Book Reviews

The Research Enterprise in the Soviet Union

Soviet Science. ZHORES A. MEDVEDEV. Norton, New York, 1978. xii, 262 pp. + plates. $10.95.

Despite the conceptual universality of scientific knowledge and the practical uniformity of advanced technology, science in the Soviet Union is not quite the same as science elsewhere. It differs from "Western" science in its goals, its professional norms, and its institutional structure. Forged—or mangled—by more violent historical hammering, it has strengths and weaknesses that are difficult for us to appreciate.

Until he was tricked into exile in England in 1973, Zhores Medvedev knew it from the inside as a successful research biologist. In several previous books he has illuminated various aspects of Russian scientific and intellectual life by the light of his own personal experience. His present theme is the contemporary condition of science and technological development in the Soviet Union, in the context of its history since 1917. The book is not a historical or sociopolitical treatise, but a lucid, witty, and thoughtful book for the general reader, much to be recommended.

The goal of all Soviet science is quite explicit—to serve the interests of the Soviet Union. As Medvedev himself seems to see it, the ultimate justification of science is severely practical, toward human benefits such as food and long life. In the present political situation, more patriotic technological and military goals must be given high priority. This includes, of course, a strong infrastructure of basic science; but there is no mention of more humanistic motives, such as the satisfaction of natural curiosity or the search for truth as an esthetic or transcendental enterprise. A peculiar characteristic of Soviet science (which Medvedev scarcely mentions) is the separation of basic "academic" research from higher education. The universities have poor research facilities, and the scientific workers in the research laboratories of the Academy of Sciences have little contact with undergraduate students. Science teaching at all levels is thorough and rigorous, but its goals also are strictly instrumental—to give a good technical training to scientific and technological specialists. There seems no fertile ground for the growth of the ethos of our own academia, where the specialized originality of mind of the research scholar interacts with the unsophisticated radicalism of the student, generating and sustaining the tradition of a love of learning, intellectual integrity, and boldness of thought.

Such a tradition was certainly very much alive in Russia after the Revolution. But the subsequent history of Soviet science can be written in terms of various deliberate policies to direct science toward the goals favored by the political authorities. Until 1929, the rapid expansion of science was supposed to produce the necessary intellectual goods, without positive interference or constraint by the government or the party. Then, for more than 20 years, Stalin insisted that an ideologically purified and isolated scientific community would soon overtake and supersede the science of the decadent bourgeois world. As a natural consequence, the pseudoscience of T. D. Lysenko did irreparable harm to Soviet biology and agriculture. In the more exact sciences, such as physics, charlatanism was not allowed into the seats of authority, but the general level of scientific achievement was not proportionate to the immense scale of research activity or the abilities of such brilliant individuals as Kapitsa and Landau.

Khrushchev still apparently believed in the inherent superiority of socialist science, but realized that it could not make progress in complete isolation from foreign science. His strategy was to assimilate and "duplicate creatively" the advances made by Western technology, on the way to surpassing it. In the 1960's, the doors were opened, inward and outward, for people, publications, and technical equipment. Soviet scientists were once more able to assess their work by international standards—sometimes quite favorably, as in mathematics and theoretical physics, but in other fields, such as genetics, with shame and distress.

In the light of this revelation, "the myth of the peculiar advantages of a unique *Soviet* science is now almost dead." The leaders of Soviet science undoubtedly wish to participate fully in world science. This view is now probably shared by the political leadership—although one cannot be quite sure, as Medvedev suggests, that this is due on the one hand to a new-found confidence in Soviet technical and military capabilities and on the other to the enormous expense of going it alone in big sciences such as space research and high energy physics. Certainly the practice of copying imported apparatus left the Soviet Union hanging on the coattails of foreign technology: a more realistic strategy of closer technological cooperation with the West was a natural corollary of political détente, and it may continue to receive strong support within the Kremlin even as diplomatic relations become more frosty.

Nevertheless, Soviet science has been relatively free and open, ideologically and internationally, for some 20 years; why is it not doing better? On the face of it, the institutional framework is appropriate to its goals. Immense numbers of scientists and technologists are gathered in large and adequately equipped institutes devoted to all manner of research topics. The professional career of every scientist is well motivated for promotion to the handsomely rewarded status of professor or academician. The various institutes are mainly under the control of the Academy of Sciences of the U.S.S.R. and of the provincial academies, all, of course, under the thumb of the government and the party. The whole system is organized as an instrument of social, economic, and industrial policy, for the benefit of the Soviet state and its citizens.

But no research system lives up to the expectations of its bureaucratic managers. Medvedev describes the proliferation of institutions and the general hypertrophic growth of Soviet science. The response to sweeping directives has usually been evasion by adaptation. Every effort by the government to get science more closely applied in industry has been frustrated by the elitism of the academy network—scarcely surprising when the inferior status of industrial research is reinforced by immense differentials of salary and perks. It is significant that Medvedev says nothing of the

elaborate procedures by which research is supposedly planned; this ritual of state socialism is not regarded seriously as a means of directing investigations toward worthwhile social or intellectual objectives.

The arbitrary terror of Stalin is now only a bitter memory. In the aftermath, the scientific community recovered sufficient strength and autonomy to protect a few political dissenters. But the era in which liberally inclined scientific notables could apparently act with some independence within the government apparatus is over. In recent years the academic bureaucracy has been more closely geared to the state and party machinery, so that higher degrees and promotion depend upon outward political conformity. By various "administrative" devices, scholarly criteria are overridden, so that only politically reliable people can make their way up to influential scientific positions. The stick of the prison camp for an incautious word is replaced by the carrot of foreign travel as a reward for good behavior.

The fact that many of those now being persecuted as human rights activists are scientists is not without significance but does not mean that all Soviet scientists are of a similar mind. Of course there is always a mutter of unfocused discontent and passive resistance to unpopular official policies, but Medvedev is probably right in suggesting that public dissidence is a trivial factor within the enormous Soviet scientific community. Indeed, in his not altogether sympathetic comments on the disunity of the dissidents in the early 1970's and the current tribulations of the Jewish refuseniks, he probably reflects the point of view of the more thoughtful scientists in Russia on these same issues.

Nevertheless, the emphasis on political conformity is an important factor in Soviet science. In suppressing overt ideological or political dissent, the administrative machine also puts a damper on many other manifestations of independence of mind in the technical intelligentsia. Consider, also, the rigid progression through the hierarchy of advanced degrees and a gerontocratic tradition that leaves energetic old academicians at 70 or 80 in full command of their institutes—and of the scientific theories that may be validated within them. The impression one gets from various instructive episodes in the careers of individual scientists is that everyone is concerned mainly with living quietly, protecting his or her research program from serious disruption, and furthering personal advancement. Unfortunately, science does not progress by technical competence alone: it is driven by obsessional dedication, outrageous ambition, commitment to excellence, and other distinctly idiosyncratic quirks of personality. Those quirks are still to be recognized in individual Soviet scientists, but they don't seem to light up the whole crazy system the way they used to, even in the days when Stalin was knocking them off like ninepins and Hitler's armies were at the gates of Moscow.

That is what it looks like in its more public aspects. But the feature to which Medvedev attaches the greatest weight is the capacity of the Soviet system to concentrate immense resources on particular scientific projects, especially in the military sphere. He refers to immense secret laboratories, staffed by some of the most brilliant graduates and directed by powerful, capable, highly privileged scientists and engineers who never travel abroad and are seldom ever seen or mentioned in public. Out of these hidden technocratic empires have come such triumphs as the Soviet space and nuclear programs, competing successfully with American science and technology at its most advanced and sophisticated.

The history of science has no more bizarre—or frightening—episode than the research and technological development carried out in Stalin's political prisons. Medvedev tells of aircraft designers and nuclear physicists working under the conditions exposed so vividly by Solzhenitsyn in *The First Circle*. This was no aberration, no insignificant tragicomedy, but a major component of the R & D sector of the Soviet economy for a number of years during and after the war. Slave science, almost inconceivable in principle, was a practical reality.

The interesting question is whether the secret research institutions of the modern Soviet Union are more than featherbedded, voluntary variations on the same fundamental theme. Certainly there have been terrible failures as well as achievements: Medvedev gives convincing evidence for the disaster that covered a large region of the South Urals with highly radioactive materials in late 1957 or early 1958. We do not know the real cost of the brute-force approach to nuclear warheads, or space rockets, or sophisticated conventional weapons. There is no proof that Soviet science is more efficient in meeting the demands of the military than is its U.S. counterpart.

Medvedev argues that "scientists in the U.S.S.R are less free to ignore governmental attitudes but more independent of public opinion. The consequences of this in the future are rather clear—research in the U.S.S.R., although a matter of public concern, has more of a chance of proliferating and succeeding than in the democratic countries because it is supported by the government." This instrumental, technocratic view is also widely shared in the West. But it is shortsighted in ignoring factors of morale, of ethics, of values, of human insights and needs, that can come only from public participation in the scientific enterprise and a direct feeling of responsibility on the part of scientists for the benefits they may bring. Without these factors Soviet science is slave science, heading for decadence and sterility. The dissidents and refuseniks have got it right. The only real science in the Soviet Union is in their unofficial seminar, whose members, however persecuted, are free to think and speak their minds.

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Molecular Interactions

Cooperative Equilibria in Physical Biochemistry. D. POLAND. Clarendon (Oxford University Press), New York, 1978. x, 344 pp., illus. $34.95. Monographs on Physical Biochemistry.

This book is a unique and valuable introduction to statistical mechanical methods for analyzing multiple equilibria in general and cooperative equilibria in particular. Multiple equilibria are ubiquitous in molecular biology; every interaction involving biopolymers in solution is a multiple equilibrium. Analysis of these interactions provides information about the magnitudes and chemical nature of the intermolecular forces (noncovalent interactions) responsible for the association equilibria under study, and is a prerequisite for understanding biological processes at a chemical level.

Numerous examples of conformational transitions and ligand binding equilibria are treated at a useful level of detail. In addition, a thorough discussion of various intermolecular forces provides a background for the interpretation of thermodynamic quantities and cooperativity parameters that are extracted from binding isotherms or titration curves. A unifying feature of the author's approach is the use of energy levels and occupational probability distributions over those levels. Parallels are drawn between distributions over energy levels in quantum statistical ensembles, free ener-