1958.

⁹²See Ershov and Shura-Bura, “The Early Development of Programming,” 144–48.

⁹³Dmitrii Iu. Panov, “Ot redaktora perevoda,” in *Bystrodeistvuiushchie vychislitel’nye mashiny*, trans. from English (Moscow, 1952).

⁹⁴Dmitrii Iu. Panov, “O malogabaritnykh elektronnykh vychislitel’nykh ustroistvakh i ikh primeneniia dlia tselei upravleniia,” 13 July 1953, RGANI, f. 5, op. 17, d. 412, l. 78.

⁹⁵See Anatolii I. Kitov, “Ról’ akademika A. I. Berga v razvitií vychislitel’noi tekhniki i avtomatizirovannykh sistem upravleniia,” in *Put’ v bol’shuiu nauku. Akademik Aksel’ Berg*, ed. Vladimir I. Siforov (Moscow, 1988), 131; and V. Neskromnyi, “Chelovek, kotoryi vynes kibernetiku iz sekretnoi biblioteki,” *Komp’iuterra* (18 November 1996): 44–45.

began working on automated troop-control systems.⁹⁶ This center also provided crucial computing support for the design of nuclear weapons, ballistic missiles, and spacecraft.

The military played a crucial role in the eventual legitimation of cybernetics in the Soviet Union and its subsequent elevation to an almost canonical status. With the advent of Khrushchev's "thaw," cybernetics, along with some of the other victims of persecution in the Stalin era, was "rehabilitated." In August 1955, Kitov, then deputy director of Center No. 1, coauthored the first Soviet publication that spoke positively about cybernetics in the open press.⁹⁷ His two coauthors were also leading specialists in military computing—Aleksii Liapunov of the Applied Mathematics Division, and Sergei Sobolev of the Institute of Atomic Energy. In 1959 the Academy of Sciences established the Council on Cybernetics for the coordination of Soviet cybernetic research on a national scale and appointed Berg, who by then had retired from his post of deputy minister of defense, as its chairman. Berg actively used his huge influence and connections in the party and government to promote cybernetics as a universal "science of government," most suitable for the tasks of organized socialist construction. Due to his efforts, the program adopted by the Twenty-Second Congress of the Communist Party in 1961 immortalized cybernetics as one of the sciences called upon to play a crucial role in the creation of the material and technical basis of communism.⁹⁸

The myth that the anticybernetics campaign was a major obstacle to the development of Soviet computing has already been exposed as an attempt to "hide deficiencies in the Soviet [computer] program and shift the blame to unnamed, undefined reactionary philosophers."⁹⁹ Unlike the campaigns in biology and linguistics, fueled by institutional rivalries, the anti-cybernetic campaign was not directed against any particular group of Soviet scientists. Attacks were aimed only at American cyberneticians (Norbert Wiener, Claude Shannon, Warren McCulloch, and others); not a single Soviet scientist was ever mentioned in a negative context. On the contrary, party and government authorities provided complete support to computing, control engineering, and communications engineering, especially if they contributed to national defense. The construction of the Soviet image of computing as a technology without ideology, however, had its cost. Trying to distance themselves from controversial cybernetic models and man-machine analogies, Soviet computer specialists severely limited the field of prospective computer applications. They placed emphasis on the narrow technical functions of computing and information theory and ignored any

⁹⁶"27 TsNII—stareishaia nauchnaia organizatsiia Ministerstva oborony," *Chelovek i komp'iuter*, no. 21–22 (1996): 4.

⁹⁷Sergei L. Sobolev, Anatolii I. Kitov, and Aleksii A. Liapunov, "Osnovnye cherty kibernetiki," *Voprosy filosofii*, 1955, no. 4:136–48. The same issue featured an article by philosopher Ernest Kol'man (Arnost Kolman), who supported a positive view of cybernetics.

⁹⁸On the history of Soviet cybernetics in the Khrushchev period see Boris V. Biriukov, ed., *Kibernetika: Proshloe dlia budushchego. Etiudy po istorii otechestvennoi kibernetiki* (Moscow, 1989); Slava Gerovitch, "Striving for 'Optimal Control': Soviet Cybernetics as a 'Science of Government,'" in *Cultures of Control*, ed. Miriam R. Levin (Amsterdam, 2000), 247–64; Gillespie, "The Politics of Cybernetics"; Graham, *Science, Philosophy, and Human Behavior*, chap. 8; David Holloway, "Innovation in Science—the Case of Cybernetics in the Soviet Union," *Science Studies* 4 (1974): 299–337; Kerschner, "Cybernetics: Key to the Future?"; and Dmitrii A. Pospelov and Iakov I. Fet, eds. and comps., *Ocherki istorii informatiki v Rossii* (Novosibirsk, 1998).

⁹⁹David D. Comey, as quoted in Kerschner, "Cybernetics: Key to the Future?" 60.

potential conceptual innovations. The computer was legitimized in this Soviet context as a giant calculator; its capacities as a data processor for economic and sociological analysis and as a tool for biological research were downplayed to avoid ideological complications.¹⁰⁰

The “Russian scandal” around cybernetics emerged in the context of the fundamental ideological uncertainty of the late Stalinist period. While postwar ideological campaigns in Soviet science often looked orderly and planned to outsiders, the insiders, ironically, found them utterly disorderly and self-contradictory. Those who tried to play by the rules and uphold the official line found that the rules seemed to change and the line to turn much more often than they could grasp. Yesterday’s scientific orthodoxy could become today’s heresy, and vice versa. To paraphrase Moshe Lewin, who, referring to the early Soviet period, spoke of a “quicksand society,” in the postwar period one might speak of a “quicksand ideology.” In this context, campaign activists often found an opportunity to manipulate the ongoing campaign to their own ends.

Viewed through the serial reproduction mechanism of “Russian scandal,” postwar ideological campaigns appear as self-perpetuating discourses which often strayed far from the party leadership’s plans or even emerged without any master plan as epiphenomena of the Cold War. As in Bartlett’s experiments, Soviet images of Western scientific theories were gradually reshaped as they passed from one critic to another and from one campaign to another. Whether trying to follow the party line or to evade it, to denigrate Western science or to exonerate its “objective content,” Soviet authors inevitably transformed the scientific theories they criticized and twisted the ideological dogmas they ostensibly professed. The “Russian scandal” around cybernetics not only transformed a theory advanced by an American pacifist and social critic into a weapon of imperialist reaction but also turned an unremarkable critical note by a semi-exiled outcast into a nationwide ideological campaign.

The story of the anticybernetics campaign suggests that discursive mechanisms eventually played a more important role than the point of origin of this chain of events. Whether an overzealous journalist jumped on an easy target, an academic picked up a fancy word from a foreign periodical, or a party official compiled a list of prescribed propaganda topics from various sources provided by the journalist and the academic, they eventually set a discursive propaganda machine in motion. The mechanism of serial reproduction began to work, producing a “snowballing” effect. “Fear bred fear,” as Georges Lefebvre put it, referring to the spontaneous Great Fear of 1789 in the French countryside on the eve of the Revolution. In his study of the 1775 French grain riots, George Rudé has discovered “a similar pattern of rumour, carried (in this case) from village to village and market to market; the same absence of any concerted plan or organization as of any ‘conspiracy’ hatched from outside; the same conviction that the King was on the rioters’ side and approved what they were doing.”¹⁰¹ Instead of looking for some decisive “trigger” that could single-handedly

¹⁰⁰See Slava Gerovitch, “‘Mathematical Machines’ of the Cold War: Soviet Computing, American Cybernetics, and Ideological Disputes in the Early 1950s,” *Social Studies of Science* 31 (April 2001): 253–87.

¹⁰¹George Rudé, “Introduction,” in Georges Lefebvre, *The Great Fear of 1789: Rural Panic in Revolutionary France* (New York, 1973), xiv–xv.

launch a campaign, it may be more useful to analyze the discursive mechanism that was turning small events into large-scale social phenomena.

Ironically, cybernetics may help illuminate its own history. Instead of perpetuating the false dichotomy “from above/from below,” one might think of the relationships between the party apparatus and the academic community in terms of feedback. Negative feedback, by suppressing small disturbances, produces purposeful action, while positive feedback, by accumulating and amplifying tiny deviations, leads to uncontrollable oscillations. In the latter case, a small fluctuation perceived as a deliberate “signal from above” can launch a self-perpetuating chain of events, driving the system out of its unstable equilibrium. Truly, the participants of the anticybernetics “Russian scandal” did not know cybernetics.