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.

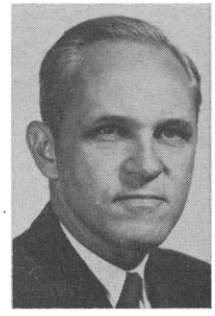
The Soviet Union continues its emphasis on training large numbers of scientists and engineers. Kozlowski writes that the quality of the training in Soviet engineering schools has improved and that great attention is being paid to developing electrical engineers and engineers for machine-building and 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.