growth, rising by about $100,000 a year. Research of direct military significance is outside its province, since this is handled by a separate body, the Defense Research Group, which is simply a small secretariat for coordinating the military research activities of the member nations. And NATO's two research facilities, the Anti-Submarine Warfare Center at La Spezia, Italy, and the Technical Center at the Hague, are administered by the military branches of the alliance.

"What we need," Schall said, "is a new impetus." And, for this purpose, the division has been looking into oceanography and computer software. Just how it might involve itself in these fields is not clear, but one administrative form that NATO finds attractive is that of the Von Karman Institute for Fluid Dynamics, in Belgium. Referred to as a NATO-related institute, it is financed by all the NATO countries, and the Scientific Affairs Division also provides some support through grants and fellowships. In oceanography, Schall said, the NATO role would probably be confined to coordinating existing activities, but in the computer field—which the division has had under study for 2 years—there might be an actual research facility, closely linked to NATO, but, on the style of the Von Karman Institute, administratively independent of it.

At this point it cannot be said whether these plans will ever be carried out. For one thing, they involve subjects that are already being handled by existing organizations that, in many cases, are having a difficult time getting resources. The division's present activities—fellowships, conferences, and research grants—do not intrude on anyone's bailiwick, and are welcome no matter how many other organizations are in the same business.

But perhaps of greater importance is the fact that American scientific leaders no longer seem to consider the division as important as they once considered it. Its first five heads were Americans, and rather high-ranking ones. Its new chief is one of Norway's most distinguished physicists, but the United States is the centerpiece of NATO—an American has always been its top military commander, and those NATO matters in which the United States has shown little interest are not among the most thriving in NATO affairs. —D. S. GREENBERG

# Soviet Science: OECD Reports a Pattern of Uneven Development

Immediately after Sputnik, waves of apprehension swept through the United States and other Western nations about the surprisingly high quality of Soviet science and technology. In subsequent years, great curiosity about the nature of Soviet science has not been matched by detailed information. This deficiency is partly remedied by the publication of a long-awaited report, "Science Policy in the USSR," which was completed recently under the sponsorship of the Directorate for Scientific Affairs of the Organisation for Economic Co-Operation and Development (OECD).* The report indicates that Soviet scientists and political leaders need to spend considerable time thinking about how to correct imbalances in their R&D system.

Those intrigued by Soviet science and technology will find this massive document (more than 700 typescript pages in the restricted version) an indispensable source of information and analysis despite its production under very difficult conditions. In preparing reports on the science policy of other nations, the OECD has been able to obtain full cooperation from the countries under study, which have provided facts, made provisions for travel, and arranged clarifying "confrontation" meetings with their scientists. Such was not the case with the Soviet Union. The authors of the report had to rely on extensive published data and on their personal visits.

The study is divided into five principal sections which were written by specialists on the Soviet Union from several Western countries. The introduction was written by Pierre Piganiol, science adviser to the Compagnie Saint-Gobain of France. The section on central planning of Soviet R&D is by Eugene Zaleski, Director of Research at the Centre National de la Recherche Scientifique, Paris. The second section, on scientific and engineering manpower resources of the U.S.S.R. from 1961 through 1966, contains a great deal of valuable information on the utilization of Soviet technical personnel; the author is Joseph P. Kozlowski of the National Science Foundation in Washington. Helgard Wienert, a consultant to the OECD Secretariat, wrote two of the major parts, one on the organization and planning of research in the academy system, the other on research in institutions of higher education.

The final section, on science and industry in the U.S.S.R., is, in this reader's view, the most interesting; it was written by R. Amman, M. J. Berry, and R. W. Davies of the University of Birmingham in England. Through use of central planning and the establishment of R&D priorities, the English specialists conclude, the Soviet Union has been able to achieve outstanding successes in aviation, rocketry, space exploration, atomic energy, machine tools, and iron and steel technology. But, despite the Soviet system's ability to organize to meet new and important research objectives, much of the Soviet R&D system seems characterized by sluggishness. Although Soviet military R&D seems relatively well-financed, the adequacy of civilian facilities receives much criticism. The standard for facilities for civilian scientists seems somewhat below the British standard and well below that of the United States. Soviet accounts emphasize that there is a "research development imbalance"—that development is given insufficient resources as compared to research. The main bottleneck in Soviet R&D, the Birmingham specialists conclude, is the relative unavailability of testing facilities, primarily for manufacturing and proving prototypes. Soviet scientists commonly argue either that such an imbalance does not exist in the United States or that the imbalance here is much less pronounced.

Another obstacle to technical inno-

* The report, though completed, has not yet been publicly distributed and was obtained by *Science* from a source outside the OECD. It is expected that the report will be published by April when it can be purchased from the OECD Publications Center, 1750 Pennsylvania Avenue, NW, Washington, D.C. 20006.

vation is the separation between R&D establishments and industry, a separation much more rigid than in the United States. This separation is reinforced by the planning system; the impact of central planning is also said to contribute to the reluctance of factories to innovate.

Soviet experts now regard improved planning and organization as insufficient to meet the requirements of technical innovation. Many see the key to such innovation in (i) relying on economic calculation as the main guide to decisions about R&D, and (ii) giving economic incentives to factories and other relevant organizations so that they will innovate without detailed central directives.

In addition, increasing use is made of the contract system in the Soviet Union. Industries are placing a growing number of R&D contracts with institutions of higher education, a development which, to some extent, is helping bridge the gap between research centers and industry.

Though the Soviet Union seems to have less of a civilian R & D output than the United States, this is hardly for lack of trying. The Soviet Union has at least as large a proportion of its labor force doing R & D work as the United States has, and since it has a larger population, there are more Soviet than U.S. workers in R & D. In the decade between 1955 and 1965, both the United States and the Soviet Union doubled the proportion of its gross national product expended on research and development, increasing from about 1.5 percent to about 3 percent. Such an investment represents more of a sacrifice for the Soviet Union than for the richer United States. In both countries the rate of growth for R & D has slowed somewhat in the past few years. Some Soviet scientists argue that their economy cannot sustain the rapid R & D growth rate which has characterized the post-1955 period.

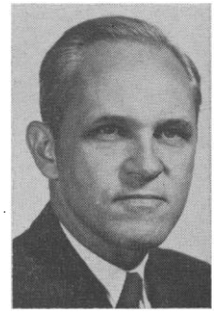
The Soviet Union continues its emphasis on training large numbers of scientists and engineers. Kozlowski writes that the quality of the training in Soviet engineering schools has improved and that great attention is being paid to developing electrical engineers and engineers for machine-building and instrument-making industries. "The hub around which the USSR's scientific and technological development revolves is the engineer," Kozlowski writes. In the Soviet Union, about 57 percent of the graduates of institutions of higher education are in science and engineering. Approximately two-fifths of the entire total is comprised of engineers. Among university graduates, a great number are in the combined discipline of physics and mathematics.

Despite the Soviet Union's phenomenal increase in producing engineers and physical scientists, there are still problems in the manpower area. The most significant problem is the lack of trained teachers. Teaching remains one of the lowest paid professions in the Soviet Union, and the more qualified teachers are often tempted to go into research. There is reportedly a dire shortage of science and engineering teachers willing to live in the hinterland areas such as Siberia. In 1965, about 35 percent of Soviet science teachers did not have a higher education. A lack of chemistry teachers is reported throughout the country.

In the Soviet Union, the institutions of higher education seem to have research tasks different from those of the Academies of Sciences with their research institutes. The institutes are often concerned with "big science" and with fundamental research, while the university scientists, who often have a heavy teaching load, tend to work in "little science" areas, on applied research, and, increasingly, on research for industry. The U.S.S.R. Academy of Sciences, while not expanding the proportion of Soviet R & D it does, still has more than 27,000 scientists working under its auspices. Having divested itself of many responsibilities for industrial research, the Academy has returned to its original emphasis on theoretical research. The Academy, like other Soviet research institutions, is often criticized for delay in transforming research findings into practical applications.

The Soviet Union has R & D problems which seem at least as severe as those of its major national competitors. Piganiol, in his introduction to the OECD study, notes that Soviet society is built on absolute confidence in the power of science and has had an opportunity to build up research organization unencumbered by the weight of past institutions. "Russia might have been expected to show the way to other countries in the organization of research," he comments. Instead, "it is curious to see its efforts in this field bearing fruit slightly later than those of Western countries." Nevertheless, the Soviet Union, having achieved a substantial military, space, and industrial research base, is becoming freer to move in new directions. With a great capacity and a forward momentum, the Soviet scientific and technological system will doubtless have other significant achievements with which to surprise the world.—BRYCE NELSON

# APPOINTMENTS



D. W. Talmage

M. B. Schaefer

**David W. Talmage,** to dean of the University of Colorado School of Medicine. . . . **Milner B. Schaefer,** science adviser in the Department of Interior will return to his position as professor of oceanography and director of the Institute of Marine Resources at the University of California, San Diego. . . . **Charles Vevier,** vice chancellor of the University of Wisconsin, to president of Adelphi University. . . . **John C. Noyes,** head of the geoastrophysics laboratory of Boeing Scientific Research Laboratories, to director of BSRL. . . . **James G. Roney,** director of health planning research at Stanford Research Institute, to president of Applied Health Research Corporation in Palo Alto. . . . **Lysle H. Peterson,** executive vice president of the Science Center in Philadelphia and vice president for health and life science will also become executive vice president of the University City Science Institute. . . . **Bernard C. Abbott,** head of the division of biophysics at the University of Illinois, to director of the Allan Hancock Foundation. . . . **Edward J. Martin,** chief of the pollution control analysis branch of the Federal Water Pollution Control Administration, Department of the Interior, to head of Cleveland's program to combat water pollution. . . . **John A. D. Cooper,** dean of sciences and associate dean of faculties at Northwestern University, to be the first permanent president of the Association of American Medical Colleges.