novation, and new work is being done in order to determine the limits for innovation and to establish the essential functions which a communication system must fulfill for the discipline. A program of innovation directed at a wide range of users is planned. A further goal of the project is that of preparing and evaluating a continuing program to monitor data on the function of the communication system in psychology. Ideally, this plan should coordinate such data with data gathered by the American Psychological Association on manpower, productivity, and educational and research facilities and furnish a rationale for the management and future development of communication programs in psychology.

In response to the concern of many disciplines that have information problems and an interest in studying and improving their systems of communication, this approach has now also been introduced into other scientific areas with the establishment of the Johns Hopkins University Center for Research in Scientific Communication. An emphasis of this Center is the recognition that the information systems of different scientific disciplines have developed more or less independently, frequently function differently, and can involve different elements which are utilized in varying ways and to varying degrees.

Comparative studies seem particularly necessary, so that communication innovations and system modifications may be widely useful and so that a coordination of effort, firmly grounded upon and guided by data from the social sciences, the natural sciences, and engineering and technology, can develop. Cooperating with the Hopkins Center in this program of research are the American Sociological Association, the American Institute of Physics, the Optical Society of America, the American Geophysical Union, the American Meteorological Society, the American Institute of Aeronautics and Astronautics, the American Institute of Mining Engineers (a member group of the Engineers Joint Council), and the Association of American Geographers.

References and Notes

1. *Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology*, vol. 1 (American Psychological Association, Washington, D.C., 1963); *ibid.*, vol. 2 (1965).
2. For a description of the dissemination system for scientific information in psychology and of the scientists' information-exchange behavior within this system, see W. D. Garvey and B. C. Griffith, *Science* **146**, 1655 (1964).
3. We are speaking about a communication system that is relatively closed but not static, somewhat analogous to physical systems that conserve energy. A discipline's being a closed system seems to require identifiable membership or a membership that changes in predictable ways. Since this requirement generally develops from some degree of institutionalization, much of this discussion might not apply to the early stages of a discipline or to newly formed "aggregates" of scientists (for example, in oceanography or communications) largely based upon scientists trained in other disciplines.
4. "The discovery and dissemination of scientific information among psychologists in two research environments," in *Reports of the American Psychological Association's Project on Scientific Information Exchange in Psychology*, vol. 2 (American Psychological Association, Washington, D.C., 1965), gives a detailed description of some scientists' values relative to dissemination. The reader is also referred to *Science* **153**, 695 (1966); *ibid.*, p. 1468; *ibid.* **154**, 843 (1966) for the correspondence on IEG's (Information-exchange groups). A classic article in this area is R. K. Merton, *Amer. Sociol. Rev.* **22**, 635 (1957).
5. Students of science seem to disagree as to the relative efficiency and expense of informal channels of information exchange. However, it is clear that informal media require considerable amounts of the individual scientist's time and are, in that sense, somewhat expensive on a per-message basis. Their functional characteristics may make their efficiency very high indeed in terms of expediting the scientist's work.
6. See B. C. Griffith and W. D. Garvey, "Systems in Scientific Information Exchange and the Effects of Innovation and Change," *Proc. Amer. Documentation Inst.* (1964), pp. 191–200, and W. D. Garvey and B. C. Griffith, *Amer. Psychologist* **20**, 157 (1964) for earlier conceptions of this approach.
7. A more complete formulation of the approach to "formalize the informal channels" and "informalize the formal channels" is given by W. D. Garvey and B. C. Griffith in *The Foundations of Access to Knowledge*, D. Berger, Ed. (Syracuse Univ. School of Library Science, Syracuse, N.Y., 1967).
8. These studies were conducted, and the innovations were planned and executed, by Philip J. Siegmann, editor of *Psychological Abstracts*, with the assistance of APA's Project on Scientific Information Exchange in Psychology. For a more detailed description of this effort see P. J. Siegmann and B. C. Griffith, *Amer. Psychologist* **21**, 1037 (1966).
9. See B. E. Compton, *Amer. Psychologist* **21**, 176 (1966) for a review of some findings relative to this meeting; see B. C. Griffith and W. D. Garvey, *Amer. Behavioral Scientist* **10**, 3 (1966) for an analysis of certain behavioral processes relative to scientific meetings.
10. A full report of the data on the trial of the second and third innovations is given in *Innovations in Scientific Communication in Psychology* (American Psychological Association, Washington, D.C., 1966). This report may be obtained by writing the Project on Scientific Information Exchange in Psychology, 1200 17th Street, NW, Washington, D.C.

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NEWS AND COMMENT

Civilian Technology: NASA Study Finds Little "Spin-off"

One of the most persistent arguments on behalf of the space program is that it has a beneficial "spin-off" effect on processes and products that are remote from the problems of working in space. At this relatively early point in space history it is difficult to ascertain the validity of the argument. There is no doubt that the forced-draft development of space hardware underlies many products in the civilian marketplace. On the other hand, it is doubtful that the ceramic nose cone is the most expeditious route to new frying-pan technology.

Nevertheless, since space research is big and booming, interest is high in maximizing its spin-off, as well as the spin-off from the other billions of federal dollars spent on noncivilian R & D. The latest manifestation of this interest is an illuminating report produced by the Denver Research Institute (DRI) under a NASA contract. Titled *The Channels of Technology Acquisition in Commercial Firms, and the NASA Dissemination Program*,* the report is based on a study conducted over a 14-month period by a group headed by John S. Gilmore, senior research economist of DRI's industrial economics division. It is modest in scope, confining itself to an examination of the methods, or work habits, that govern the acquisition of new technology in 62 firms in four industries—electric batteries, printing and reproduction, industrial controls, and medi-

*Available for $3 from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

cal electronics. In addition, the study also examined technology-acquisition methods used by 11 "vocational-technical" schools.

Though considerable variations existed among the 73 organizations surveyed, the dominant conclusion to emerge was that few, if any, of them are vigorously seeking to dip directly into the vast outpouring of science and technology that the federal government is underwriting at the rate of some $16 billion a year. To complement the picture, it turned out that, while technology dissemination receives some money—$4.8 million a year in the case of NASA—and a good deal of verbal support in federal agencies that support research, relatively little has actually been done to simplify the problem of increasing the technical awareness of the manufacturer who is outside the space and military fields.

In line with what many observers have noted, the DRI study concluded that, while a scientific revolution may be raging in the laboratory, the technologist faced with an immediate problem is inclined to fall back on the tried and true information that is contained in standard manuals. "Textbooks and handbooks," the study observed, "tend to be from two to five years or more behind the state-of-the-art. Nevertheless, they were one of the most important sources of information for problem solving. Written primarily by academicians, they provide broad in-depth coverage [that] a periodical cannot. The tables, charts, and indexes were considered particularly useful. Another apparent reason for their importance was the famliarity individuals had with texts used in their formal training. Having learned to use a particular text or handbook, they continued to rely on it."

As for technical publications that pour from government agencies, the conclusion was that they are not doing the organizations in the survey much good. "Government publications were not perceived as major channels for acquiring technological information," the report noted. "The variety and mass of government publications tended to overwhelm people and many were simply not familiar with potentially useful sources, and did not know how to screen and select relevant material." Specialized publications, such as the *Official Gazette* of the U.S. Patent Office, were found to be valued by at least one person in most of the

NEWS IN BRIEF

● **NIH BUDGET**: The Senate has approved a budget for the National Institutes of Health (NIH) nearly $78 million higher than the NIH budget measure the House passed. The Senate bill would appropriate $1.25 billion for health research during the next fiscal year compared with the $1.17 billion that the House approved. The Senate measure increased funding to each of the eight NIH institutes. The increases include an addition of $15 million over the House-approved $50 million for construction of health and research facilities, $10 million more than the House's $167.9 million for the National Heart Institute, restoration of $10 million that the House cut from the Administration's $64.3 million request for regional medical programs, and $9 million more than the $183.3 million approved by the House for the National Cancer Institute. A conference committee met 16, 17, and 22 August to work toward a compromise agreement.

● **FOREIGN STUDENTS**: More U.S. and foreign university students and teachers studied or worked outside their own countries during the 1966–67 academic year than ever before, the Institute of International Education's annual survey, *Open Doors 1967*, reports. The study indicates that 140,573 individuals were involved in 1966–67, compared with 125,000 the previous year. Foreign students studying in the United States during the year numbered 100,262, the highest total on record. In addition, 10,737 foreign faculty members were in the United States, 4,674 American faculty and administrative personnel were abroad, and about 25,000 U.S. students were regularly enrolled abroad. Twelve countries sent more than 2,000 students each to the United States, with Canada leading the list with 12,000. One-third of the foreign students in the United States were from the Far East, 18 percent from Latin America, 14 percent from Europe, 13 percent from the Near and Far East, and 7 percent from Africa. Of the foreign students, 48 percent were graduate students; 45 percent were undergraduates, and 7 percent were special students. The largest number of foreign graduate students were enrolled in the physical and life sciences, engineering, and the social sciences, respectively. Undergraduates favored engineering. Copies of *Open Doors 1967* are available for $2 each from the Institute of International Education, 809 United Nations Plaza, New York 10017.

● **UNDERSEA WILDERNESS PROPOSAL**: Public protest against oil industry plans to explore and develop portions of the Santa Barbara Channel off southern California and the Georges Bank adjacent to lower Cape Cod has led to the introduction of 20 bills in the House that call for the study of possible marine sanctuary areas. The measures, which have been introduced within the last few months, call for a study of the most feasible and desirable means of establishing certain portions of the tidelands, bays and estuaries, outer continental shelf, seaward areas, and Great Lakes of the United States as marine sanctuaries. The Sierra Club, a conservation group, has endorsed the proposals which would give the Secretary of the Interior authority to spend up to $1 million for a 2-year study of undersea areas valuable for sport and commercial fishing, wildlife conservation, outdoor recreation, and scenic beauty. During the evaluation period, there would be a moratorium on mineral development in certain continental shelf areas. Fred Eissler, Sierra Club director, said in a written statement, "No one is against the development of oil and other minerals in ocean areas . . . [but] some of the best parts of the sea must be saved as wilderness ecological reserves against which to measure the impact of man on modified areas." The study bills are being referred to the House Committee on Merchant Marine and Fisheries.

● **PROGRESS REPORTS**: The U.S. Bureau of the Budget has authorized college and university instructors who are engaged in federally financed research projects to submit their research progress reports on the basis of academic terms. The new ruling will permit academic researchers to submit reports at the end of each semester rather than quarterly as in the past. The regulation, which becomes effective with the beginning of this autumn's academic term, permits institutions that do not want to change to remain on the quarterly report basis.

organizations. However, the study concluded, "most individuals felt it too difficult to retrieve relevant material from the mass of government publications and indicated that they expected to learn of important government-developed technology through trade and professional channels. In several firms, those interviewed felt that it wasn't really practical to keep up with and use government technology unless one's firm had government R & D contracts."

How did the respondents feel about various centers that have been established for disseminating technological information? The DRI study found they did not regard them as especially important. Such centers, it was found, "were not widely used, in part because they were not readily accessible. Some interviewees preferred either to rely on available internal services or go directly to known sources of new technology. Going through an information center, they felt, would simply add time and communication problems."

Ranking high among the means for acquiring information about new technology were trade publications and professional journals and face-to-face contacts, especially at conventions, professional meetings, and symposia. It was pointed out, however, that "many individuals questioned indicated that formal papers presented at meetings tended mainly to serve the interests of the speaker (by boosting his status), and that they typically failed to include proprietary or really useful information. . . . While both local and national meetings were important, the highest value was placed on meetings which narrowly focused on the individual's particular field of interest."

On the basis of their study the DRI investigators produced a number of recommendations. Since it was found that over one-third of the respondents had taken formal course work during the previous year, it was suggested that the back-to-school habit be exploited for the purpose of accelerating the dissemination of new technology. It was suggested, for example, that efforts be made to establish closer ties between industry and the academic world through establishing lecturing posts for industrial scientists and engineers. In addition, it was proposed that the science and engineering curricula include "problem-solving courses emphasizing technology acquisition." It was also suggested that internships be established enabling industrial employees to work in federal laboratories, and, in general, that manufacturers pay more attention to the federal R & D effort, and especially to the systems now under development for disseminating scientific and technical information.

Since a politically well-entrenched order of priorities dictates that some 80 percent of federal R & D money goes into military and space objectives, it is difficult to argue against the proposition that efforts should be made to extract all the good that is to be had from this lopsided allocation of resources. When viewed from this premise, NASA's inquiries into spin-off are praiseworthy and merit continuation. Still it has to be recognized that primitive cost-effectiveness analysis long ago discredited the burning of barns for the roasting of pigs. If the federal government is concerned about the state of technology in electric batteries, printing and reproduction, industrial controls, and medical electronics, it might as well recognize that there are more direct routes to progress than through the collection of droppings from military and space research programs.—D. S. GREENBERG

Air Pollution: The "Feds" Move To Abate Idaho Pulp Mill Stench

"How many times have I heard it said 'it smells like money.' This stupid silly joke is not funny. To me it 'smells like death.' "—From a letter written by a Lewiston, Idaho, resident.

Lewiston, Idaho. Officials of the Public Health Service (PHS) estimate that more than 50 percent of the American population lives in areas of constant air pollution. Some of those who suffer from bad air in the nation's cities may have the idea that they could escape these irritants if they moved to a less populated region, say, to some location in the Rocky Mountain states —"where the skies are not cloudy all day," as the song goes. But unpolluted places are becoming more and more unusual. Communities such as Salt Lake City, Utah, Lewiston, Idaho, and Missoula, Montana, are only a few of the western cities where the skies are often clouded by a man-made haze.

On 19 August, a couple was awarded $2147 by a U.S. District Court because pollutants from the Weyerhaeuser pulp mill in Springfield, Oregon, had fallen on their property. On that same August date, the participants in a federal air pollution conference in Montana called for the Rocky Mountain Phosphates, Inc., plant at Garrison, a town of about 200 people between Missoula and Helena, to take pollution control measures or face closure. The conference on the Garrison plant is of importance to citizens in other areas of the country, because it is the first federal conference called to deal with an air-pollution problem located exclusively in one state. It sets a precedent for future federal efforts to abate intrastate air pollution.

All other federal conferences conducted under the provisions of the Clean Air Act of 1963 have been called to deal with interstate situations. In all, there have been six formal interstate conferences, four of which were held this year: (i) Bishop, Maryland—Selbyville, Delaware; (ii) a pulp mill in Ticonderoga, New York, which was bothering Vermonters; (iii) northern New Jersey—southern New York; (iv) Kansas City, Kansas—Kansas City, Missouri; (v) Lewiston, Idaho—Clarkston, Washington; (vi) Parkersburg, West Virginia—Marietta, Ohio. The first example involved the Bishop Processing Company which was found to produce "sickening, nauseating and highly offensive odors"; this is the only case to be taken to a more advanced enforcement stage—that of a formal hearing. In May of this year, the Hearing Board told this animal-rendering company in Maryland to abate the "discharge of offen-