always demanded. The writer was given a membership card for the Hotel Russel Erskine's "Rocket Club" along with his room key. One imbibes knowing that he is contributing to a good cause. "We have a joke here," says James Record, chairman of the county commissioners. "When you bend the elbow, you're doing it for art."

The liquor-tax money is piling up, and construction of the cultural center may start sometime next year. Once the center's doors are flung open and other objectives of the city's ambitious renewal plan are met, perhaps the downtown and its new cultural attractions will pull a few more people away from the motel, drinking-club, shopping-center culture found along Memorial Parkway.

In sum, Huntsville is moving on a broad front to try to capitalize on the fortunate circumstance that the Army and NASA have come with lots of jobs and federal dollars. In view of its beginnings and its problems, it is difficult to see how Huntsville could have done much more to make the most of its good luck.

—LUTHER J. CARTER

Technological Innovation: Panel Stresses Role of Small Firms

Efforts to force the federal government and the country as a whole to pay attention to the problems of civilian technology have met with relatively little success. For instance, in 1963, Congress decisively indicated that it was not interested in spending money for the Civilian Industrial Technology program proposed by the Administration and J. Herbert Hollomon, Assistant Secretary of Commerce for Science and Technology.

Hollomon has had to seek out other methods to focus attention on civilian technology. He has created and utilized a Commerce Technical Advisory Board, many of whose members are drawn from industry, as a source of scientific and technical advice independent of such traditional authorities as the President's Science Advisory Committee (PSAC). When asked about his relationship to PSAC in a recent interview with *Science*, Hollomon replied, "PSAC is concerned about the support of science; we are concerned about what you do to stimulate innovation in the private sector. . . . The people who use science are a different breed of cat than the scientists."

In the past few years, the Technical Advisory Board, which Hollomon heads, has created a group of panels to study important national problems in civilian technology. In 1965, the Board appointed a Panel of Invention and Innovation* which recently issued a report entitled "Technological Innovation: Its Environment and Management." Although discussion about technological change has long centered around the need to increase expenditure on research and development, the panel reports that it is unable to state that the nation is lacking in R & D investment for promoting innovation.

Rather, the panel concluded, there is need for much more attention to the social and business climate which creates the possibility for such change. The panel argued that R & D accounted for less than 10 percent of the total cost and effort of technological change, and that it was necessary to separate the idea of "invention" from that of "innovation"—the process by which an invention is injected into the economy. The group readily admitted that it lacked much of the information necessary to comment with complete accuracy on technological innovation but stated that this gap was in itself significant: "the lack of objective data, in or out of government on the innovation process in general and the technologically based firm in particular, is symptomatic of a very serious deficiency

*Robert A. Charpie, president of Union Carbide Electronics, served as chairman of the panel. The other members were: Lawrence S. Apsey, John F. Costelloe, John F. Dessauer, John McK. Fisher, Aaron J. Gellman, Peter C. Goldmark, Earl W. Kintner, Mark S. Massel, Richard S. Morse, Peter G. Peterson, Sidney I. Roberts, Dan Throop Smith, John C. Stedman, William R. Woodward. Daniel V. De Simone, director of the Office of Invention and Innovation in the National Bureau of Standards, served as executive secretary of the panel and wrote the report. The panel was composed of private citizens, most of whom were drawn from industry, academic life, and the legal profession.

The 83-page report can be obtained for $1.25 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

President Proposes Patent Reform

President Johnson recently sent to Congress the Patent Reform Act of 1967. If passed, the bill will mark the first significant changes in the patent law since 1836. The slowness and complexity of the patent system have often been criticized as impediments to U.S. technological progress. Although requesting many procedural changes, the President's bill does not deal with the controversial question of the ownership of patents resulting from government-sponsored research.

The Patent Reform Act of 1967 closely follows the recommendations of the President's Commission on the Patent System (which are described at some length in *Science*, 30 December 1966). The new patent legislation embodies most of the Commission's recommendations including adoption of a "first to file" system; giving patents a 20-year term after filing date; publication of patent applications within 2 years of filing; creation of a statutory advisory commission to provide continuing evaluation of the patent system; and presumption by the courts of Patent Office correctness in denying patent claims. The bill did not include the Commission's recommendation that patents no longer be given on ornamental designs and on certain types of asexually produced plants.

NEWS IN BRIEF

● **TRIAL DRUG-TESTING CENTER:** The Food and Drug Administration has begun a pilot program at the St. Louis district office to study the feasibility of a National Drug Testing Center. Under the project, all samples of drugs in certain therapeutic classes will be sent to St. Louis from other FDA districts for testing. Commissioner James L. Goddard explained that a national testing center would permit greater use of the sophisticated, automated instrumentation developed in recent years, and would further the development of more advanced instrumentation and procedures. The pilot program at St. Louis will be implemented gradually with other duties of that office being shifted to different field laboratories as the drug workload increases. Even if a National Drug Testing Center were established on a permanent basis, Dr. Goddard said, district offices would continue to handle some drug analytic work since not all products lend themselves to automated analytic techniques.

● **INDUSTRIAL RESEARCH AND DEVELOPMENT**: Industry is substantially increasing its own expenditures for research and development, according to a study by the National Science Foundation, but the federal government remains the major source of financial support for industrial R&D. In a study comparing 1964 and 1965, NSF reports that industry increased its expenditures by 11 percent, while the federal contribution rose only 1 percent. Total R&D industrial expenditures in 1965 was $14.2 billion, up 5 percent from 1964. Of this, 55 percent was federal funds. Spending for basic research increased 8 percent; development, 6 percent; and applied research, 3 percent. The aircraft and missiles industry maintained its position as the largest industrial source of research and development, accounting for $5.1 billion or 36 percent of the total R&D activity. Of this, almost 90 percent was financed by the federal government. However, this was an increase of only 1 percent over 1964 expenditures while other major industries showed gains ranging from 4 percent for rubber products to 19 percent for professional and scientific instruments. In 1965, five industry groups spent 85 percent of the total R&D dollar: aircraft and missiles, electrical equipment and communication, chemicals and allied products, motor vehicles and other transportation equipment, and machinery. Industry employed approximately 358,000 R&D scientists and engineers in January 1966, up 4 percent from the January 1965 level. The ratio of total R&D funds to net sales for all manufacturing industries dropped slightly from 4.6 in 1964 to 4.3 in 1965. This data is included in a preliminary report on the 1965 industry survey conducted for NSF by the Bureau of Census, U.S. Department of Commerce, and contained in NSF *Reviews of Data on Science Resources, No. 10*, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 20 cents.

● **METRIC SYSTEM STUDY**: The House Science and Astronautics Committee is making another try this year to get a bill passed calling for a Department of Commerce study of the metric system. The committee approved HR 3136 last week which asks for a 3-year study of whether the United States should convert to the metric system. A similar bill was approved last year but never got out of the rules committee. That committee has a new chairman, Representative William M. Colmer of Mississippi, and prospects look better. The Senate passed a similar bill in the last Congress.

● **DENTAL RESEARCH CENTER GRANTS**: The University of Washington and the University of Pennsylvania have been awarded grants under a new National Institute of Dental Research program of support for planning and developing dental research institutes or centers. Washington will receive $252,905 for the first year to plan an interdisciplinary Research Center in Oral Biology. Pennsylvania was awarded $600,851 to develop a Center for Oral Health Research, a long-range project expected to total $7.5 million. The new program encourages institutions to develop research and training centers on a broad base bringing the total university resources of clinical, basic, and life sciences together. In some instances, a proposed center may draw on resources available within a region, rather than a single university.

in our thinking regarding technological innovation . . . too few people in government, in industry, in banks, and in universities understand the special forces at work in the conception, appraisal, and nurturing of the innovative, technological enterprise."

While noting that large firms with more than 5,000 employees did "almost all" of the nation's industrial R & D, the panel argued that independent inventors and small firms contribute a larger percentage of the nation's inventive progress than their relatively small R & D expenditure suggests. As evidence, the report listed 33 "important inventive contributions of independent inventors and small organizations in the twentieth century." These included: xerography, DDT, insulin, the vacuum tube, rockets, streptomycin, penicillin, the cyclotron, the jet engine, the FM radio, the helicopter, air conditioning, the Polaroid camera, the ball-point pen, and cellophane. Large firms, the panel noted, are often unwilling to take the risks necessary for the invention and development of new products or techniques.

The climate for technological innovation and the propensity to generate new technologically based firms varies greatly within the United States, the report said. It singled out Boston, Palo Alto, Washington, D.C., and Pittsburgh as cities producing many new firms, while Philadelphia, Chicago, Kansas City, and Atlanta created few such companies. The panel formulated some general conclusions about the environment encouraging the development of such companies which included: (i) venture capital sources which are "at home" with technologically oriented innovators; (ii) technologically oriented universities located in a business climate which encourages university personnel to generate technological ventures; (iii) entrepreneurs who have been influenced by examples of entrepreneurship—"It is our contention that entrepreneurship breeds entrepreneurship."

Policies of Federal Government

Despite the importance of small companies in technological progress, the policies of the federal government often do not contribute to their success. The report stated that the total percentage of federal work performed by small companies has decreased in the past 5 years and that current contracting trends of the Department of Defense and NASA "work against the interests of small technologically oriented

ventures." The group formally recommended an interdepartmental review of the contracting practices of agencies such as DOD, NASA, AEC, and NIH, "to ensure that these policies are conducive to the long-range growth of small enterprises." The panel also said that small companies are hampered because they have no official governmental spokesman in Washington, and it urged the Commerce Department to assume that role.

No Major Legal Changes

Since there is adequate venture capital in the United States, the panel concluded, there is no need for a federally supported program to provide such capital. It also rejected the commonly made proposal of a 75 percent tax credit for all R & D expenditure, and expressed its skepticism that any tax incentive for R & D alone would automatically lead to major increases in innovation. In short, the group concluded that there was "no need to recommend any major changes in the present laws" governing the three major factors affecting invention and innovation—taxation, finance, and competition. The panel did not go so far as to suggest a proposal which some technologically minded observers have recommended—that the federal government help new companies bear some of their financial losses during their first precarious years.

Recommendations for Federal Action

The panel did not propose radical new federal departures in promoting technological change, but it did make 17 specific recommendations for federal action. Most of these were concerned with taxation or with the administration of the antitrust laws. The panel's recommendations included: a White House conference on technological innovation, followed by a series of regional conferences on the subject; a 10-year tax "carry forward," against profits, of the losses of small technologically based companies; an improvement of the stock option to allow new firms to attract management personnel more readily; amendment of the Internal Revenue Code to permit a casual inventor to deduct out-of-pocket expenses legitimately incurred for the purpose of ultimately producing income; and the taking into account of the effect of innovation, as well as competition, in the administration and interpretation of current antitrust laws.

Although the panel's specific recommendations are of interest, the main thrust of the report is educational—both in providing ideas about the process of innovation and in stressing the need for much more intensive study of the subject. Daniel V. De Simone, who served as executive secretary for the group, indicated that the study had been a highly informative foray into a largely uncharted area for the members of the panel. One factor which impressed the group, De Simone said, was the importance of social innovation. "If we speak only in terms of technological change, without considering the social factors, we're just going around with horse blinkers," he said.

Hollomon's Reaction

The panel recently presented its report to the Commerce Technical Advisory Board and to Hollomon. (On 1 February, President Johnson gave the energetic Hollomon the additional job of Acting Under Secretary, the second highest position in the Commerce Department.) "It's a first-rate report," Hollomon said. "It illuminates a phenomenon that few people understand." He agreed with the panel's downplaying of the importance of R & D in promoting technological change, "R & D by itself doesn't do anything, it's sterile without the innovator and the entrepreneur." Hollomon said that he plans to distribute the report widely through Federal agencies and hopes that it is carefully read. He said that the recommendations will be considered by the concerned agencies, and indicated that he thought that a national conference on technological innovation would be held, although probably under the auspices of the Secretary of Commerce rather than the White House, in contrast to the recommendation of the panel.

Although it will still probably be difficult to focus adequate attention on civilian technology problems, the panel's report on technological innovation is likely to provoke considerable discussion in coming months.

—BRYCE NELSON

Appointments

Arnold B. Arons, research physicist and undergraduate science teacher at Amherst College, to president of the American Association of Physics Teachers; **Stanley S. Ballard**, head of the department of physics at the University of Florida, to president-elect of the Association. . . . **Peter A. Franken**, physicist at the University of Michigan, to deputy director of the Advanced Research Projects Agency of the Department of Defense, succeeding **Robert Frosch**, who has been appointed assistant secretary of the Navy for research and development. . . **Nolan Estes**, deputy associate commissioner for elementary and secondary education, to associate commissioner and head of the Bureau of Elementary and Secondary Education. . . . **James M. Stengle**, special assistant to the associate director for extramural programs, National Heart Institute, to chief of the national blood resource program. . . . **Jack A. Hunter**, assistant director for engineering and development, Office of Saline Water, to director of the Office succeeding **Frank C. Di Luzio**, who was appointed assistant secretary of the Interior for Water Pollution Control. . . . **Robert B. Abel**, assistant research coordinator, Office of Naval Research, and executive secretary of the Interagency Committee on Oceanography, to head the National Science Foundation's program to implement the National Sea Grant College and Program Act of 1966. . . . **William D. Mayer**, associate dean of the School of Medicine, University of Missouri, to dean of the school and director of the Medical Center; **Vernon E. Wilson**, now dean and director of the school, to executive director for health affairs. . . . **William D. Toussaint**, professor of economics, North Carolina State University, to head of the department of economics, the Institute of Agricultural Policy, the Center for Economic Studies and extension and research programs in economics at the University. He will succeed **C. E. Bishop**, who has become vice-president of the consolidated University of North Carolina.

A Correction

The first of two articles on chemical and biological warfare (Chemical and Biological Warfare (I): The Research Program, *Science*, 13 January 1967) incorrectly stated that the Illinois Institute of Technology is among institutions conducting research on CBW. IIT is conducting no work on CBW and does not engage in classified research. The work in question is being performed at the Illinois Institute of Technology Research Institute, a separate organization affiliated administratively with IIT.