Views from the U.S.S.R.

Science, Technology and the Future. Soviet Scientists' Analysis of the Problems of and Prospects for the Development of Science and Technology and Their Role in Society. E. P. VELIKHOV, J. M. GVISHIANI, and S. R. MIKULINSKY, Eds. Pergamon, New York, 1980. viii, 480 pp. $34.

This collection of papers by Soviet scholars, including some of their best-known scientists such as P. L. Kapitza and N. N. Semenov, is as interesting for the attitudes it reveals as it is for factual content and predictions of future developments in science and technology, much of which will already be familiar to well-informed Western readers. This volume appears to be in part the spinoff of a long-term forecasting effort undertaken by the U.S.S.R. Academy of Sciences, called the Comprehensive Programme of Scientific and Technological Progress and Its Socio-Economic Implications, 1976–1990, which was put together by various institutes of the Academy in the mid-1970's. Some of the results of this program are here made available for the first time in English. The volume covers fields as diverse as economics, chemical kinetics, solid-state physics, medicine, genetics, geology, studies of photosynthesis, and metallurgical machine building. This points to one of the problems of such collections: the lack of unity, which makes it difficult to read from start to finish. Some of the papers seem designed for the general educated lay reader with an interest in science, technology, and society, and others are aimed more at the scientist who does not read Russian and wishes to know something about the thinking of Soviet scientists in particular specialized fields. Still other papers, such as those on high energy physics, space exploration, and oceanography, read at times like grant proposals designed to convince the Soviet authorities that research in these particular fields is worth the high costs involved. The reader is cautioned, therefore, to treat the volume more as a reference work to be dipped into here and there for some understanding of the public attitudes of Soviet scholars and how they conceptualize problems in particular areas of science or technology.

Nonetheless, there are several persistent themes that run through a number of the papers collected here: in particular, the problems of energy, the environment, and the relationship of science to society.

Papers that deal with energy problems of the future, particularly those by Kapitza and Styrikovich, may be of particular interest to readers concerned with Soviet thinking about the energy crisis and recent debates about Soviet and world energy supplies. Both writers put their hopes for solution of global energy shortages on the use of nuclear energy, but Kapitza places his emphasis on fusion research, whereas Styrikovich sees more immediate hope in breeder reactors. Neither writer places stress on solar or chemical sources of energy, although Kapitza does find some hope in geothermal energy. None of these papers echo any of the major qualms of the antinuclear movements in the West or Japan. Styrikovich calls for more stringent safety requirements for nuclear plants but declares, "Any attempts to renounce the broad use of nuclear energy will inevitably lead either to a sharp decline in the rates of development of world energy consumption or to investments in the fuel and energy complex that would be beyond the means of the world economy." He declares that the nuclear industry over the last several decades has an excellent safety record and feels that most of the safety problems "have already been solved while others are raised due largely to misunderstanding." So far as the problem of nuclear wastes is concerned, he would dispose of the small amounts of dangerous fission products generated by a breeder program by sending them into outer space, perhaps to some "orbit in the asteroid belts." The chief advantage of a much increased reliance on nuclear energy, he argues, is that "the system of world energy supply will be much more stable than the existing one which is based largely on oil." Kapitza agrees, stating that "calculations have shown that if it is correctly used there are sufficient reserves of uranium for there to be no danger of their depletion in millenia." There is every indication that the Soviet government has already begun to implement such a program of heavy reliance on nuclear power, at least for the base load in Soviet electricity production, backed up by more coal-driven power plants for the intermediate and heat loads.

Styrikovich even chides those governments that have failed to place as much emphasis on the nuclear option. "The breeder and reprocessing programme," he writes, "must be stepped up. Yet while in some countries these programmes are being implemented rather actively, in other countries these programmes are being slowed down or even put off. This is a very alarming sign and all measures must be taken to overcome difficulties in the way of speedy implementation of these programmes on a broad scale." Kapitza, while obviously favoring nuclear energy, sounds a somewhat more cautious and critical note, at one point advising governments "not to waste energy resources on military requirements." At another point, he even suggests putting atomic power stations on small unpopulated islands where the liberated energy could be used to decompose water and the resulting hydrogen could be transported for use in liquid form. Styrikovich does not discuss this possibility but places emphasis on building centralized nuclear power plants to serve large urban populations. He compares the high energy efficiency of the U.S.S.R. (with its emphasis on cogeneration and the concentration of population in large housing blocs near factories and offices, served mainly by public transportation) to the low energy efficiency of the United States, with its population living largely "in individual cottages, far from places of work where a considerable distance must be traversed by individual cars." There is a good deal of truth to this, of course, but in emphasizing efficiency alone and not quality of life Styrikovich fails to mention some disadvantages of the Soviet energy system that become obvious to anyone who has lived in the U.S.S.R. for a time. These include frequent breakdowns and repairs that deprive Soviet housing blocs of heat or hot water for long periods of time. (On a recent two-month visit to Moscow, for example, this writer experienced a total of 15 days without hot water in his hotel owing to such breakdowns. Soviet friends mentioned being without heat or hot water in their apartments for as long as a month at a time.)

A number of papers in the volume deal with environmental problems. Much of the thinking here will be familiar to Western readers. For example, Yu. A. Izrael's paper on determining maximum permissible concentrations of pollutants and setting up a system of monitoring stations throughout the Soviet Union

seems consistent with Western thinking on this subject. What these particular papers lack is a strong critical sense regarding the barriers to effective pollution control that have arisen in Soviet society, including such criticisms as can be found in the Soviet periodical press and the recently translated *samizdat* work by Boris Komarov (*The Destruction of Nature*), as well as the works of numerous Western authorities such as Goldman, Powell, Kelley, Gerner, Lundgren, Ruble, and others. Though the factual material here is interesting, these chapters seem directed largely at convincing a Western audience that all is well. They read too often like pieces from *Soviet Life* and lack even the critical bite of many articles on these topics that can be found in the Russian-language Soviet press. Our credulity is stretched particularly by the assertion of E. K. Fyedorov that "if mankind were totally embraced by the socialist social system, the social aspect of the problem of optimizing the interrelationship between man and nature would disappear." In other words, only Soviet-style systems with centrally planned economies are, in his view, able to cope effectively with environmental problems. Since 1975, he writes, when the state plan for the development of the economy first incorporated a special section on environmental protection, pollution levels in the U.S.S.R. have stabilized. It would be nice to think that this is so, but given the inability of Western experts to check on such claims a certain skepticism is in order.

In general, the writers in this volume are quite optimistic about the ability of new scientific discoveries, technological progress, and greater efficiency to solve most of the problems of resource shortages and environmental degradation. Soviet writers are consistently critical of pessimistic Western studies, such as those of the Club of Rome, and of "doomsayers" such as Garrett Hardin and Paul Ehrlich. Soviet social scientists in particular (such as the philosophers and economists represented in this volume) often remain distinctly different in mentality and approach from many of their Western counterparts: not only more optimistic about the ability of science and technology to solve the world's problems but more convinced that science can only flourish as an institution under a system of centralized planning where the emphasis is on conscious control by state organs. Certainly the enormous growth of resources and manpower devoted to science and technology in the U.S.S.R. over the past several decades reflects this belief. But one can be permitted a modicum of doubt regarding the efficacy of Soviet science, given the problems of low productivity and relative lack of creativity in many areas, problems frequently discussed in the Soviet press but never alluded to in this collection.

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Historical Inquiries

The Analytic Spirit. Essays in the History of Science. In Honor of Henry Guerlac. HARRY WOOLF, Ed. Cornell University Press, Ithaca, N.Y., 1981. 366 pp. $25.

In his distinguished academic career, nearly all of which he has spent (like his father) at Cornell, Henry Guerlac has earned the unqualified respect of colleagues and students alike. Among his many achievements is a major recasting of the historiography of the chemical revolution of the 18th century; it was he who 20 years ago demonstrated the importance of the "crucial year" of 1772 in which Lavoisier turned decisively to the problems of combustion in general and of the calcination of metals in particular. Since Guerlac has always successfully married the gifts of a scholar with those of a teacher, his standards of precise yet imaginative scholarship have been passed on, year by year, to younger historians of science fortunate enough to have worked with him at Cornell. It is the high quality of this continuing tradition that makes *The Analytic Spirit* an uncommonly impressive festschrift. The work of 16 of Guerlac's former students, it is a collection imbued with a real flavor of what historians of science throughout the world will recognize as the Guerlac style.

It is no reflection on Guerlac's brilliant book-length work to suggest that he has always been preeminently the master of a different genre—the intricately argued scholarly article. He has shown time and again that the minute examination of a text need not be synonymous with pedantry. That particular lesson is implicitly repeated here by Margaret Jacob, who builds on her chance encounter with a manuscript in the British Library to illuminate a clandestine network of Continental freethinkers, the Knights of Jubilation, and thereby to raise a hornet's nest of problems concerning the relations between free thought, Protestantism, Freemasonry, and the infant Enlightenment in the age of Bayle, Toland, and Bolingbroke. (Interested readers should refer to her recently published book, *The Radical Enlightenment*, for an extension of the argument.)

Leslie Burlingame's eye for a subject is no less keen than Jacob's. She penetrates the murky obscurity of Lamarck's chemistry, treating it refreshingly as a worthy topic in its own right and not simply as a possible explanation for the rejection of his evolutionary ideas. She traces Lamarck's eclectic Stahlianism (which involved the retention of a four-element matter theory and a resolute opposition to Lavoisier's chemistry) to the influence of the Rouelle brothers and, more originally, places it in the context of Lamarck's comprehensive hostility toward speculative system-builders in all branches of science. Burlingame makes it very plain that Lamarck's chemistry was in no sense a peripheral aberration surviving from his youth, but rather was the foundation of a unified view of nature that explained, with equal ease, the history of the earth and the origins and continuance of life. Though it has never been properly explored by historians, the point was not lost on Cuvier, who, in 1832 in his *éloge* of Lamarck, chose to argue in detail against Lamarckian chemistry. Burlingame's paper, together with Carleton Perrin's careful study of the determined strategy of the "antiphlogistians" between 1785 and the early 1790's, serves the useful purpose of making the victory of the new chemistry appear far less inevitable than is commonly supposed. In this respect, it is particularly refreshing to see Perrin paying overdue attention to De La Métherie's rearguard action in favor of phlogiston, launched from a powerful base in the monthly *Journal de Physique*.

Appropriately, more than half the papers in this volume treat Guerlac's favored theme of French science in the Enlightenment. Some break new ground, like Rhoda Rappaport's immaculately researched study of the "liberties" of the Paris Academy of Sciences in the 18th century; in tracing the shifting response of academicians to the attempts by the royal bureaucracy to sway the outcome of elections and promotions, she points astutely to a growing rigidity and unimaginativeness in the acknowledged citadel of the French scientific establishment. Other papers, like Roger Hahn's caution against the lingering belief that Laplace was an atheist, take a fresh look at familiar received opinions. It is in this latter spirit that L. Pearce Williams reviews the literary and scientific evidence