be acquiring new technical skills. They all, however, were anxious to return to their professional careers.

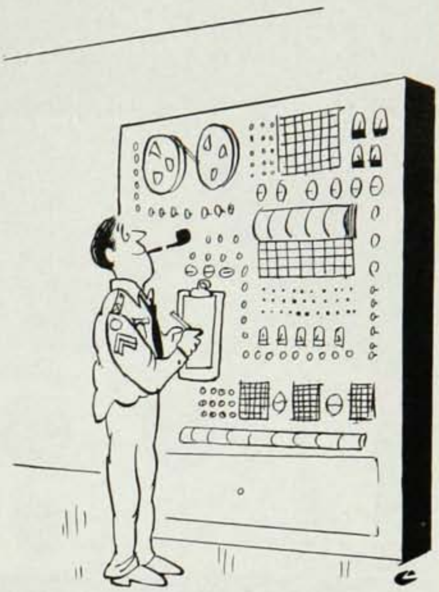
Despite criticism of the program by some segments of the military and others, the army as well as civilian scientists directing S&E projects testify to its success. The S&E contributes importantly to defense research, say the latter, and at the same time is given opportunity to continue his scientific training. He can take courses at a neighboring university or through the US Armed Forces Institute, he associates with senior scientists in many disciplines and (most important to the military) he learns how scientific work is fitted to defense needs. Some critics of the program, however, maintain that student draftees (if they are drafted at all) should go into the army as fighting soldiers and not as scientists. Others assert that civilian scientists, not draftees, should perform the army's defense research.

Once a physics student is inducted, he reports to a reception station where he takes a series of aptitude tests and is interviewed about his education and interests. If he has at least a BS in physics (also astronomy, astrophysics, biophysics, geophysics or nuclear-reactor technology), he fills out a special qualification form that is forwarded to the Department of the Army. There the student's record is evaluated, and the army may issue him assignment instructions to a military laboratory. Military requirements prohibit establishment of a policy that assures inductees that their military duty will be served in their area of choice or training. Nevertheless a large fraction of draftees having a BS in the physical sciences serve in the S&E program, and the army notes that physics S&E's are continually in short supply though it usually has a surplus of biology students.

Cold Regions Laboratory. Almost 70 S&E's work at the Army Cold Regions Laboratory in Hanover, N.H. The installation is one of the few laboratories in the world that addresses itself wholly to research in snow, ice and frozen ground. Physics research includes such activities as solid-state studies of ice and structure of liquids in the presence of solid surfaces. At the laboratory an S&E usually goes from private to specialist fifth class during his two-year service. His monthly pay averages \$70 without dependents and \$105 with dependents. He lives off the base, and the only military duty he may be involved in is raising and lowering the flag. Some S&E's augment their army pay with civilian part-time jobs and about 15% take courses through the Armed Forces Institute. A few stay on at the laboratory when their tours of duty are ended.

"The S&E's work area is directed," says Andrew Assur, laboratory chief scientist. "But within that area he has freedom to roam wherever he wants." Do the student draftees make good soldiers? "We get a good random sampling of graduates from US universities," says Assur. "The highly individualistic S&E's often make disorderly soldiers, but they are often the most creative ones here. The new S&E is brought in at a junior professional level and he has to learn to engage in a human dialog. Many feel they are not being compensated adequately for their work, some feel an underutilization of their talents. When they come here, they have to overcome a block in their minds. They must become self-propelled to be productive. Altogether we feel they make a great contribution to the laboratory."

S&E reactions. Linwood Bracy, a graduate of Olivet College in Michigan, wants to teach physics in a small college some day. He told us, "The army experience definitely set me back two years. But here I learn a lot of laboratory techniques such as handling electronic apparatus and working with the computer. At the moment, I am studying the coefficient of restitution for ice." "I was disappointed that my career was halted," said Thomas Nasman, who was working with Westinghouse and who had planned to go on to graduate school. "But my experience here has cleared my thinking and definitely turned me toward applied research." Daryl Hatfield, who was doing telemetry data reduction at White Sands, N.M. missile range before being drafted, had appealed unsuccessfully to Washington for a draft deferment. "As it turned out, I feel I am better off being drafted," he said.



"THE HIGHLY individualistic S&E's often make disorderly soldiers, but they are often the most creative ones here."

"Getting drafted changes everybody's life aims. I work in photointerpretation here, and I may continue this work when I get out." Norman Craig, who was studying geophysics and engineering at Whittier College in California, is now working on avalanche prediction studies at the laboratory. "For my own professional use, I doubt if this information will be useful," he said. "Yet I'm getting a good training in handling statistics, and I work closely with a cross section of scientists in many fields."

Almost All Congressional Committees Studying R&D

A recent Library of Congress study of congressional involvement in federal research and development has indicated that virtually every committee in both Senate and House is concerned with some form of technology. Basing its analysis on the number of pertinent publications on R&D issued by each committee during the 88th and part of the 89th Congresses (1963–65), the study shows that two joint, 20 House and 16 Senate committees exercised some jurisdiction over various aspects of the \$15.5 billion annual federal expenditure for R&D. On the House side, the most active R&D committees were Appropriations, Government Operations, Interstate and For-

eign Commerce, Science and Astronautics, and Education and Labor. On the Senate side, the most involved were Appropriations, Commerce, Labor and Public Welfare, Government Operations, Public Works, and Judiciary. The Joint Committee on Atomic Energy was also near the top in terms of R&D activity.

Congressional publications on science and technology during the period studied constituted about 15% of all publications issued by Congress. This figure is roughly comparable to the 12% of the federal budget spent for R&D.

Physicists in the Industrial Environment—A Talk with Gardiner Tucker

Gardiner Tucker, former head of research at IBM, is one of a handful of scientist-administrators who since World War II, have directed the expansion of industrial basic research to its position of eminence today. The 42-year old physicist has recently been appointed deputy director of defense research and engineering for the Defense Department, and in a recent interview we had with him in Washington he gave us his reflections on his 15 years in industry. The industrial setting may be easier to adjust to than an academic one, he said, the opportunities much greater. He also said industry has increased its science activities so rapidly that a reaction has set in, followed by a maturing attitude toward research. In education for the future industrial physicist,

TUCKER

Tucker believes strongly in more basic science and less tailoring of the curriculum to industrial needs.

Tucker joined IBM in 1952, a year before he earned his doctorate from Columbia. He rose rapidly in the organization to become head of semiconductor research in 1954, manager of research analysis and planning in 1957, and head of the IBM San Jose, Calif. laboratory in 1959. He later advanced to director of development engineering for the IBM World Trade Corporation and in 1963 was appointed director of research.

Currently, about one third of PhD physicists work in industry and only 22% of the new PhD's are going into industrial research. We began by asking Tucker:

• *Is the industrial environment more difficult for the new PhD to adjust to than the academic one?*

"I don't think so. A new PhD entering an industrial laboratory is likely to join it in a well established area, where the research direction is clear and amenable to his interests. He has one responsibility only, to do research, in the context of interests he has joined. His problems of deciding how to operate are simple. In a university environment, there is a certain confusion of purposes, for a man has a research and a teaching purpose. He has a two-headed job, which can be very stimulating but also harder to contend with.

"There are a range of opportunities in industry and a social force that attract a man to the area where he can succeed. I think there is a higher attrition rate in the academic than the industrial world. A nontenure appointment is a very insecure thing compared to an industrial appointment. In industry, there is a richer range of paths accessible to the scientist and his chances of survival and success along some of them are higher than in the university where the types of careers are more restricted."

"SCIENTISTS are social creatures too. They tend to want to derive some of their direction from their environment and share the insights and enthusiasms of their laboratory colleagues. Sometimes this social force is too strong, and you have to resist it to build a new direction."

• *Does not the new PhD in industry have to contend with a divided loyalty between his research interests and company goals?*

"That problem is more apparent than real. At IBM, from time to time, we would decide upon building up a capability in a new field. So we'd hire a new PhD whose dissertation was in this new field and we'd plant him in the lab, encouraging him in his field. But he would see many of his colleagues working in going programs about which they were excited. And he would come under the powerful attraction of their excitement and join the established field. Scientists are social creatures too. They tend to want to derive some of their direction from their environment and share the insights and enthusiasms of their laboratory colleagues. Sometimes this social force is too strong, and you have to resist it to build a new direction. Acclimatization to industrial purposes is usually a normal, spontaneous process."

• *Is there a clear distinction of personality between the industrial and academic scientist?*

"The spectra of personalities overlap one another. I suspect, however, that the man who is clearly driven by a sense of dedication to learning will tend to identify himself with a univer-