

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,

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."



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sity, and the man whose concern is for the impact of his work on society will tend to be found in industry.

"But this polarization has grown considerably less over the last decade. Industry has built up a real scientific tradition with which the dedicated knowledge-seeker can identify himself. For many fields, such as in solid-state, the major momentum has come from industry and the opportunity to do significant work is much greater than in the university because of the depth of interest and extent of technological support available.

"On the other hand, in the academic world there is a lot more sense of participation in the affairs of society than when I was a student. When I decided to major in physics, it was a sort of monastic decision; I was dedicating myself to science; I was very much surprised later to find out how much physics led to interaction with the world and its problems. Mine is a typical experience. Twenty years ago, many people went into science because it was an esoteric experience. Today, a different atmosphere prevails in many academic circles. You are going to consult, work on government contracts, solve problems related to social needs."

• *Is there then a merging of industry goals and purposes of the university?*

"They are moving closer but they will always be distinct. During recent years, reactions have occurred both in industry and the university. In industry, many people are concerned that they might have gone too far in supporting science without thinking too carefully of how they go from research contributions to visible industrial consequences. Industry has experienced a lot of soul searching and readjustment. Formerly there was a kind of faith, precipitated in part by discovery of the transistor, that if a company had excellent science, they would have excellent practical results. But it's not that simple. We have had to concentrate much more on selecting the fields and providing the intermediate steps that lead from research to practical goals. So we have a maturing in our attitude toward science. It is not a fundamental change in faith in re-

search; it is rather a realization that it takes good management to reap the practical benefits of research.

"And in the academic community, there have been reactions against proceeding in too practical a direction. University people are saying to themselves, 'Maybe we are living too much on contracts and getting too many rewards out of practical contributions. Maybe that isn't the best fulfillment of our intrinsic role.'"

• *Does the somewhat deprecating feeling of the academic scientist to his industrial counterpart still exist?*

"Such a feeling was often apparent 15 years ago but it has dissipated. There is better understanding now between industrial and academic physicists. A lot of graduate students have moved into industry and then back to the campuses. There are also strong contractual relations, you meet your colleagues at society meetings, and you can't tell on any intellectual basis who comes from where. In some fields, there is a reverse phenomenon that (I must admit) is rather disturbing, that of academic people feeling jealousy over the scientific resources of industry. It just shows that the research initiative is often with industry in these fields."

• *Would you have two separate graduate curricula, one for the future industrial physicist and one for the academic physicist?*

"I would push in an almost opposite direction. I fear there may be too much responsiveness by people who try to tailor curricula to the needs of industrial research and tailor their students accordingly. The problem is that a PhD physicist is going to have a 30-35 year career. If you tailor his course works too much to the things that are exciting today, you are not aiming at the center of gravity of that career. Attempts to develop students who will be immediately recruitable by industry have been overdone. What we need are scientists, even though these scientists will have to adapt themselves to the industrial environment. But that's an experience you can't put them through in advance. The most valuable man to industry is not the one trained at the frontiers of industrial practice but the one who has the breadth and depth of understanding at the frontiers of science."

High-Energy Physicists Seek Preprint Experiment

An American Institute of Physics study has found that most high-energy physicists seek a definitive experiment to determine the value of centralized distribution for informal communications. The study, headed by Miles A. Libbey, AIP director of systems development, is based on a sample of 997 physicists who returned questionnaires. About 75% of the respondents believed an experiment should be tried and approximately 13% were opposed. The remainder were undecided. At the same time, the study indicated that many of the

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