ting back centralized labs where basic research tended to be done. The OECD surveyors wonder whether some basic research labs might not have been closed before it could be determined whether their work would have led to useful innovation.

The OECD sees U.S. industry as confronted with serious new challenges. The relative competitive advantage of U.S. industry in international markets is seen as diminished by the growing sophistication of industry abroad. Environmental legislation in the United States has imposed restraints on industry operations, and the energy crisis has increased costs and created need for new energy sources.

Tensions between government and industry have been sharpened because new legislation and regulatory agency orders sometimes place conflicting demands on industry. Auto manufacturers, for example, may find it difficult to reconcile requirements to meet new air emissions and safety standards while simultaneously increasing mileage performance of autos to meet energy conservation demands. At the same time, car makers may be barred from collaborative research by antitrust laws.

A more subtle but nevertheless serious problem facing industry is what the OECD teams dub "the technology trap." The study describes it this way.

> Several R & D directors underline independently that the choice of technologies to be pursued has become a graver and more difficult problem than it has ever been before in the United States. It is easier to present concrete examples of this difficulty than statistical data or final explanations. Two interpretations of this problem can be found; they are probably more complementary than contradictory. According to the first one, the growing pool of scientific and technological knowledge multiplies the number of possible technical solutions to the same problem, whereas 10 or 20 years ago the number of choices was still smaller and industrial decisions therefore simpler. Aircraft builders support this interpretation: "Technology advances are now being made in so many directions that a new problem has arisen: the technology trap. Just because something is technologically possible does not mean that it should be developed into hardware."
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> According to the other, complementary interpretation, presented among others by the research director of IBM, the development costs of new technologies are increasing quicker than for example other production and marketing costs; in other words, the R & D part in the total costs of certain advanced technologies is increasing.
>
> Hence, choosing the right technology at the very beginning is more and more vital, and choosing the wrong one can be more and more fatal. While the number of possible solutions apparently increases, each single solution is said to become more expensive in relation to other costs, at least in some high technology sectors. This explains why individual companies are apparently less able than before to test alone all possible technologies in one sector, and less willing to choose, because the penalty for choosing wrongly can be fatal for a single company. . . .

The days when defense and aerospace industries and other government contractors enjoyed relatively simple relations with Washington have passed. Using the ordeal of Lockheed and other contractors as examples, the report questions whether the old "pluralistic, competitive" system can survive. In Japan, some European countries, and Canada, cooperation between government and industry is much more highly developed. And although they concede that tradition in the United States strongly opposes government intervention in industry, the authors see a trend toward government action.

A main finding of the OECD group is that the United States badly needs a strong technology policy. By this is meant that "responsible national authorities [should] influence the selection of industries and technologies through direct and indirect support, according to economic, social and political criteria which will indicate the most important technologies for the future of the country."

While a major remaking of habits and attitudes will be required, OECD sees some signs of a more interventionist attitude in Washington spurred on by balance-of-payments problems. The report cites the New Technological Opportunities (NTO) program headed by William N. Magruder, which caused a flurry in 1971. The idea was to provide some direct aid to industry in developing designs for new technology meant to bolster trade, security, or social enrichment. Also cited is the technology incentives program, sponsored jointly by the National Science Foundation (NSF) and the National Bureau of Standards, which is meant to encourage industrial R & D in innovative areas. However, NTO and Magruder have disappeared from the government scene, and the incentives program is just now climbing out of the incubator. Given the old and new tensions between government and industry and industry's concern over proprietary rights, the practical prospects for a workable technology policy seem highly uncertain. The OECD case for a technology policy is indeed persuasive, but so, after all, is the case for a coherent science policy, and that has never been enough to overcome the obstacles.

The report is probably right, however, in predicting that the government will increasingly give priority to oriented research designed to attain economic and social goals. In a related effort, government is seen as pressing for better measures of the value of research.

The global inference drawn in the report is that, while the scientific potential in the countries studied has increased greatly, no effective strategy for managing it has emerged, and in such countries as the United States, science policy machinery is in considerable disarray.

In the United States and most of the other countries studied, however, the authors see a tendency toward conducting discussions of scientific and technological issues more openly than in the past. They also note a trend "in favor of ministerial bodies vested with fairly broad responsibilities to influence the whole scientific and technical activity."

What they have in mind is apparently a cabinet-level body without operating responsibilities, but performing primarily coordinating functions. They see this approach being taken in the United States with the effort to enhance the role and influence of NSF.

A main conclusion of the report is that the decision-making process for science and technology should recognize the demand for broader consultation than in the past. Not only should scientists and engineers outside government be more widely involved, but "representatives of the potential users, . . . should be associated with the definition of problems, the determination of objectives and the orientation of research programs."

Achieving such participation is easier said than done. But in saying it, the OECD has expressed a revised concept of what science policy is ultimately about. And this, in fact, is a major service performed cumulatively by the three volumes of *The Research System*, which might be subtitled "From technology gap to technology trap."—JOHN WALSH

RECENT DEATHS

Rena L. Foy, 45; professor of education, Bowling Green State University; 7 February.

Samuel Gelfan, 72; professor emeritus of neurophysiology, New York Medical College; 16 March.

Morris A. Goldberger, 82; professor emeritus of gynecology, Mt. Sinai School of Medicine, City University of New York; 1 March.

Miriam C. Gould, 85; former professor of psychology, Vassar and Smith colleges; 29 January.

Ellwood S. Harrer, 70; professor emeritus of wood science, Duke University; 5 February.

Henry L. Heyl, 68; former associate dean, Medical School, Dartmouth College; 1 March.

Israel Light, 59; dean, School of Related Health Sciences, University of Health Sci-

ences/The Chicago Medical School; 20 February.

Lloyd Lowder, 52; professor of education, Pfeiffer College; 7 January.

Theodore K. Matthes, 41; associate professor of mathematics, University of Oregon; 10 February.

Kenneth Melville, 72; former chairman, pharmacology department, McGill University; 29 January.

Bethel S. Pickett, 92; former chairman, horticulture department, Iowa State University; 25 January.

W. Conway Pierce, 79; professor emeritus of chemistry, University of California, Riverside; 23 December 1974.

Leonard Reissman, 53; chairman, sociology department, Cornell University; 29 January.

Robert Robinson, 88; former professor of chemistry, Oxford University; 9 February.

Caroline B. Rose, 61; professor of sociology, University of Minnesota; 25 March.

R. Norris Shreve, 89, professor emeritus of chemistry, Purdue University; 17 February.

Nelson T. Spratt, Jr., 63; former chairman, zoology department, University of Minnesota; 16 February.

Katherine K. Stefic, 72; former professor of psychology, Catholic University; 21 January.

RESEARCH NEWS

Diabetes (III): New Hormones Promise More Effective Therapy

The traditional view of diabetes, and a view still held by most laymen, is that the disease is a rather simple metabolic disturbance resulting from impaired insulin production alone. This view resulted from two principal sets of experiments: the demonstration in 1889 by Joseph von Mering and Oscar Minkowski of the Halle Medical Polyclinic in Germany that removal of the pancreas produces diabetic abnormalities of glucose metabolism; and the 1922 demonstration by Frederick G. Banting and Charles H. Best of the University of Ontario that administration of insulin (in the form of a crude pancreas extract) could correct these abnormalities.

Subsequently most therapy of diabetes was based on the observations of Banting and Best. But even though the use of insulin has greatly increased the life-span of many diabetics, diabetes is still a major cause of death in the United States and its side effects have crippled many individuals. As clinical and research experience became more extensive, it became obvious that some factor in addition to impairment of insulin action is operative in diabetes; this has prompted increasing interest in the mechanism of the diabetes syndrome.

The prime focus of investigation in the molecular biology of diabetes during the last decade has been on glucagon, another hormone produced by the pancreas. Work by many different investigators has led to the conclusion, only now beginning to be accepted by a majority of scientists, that glucagon is as important a factor in diabetes as insulin. But whereas insulin is normally deficient in diabetes, glucagon is normally present in excess. This fact has made it quite difficult to study the role of glucagon, for while it is easy to add extra quantities of a hormone such as insulin, it has proved quite difficult to lower the concentration of glucagon.

It was thus a major breakthrough 2 years ago when several investigators discovered that another recently isolated hormone, somatostatin, could suppress the release of both insulin and glucagon. For the first time, then, it became possible to vary the concentrations of insulin and glucagon independently to investigate their effects. It quickly became apparent that glucagon plays a crucial role in the pathology of diabetes.

Glucagon was discovered in 1923 by John R. Murlin and C. P. Kimball of the University of Rochester; but as recently as 1969 most investigators thought that it played only an insignificant role in the regulation of glucose metabolism. It is a linear oligopeptide composed of 29 amino acid residues in the sequence shown in Fig. 1. Glucagon from all mammalian species thus far examined has this same primary structure; the only exception so far known is glucagon from turkeys, which differs by one amino acid residue.

Many investigators have shown that the primary site of release of glucagon is the alpha cells from the islets of Langerhans in the pancreas. Last year, however, Mladen Vranic of the University of Toronto and Sumer Pek of the University of Michigan reported a persistent, glucagon-like immunoreactivity in the blood of dogs that had been depancreatized. This observation has been confirmed by other investigators, including Tatsuo Matsuyama and Piero Foa of Wayne State University, James B. Field and his associates at the University of Pittsburgh, and Andrew V. Schally and his colleagues at the Tulane University School of Medicine.

Earlier this year, Roger H. Unger and his associates at the University of Texas Southwestern Medical School demonstrated that a substance which is immunologically, biologically, and physicochemically identical to glucagon is also released by tissues in the stomach and upper intestine of dogs. Lelio Orci of the University of Geneva in Switzerland has shown that these tissues contain cells that are morphologically identical to alpha cells of the pancreas.

But some apparently conflicting evidence was recently presented by W. A. Muller and his associates at the Elliott P. Joslin Research Laboratory in Boston. They showed that infusions of arginine, which normally produce an increase in the concentration of glucagon in the blood, produce no effect in humans in whom the pancreas was removed. This suggests that human stomachs do not produce glucagon. Vranic and Pek have shown, however, that release of glucagon by the pancreas and the stomach are subject to different controls. And Unger has shown that administration of insulin to depancreatized dogs will block the secretion of glucagon by the stomach (Muller's patients apparently received insulin). The situation in humans must thus be considered to be unresolved.

Three different lines of evidence, according to Unger and Orci, support the conclusion that glucagon has a role in the pathology of human diabetes: (i) An increase in the concentration of glucagon (hyperglucagonemia) has been observed in association with every type of increase in the concentration of sugar in the blood (hyperglycemia) of animals and humans. (ii) When the secretion of both glucagon and insulin are suppressed, hyperglycemia is not observed unless the concentration of glucagon is restored to normal by the concomitant administration of glucagon. (iii) The somatostatin-induced suppression of glucagon release in diabetic animals and humans restores blood sugar concentrations to normal and alleviates certain other symptoms of diabetes.