George B. Kistiakowsky, chairman, NAS Committee on Science and Public Policy

carries with it the possibility of a bloody nose, the Academy had previously followed the practice of venturing no closer than necessary to matters of public controversy. It based this policy on the argument that its charter specified that it was to speak only when spoken to by government agencies seeking its assistance. The charter has not changed, but since science has grown to a point where it is a legitimate subject for public policy debate, events have led the Academy to a new conception of its role. And with formation of the Science and Public Policy committee, under the chairmanship of George B. Kistiakowsky, it has been demonstrated that if the Academy wishes to speak out on a subject, it is not difficult to elicit an invitation. In the case of the current report, the invitation came from the American Society of Biological Chemists, but it is clear that Kistiakowsky felt the study was long overdue, and clear that if that particular society, or the several others that later issued similar invitations, had not invited the study, one means or another would have been found to bring the Academy to grips with the subject.—D. S. GREENBERG

Fermi Prize Money: Congressional Committee Takes Steps To Assume Control of Annual $50,000 Award

The congressional Joint Committee on Atomic Energy has quietly moved to assert its control over the $50,000 prize that accompanies the Enrico Fermi award.

The award, which honors "specially meritorious contribution to the development, use, or control of atomic energy," would still be given annually by the President upon the recommendation of the General Advisory Committee of the Atomic Energy Commission. But the prize money either would be substantially reduced or, if maintained at the present sum, would be awarded only with specific congressional approval.

The committee's move, which was first revealed by the New York *Times*, comes from a combination of diverse motives. First of all, the committee is currently incensed by the administration's seeming preference for supporting basic research at the expense of developmental research (*Science,* 13 March, p. 1149), and, in its pique, it has noted that basic researchers have predominated among bestowers and recipients of the award. (The latter have been John von Neumann, Ernest O. Lawrence, Eugene T. Wigner, Glenn T. Seaborg, Hans A. Bethe, Edward Teller, and J. Robert Oppenheimer.) It would like to see the honor go to some of the people involved in nuclear engineering developments, among them Admiral Hyman G. Rickover.

An Alumni Prize?

Furthermore, the committee has chosen to view as conspiratorial the fact that five of the Fermi recipients were, at one time or another, members of the nine-man General Advisory Committee whose nominations have governed the award. "They just give it to each other," was the analysis of one member of Congress.

The size of the award is also something that has impressed the money-minded members of Congress. The $50,000, which is tax free, is the largest monetary award regularly given by the U.S. Government. Congressmen have noted that the Nobel Prize is generally about $40,000 and is often shared by several recipients.

Finally, complementing the committee's general inclination to take control of the prize is a small undercurrent of hostility toward last year's award to Oppenheimer. It is worth noting, though, that this hostility alone probably could not carry the issue. Before the award was made to Oppenheimer the committee informally indicated its assent, and several members of the committee were on hand last December, happily beaming, when President Johnson carried through President Kennedy's plan to present the award personally to Oppenheimer at the White House.

The most conspicuous source of discontent with the selection of Oppenheimer was the committee's senior Republican senator, Bourke Hickenlooper, of Iowa, who does not share the view that the Oppenheimer security case was a sorry chapter in the nation's intellectual history. Hickenlooper declined to attend the White House ceremony for Oppenheimer, and since then has freely used words such as "revolting" and "shocking" in reference to the Oppenheimer selection. It does not appear that many of Hickenlooper's committee colleagues share his sentiments, but when the diverse motivations are put together, they add up to a consensus for giving the committee control over the prize money.

It is the money, incidentally, that seems to have caught the committee's attention. Hickenlooper himself commented in an interview last week that "since the prize is a technical one, it should be given by technical people. But the money part should be decided in congress."

The committee has not yet completed action on the prize money, but it has agreed informally either to cut down the monetary award or, if the amount is kept at $50,000, to make the award contingent upon congressional approval, which means its approval, since the Joint Committee is the fount of virtually all legislation concerning atomic energy.—D.S.G.

Stanford: Boom in Electronics in the San Francisco Bay Area Was Ignited Down on "the Farm"

Palo Alto. Stanford's central quadrangles, with their vaguely Romanesque "mission" architecture and cloistered calm, present a pleasantly anachronistic picture for a university which is generally regarded as a powerhouse of industrial development on the San Francisco peninsula.

Stanford and the University of California at Berkeley get credit for doing, by a kind of symbiosis, for "high technology" industry in the San Francisco region what M.I.T. and Harvard have done for the Boston–Cambridge area. And Stanford is viewed as the chief begetter of an electronics industry which in recent years has grown into an $800-million-a-year business employing 50,000 people.

Scouts from other regions of the country, seeking the secrets of success of the two most highly publicized electronics belts, are confronted with the fact that the university-industry complexes on both the east and west coasts grew through luck and good management and show a relatively long history of development—conditions which are not easy to produce.

Research and manufacturing firms of the peninsula, like those in the rest of California, are heavily engaged in defense and space work for the government, but diversification into civilian production has begun in earnest, and the intimations of a leveling off in the flow of government contracts (*Science*, 13 March, p. 1151) are spurring efforts to find new products for new markets.

Stanford has put itself in the van of these efforts, and it will be interesting to see whether it will be as ingenious and successful now in developing techniques and organizations to meet emerging conditions as it was in the postwar period when the needs of the government created a new order of challenges and opportunities for universities and industry.

The nexus between Stanford and the California electronics industry depends primarily on the university's strong science and engineering faculties, which are committed to instruction and research but accustomed to collaborating with industry. Stanford has long been a major producer of scientifically and technically trained manpower—the university, for example, granted more advanced degrees in engineering (448) in the 1962–63 school year than any other institution save M.I.T. (693).

Stanford "Spin-offs"

Even more direct contact with industry and government has been afforded by two Stanford-inspired off-campus enterprises: (i) Stanford Industrial Park, which has opened the way to a clustering of high-technology firms adjacent to the university, and (ii) Stanford Research Institute, established to carry on applied research in many fields, in contrast to the basic research done on the campus.

But in examining the links between Stanford and electronics it is necessary to look back over events of a half century which afford a remarkable chronology of experimentation and work in the mainstream of telegraph, telephone, and radio development, leading to the emergence of the postwar electronics industry.

In 1908 the first radio-telephone station on the West Coast was built, in Palo Alto, by Cyril F. Elwell, and by 1912 the trio of Lee de Forest, Charles V. Logwood, and Herbert Van Etten had discovered the amplification and oscillation characteristics of the audion tube which de Forest had developed.

In this period, forerunner electronics companies were established in the Palo Alto area; in general they concentrated on long-range radio-telegraph work which carried through World War I.

In 1924 Stanford set up a "communications laboratory," and under the direction of a young engineer named Frederick Terman it became a center of research in electronics, attracting a number of young men who were to distinguish themselves in electronics research and other fields. The lab seems to have served also as a kind of early experiment station in working out modes of university-government-industry cooperation on research.

More Milestones

In 1937 Russell and Sigurd Varian in company with W. W. Hansen invented the Klystron tube, opening the way for microwave radar and many other developments in electronics. Ladislaus Marton, who is credited with invention of the electron microscope, and Cornelius Bol, who devised the mercury vapor lamp, were both Stanford researchers in this period.

In the years since World War II, Stanford's continued distinction in basic research in natural science is exemplified by Nobel prizes in physics won by Stanford researchers Felix Bloch in 1952, Willis E. Lamb, Jr., in 1955, and Robert Hofstadter in 1961. Construction of the first linear electron accelerator by Edward L. Ginzton and William Webster Hansen in 1947 led to Stanford's becoming a world center in high-energy physics research and, ultimately, to the building of the 2-mile-long, $114-million Stanford Linear Accelerator, which is now under construction.

A pivotal figure in the prewar and postwar development of Stanford, both in research and as an ally of research-based industry, has been Frederick Terman, now vice president and provost of the university. Terman was a pioneer in electronics research, the author of widely used textbooks, and, before World War II, head of the department of electrical engineering. During the war he served as director of the Government Radio Research Lab at Harvard. Terman came back to Stanford as dean of engineering and became director of the electronics research lab, created in 1951. With its five subdivisions—radioscience, solid-state physics, electron devices, systems theory, and systems techniques—the research lab became a powerful magnet for electronics firms.

Terman is credited with having seen early and clearly that the government would be using the research capabilities of universities and industry to an unprecedented extent after the war, and Terman is also said to have foreseen great potential for economic development in university-industry cooperation.

Establishment of the electronics research lab seems to have led directly to the creation of the Stanford Industrial Park and to the buildup of electronics firms in the area. Terman is looked upon as the man who built the key bridge between research and industrial applications. At Stanford, he also has acquired a reputation as an acute judge and effective recruiter of faculty material—so acute and effective, in fact, that his opinion counts in decisions on men beyond the boundaries of science and engineering. Not only are appointments often attributed to Terman but faculty members who leave Stanford are sometimes referred to as having been "Termanated."

Stanford Industrial Park seems to have been the first such major facility to be owned and developed by a university. Creation of the park struck some observers as a surprising move for Stanford, which, despite a strong science and engineering tradition, was regarded as an affluent, private university influenced by a pastoral setting which caused it to be called—as it still is, with increasing incongruity—"the Farm."

Not Fenced In

Stanford authorities may well have been nudged toward commercial use of some of the university's land simply because it was so well endowed by the seigniorial grant of nearly 9000 acres (3600 hectares) by founder A. Leland Stanford. Unlike many other universities, Caltech and U.C.L.A., for example, Stanford is not bursting its boundaries. But like other private universities it does have to pay taxes on land not used for educational purposes, and property taxes in California are not insignificant. In addition, Stanford was subjected to postwar pressure to increase enrollment at a time when educational costs were rising. The need for greater revenue was sharpened by plans to expand enrollment of graduate students, who are much more expensive to educate than undergraduates.

The industrial park was established in the early 1950's. A 1953 master plan called for leasing 210 acres of land—the Stanford will prevents sale of university land—but an informal start on the park had been made in 1950, when the Varian Associates electronics firm leased 10 acres at a corner of the university tract.

Cooperation between the university and local planning and zoning authorities has made it possible to extend the industrial park to 700 acres, about 400 of which are now developed. At latest count there were 43 firms in the park, employing over 11,000 people. More than half the firms are electronics-oriented; other tenants are in publishing and printing and in research fields other than electronics.

Stanford has also set aside blocks of leased land for a shopping center and a professional area. Taxes from university land now amount to some $5.4 million a year, with firms in the industrial park bearing about two-thirds of the burden.

Leases in the park are now set at 55 years, a term shortened from an original 99 years because of Stanford's reluctance to tie up land for protracted periods when the university's needs may change.

The park was not a runaway success at first. The lease terms and the close control of architecture, landscaping, and such details as size and design of signs may have acted as a deterrent to prospective tenants. But in recent years expansion has been rapid.

Managing Research

Stanford's approach to the problem of how to separate basic and applied research has differed from that of M.I.T. and the University of California. The two latter universities manage off-campus facilities for applied research on contract to the government. In the case of M.I.T., the big Lincoln Laboratories, run for the Air Force, is the most notable example. U.C. administers three major labs, for which the Atomic Energy Commission is the main contractor. The renowned Lawrance Radiation Laboratories at Berkeley carries on primarily unclassified research. The laboratory at Livermore performs weapons work and R&D on other projects, such as space applications of nuclear sciences. And the U.C.-managed installation at Los Alamos, New Mexico, specializes in weapons development and testing.

At Stanford, however, the Stanford Research Institute (S.R.I.), a separate nonprofit institution, does work totaling some $30 million a year in applied research for government and private clients.

S.R.I. was formed in 1946 partly at the behest of West Coast industrialists who had been impressed during the war by what was accomplished through organized thinking by scientists and other professionals.

In structure, S.R.I. is an independent, nonprofit corporation tied to Stanford only at the top. Stanford's president is chairman of the S.R.I. board, and the S.R.I. board interlocks with the university's board of trustees because the directors are elected by the trustees, some of whom also serve on the S.R.I. board.

Mutual Advantages

S.R.I. is located in Menlo Park, adjacent to Palo Alto, and the university and institute have standing arrangements for consultation and for mutual use of library services and some special research facilities.

Many of S.R.I.'s earlier contracts were for electronics work, with the federal government the ultimate customer, but in recent years the institute has broadened its horizons and has attracted private associations and foundations and state governments as clients. As the variety of S.R.I. projects increased, the institute's operations became far-flung. In the U.S., S.R.I. has field offices in other parts of California and in New York, Washington, Detroit, Huntsville (Alabama), and Toronto. Overseas, it has its name on the door in Lima, Milan, Tokyo, and Zurich. The staff now numbers about 2000, of whom some 600 have advanced degrees, some 250 of them Ph.D.'s.

S.R.I. puts its projects into three general classifications—physical and life sciences, engineering sciences, and economics and management sciences. Projects range from appraising weapons systems and building radio telescopes to doing agricultural research and making studies of the balance-of-payments problem. It is worth note that S.R.I., which has ridden the crest of the research-industry wave in California, has made one of the first major efforts to subject the development of university-industry complexes to systematic study. For a year, a systems-analysis group has been looking hard at three regional R&D centers which have emerged in the past decade, and before summer it should be releasing a report aimed at separating fact from myth in analyzing the three little centers and how they grew. Now the group is moving into a study of the much larger and more complicated subject of the rise of the San Francisco Bay complex.

A comprehensive study on the California economy (starting with 1947 and projected to 1980), which another S.R.I. group completed in 1961 for the State Chamber of Commerce, gave the institute an opportunity to ponder the dynamics of economic growth. The report focused attention on the relation of population growth in the state to the increase of civilian employment, and, therefore, to the measurable influence of defense expenditures on the state's development.

Recently, with a leveling off of defense spending predicted and a change in the procurement "mix" anticipated, S.R.I. officials and analysts have been cast in the roles of well-briefed Cassandras warning that extraordinary measures will be required if California is to sustain its remarkable momentum.

The pitch of the discussion of what to do next is rising in California. Some lament the "business climate," which generally means they think taxes and wages are too high. So far, however, a majority of the authoritative voices seem to be calling for more investment in new industry, more effort to transfer science and advanced technology to industry, more ingenious and aggressive exercise of management and sales skills. And, in an economy in which, because of technological change, rising production has not been accompanied by proportionate advances in employment, almost everybody is calling for more education.—John Walsh