are reluctant to leave the comfortable boundaries of specialized research to become involved in the hurly-burly of group action. Yet it may be that our ability to keep food production in step with population will rest to some extent on the degree to which we approach problem-solving on a wholly integrated basis.

In conclusion, I should be sorry if this article implied that agricultural scientists must climb down from their ivory towers and enter the real world. Quite the opposite. I believe that they are already in the real world, but it is the world of the past and the present and not sufficiently of the future. Among the different paths to the real world of the future is one that leads through the door *to* the ivory towers. The future pace and accomplishments of agricultural research may well be determined by the extent to which agricultural scientists use this path.

References and Notes

1. J. R. Platt, *Science* **149**, 607 (1965).
2. M. Ways, *Fortune* **69**, 113 (1964).
3. R. P. Pfeifer, *Science for the Farmer* **13**, 3 (1966).
4. N. F. Jensen, *Crop Science* **6**, 376 (1966).
5. CAED Report 24, "Structural Changes in Commercial Agriculture" (Center for Agricultural and Economic Development, Iowa State University, 1965).
6. G. R. Ball, *Fortune* **75**, 87 (1967).
7. A. Srb, personal communication, Div. Biological Sciences, Cornell University, Ithaca, New York.
8. This article is Paper No. 541 in the Plant Breeding Series of the New York State College of Agriculture at Cornell.

NEWS AND COMMENT

Philips: International Company Cultivates Basic Research

Eindhoven. A sharp commercial sense and a readiness to look to new horizons have helped the Dutch to overcome the limitations of a small country meagerly endowed with natural resources. With such international enterprises as Shell, Unilever, and Philips, the Dutch anticipated the European Economic Community's quest for a bigger market. And Philips provides an example of an advanced-technology industry with a research effort which is highly institutionalized and big by any standard.

Philips, which celebrated a 75th corporate anniversary last year, was started by Gerard Philips, a Dutch engineer who finished his studies at the polytechnical school at Delft just as the arc light and carbon-filament lamp were making electric lighting a commercial possibility. In 1891 Philips established a lamp factory at Eindhoven. The young entrepreneur at first carried out the necessary research himself and later started a chemical laboratory within the Eindhoven factory. By 1914, however, he had decided there was need for a physical research laboratory outside the factory; he established one, and employed a young physicist from Leyden University, G. Holst, to run it.

In the 1920's this laboratory's research in gas discharges led to early Philips success in bringing onto the market sodium-gas-discharge lamps for road lighting and, later, high-pressure mercury lamps. The same interest aided Philips development of x-ray tubes and radio tubes. Philips engineers and scientists were quick to grasp the commercial potential of radio.

The laboratory continues to follow Holst's original lead and concentrates on basic research rather than development. But, at the same time, research follows lines which offer hope of ultimate applications—that is, products for the company. The unexpected sometimes happens. In the 1930's, synthesis of vitamin D for livestock led to the establishment of a flourishing pharmaceutical products branch, which now has its own separate research arm.

During World War II, Philips facilities in Europe were caught in the German occupation. After the war came a great expansion for Philips into the fields of television, telecommunications, and electronic systems and a corresponding expansion of the research organization, including the growth of major research laboratories in Britain, France, and Germany and a smaller one in Belgium. The main fields of research, according to one executive, are those concerned with materials, devices, electron physics, x-ray and nuclear equipment, and electronic systems. The research laboratories at Eindhoven remain by far the largest, employing 2200 people, 400 of them holders of master's or doctor's degrees. (The Dutch master's degree in science or engineering requires 6 years of university work, and the doctoral degree, about 9.)

These "graduates," as the Dutch call them, are the object of personnel policies which are at the heart of the Philips system. Young men are brought into the company at the age of about 30, when they have received their degrees. After 7 or 8 years in the research labs, by a process which apparently includes a strong element of self-selection, decisions are made which in most cases set the direction of the individual's career. Some remain with the laboratories. Others go to the operating divisions or to the development labs attached to the factories. Others may return to the universities; a fair number of Philips labs alumni are professors.

Departure from the laboratories is no disgrace, nor does it blight a man's career. Chances of preferment—of becoming a senior scientist or director—are said to be somewhat better in the factories. The company has a big stake in seeing that posts throughout the company are manned with good, technically trained men, and assignments and rewards are said to be under constant review, so that opportunities inside and outside the research labs will be kept on a par.

The whole system, from the original selection on, is a highly personal one. Holland is a small country, and close contact is maintained with faculty in the ten institutions—universities and technical universities—which produce the candidates. Representatives from the laboratories visit the universities each year, and young men completing their studies are discussed. Prime prospects are invited to the labs, and the visits are taken very seriously. The lab's deputy director for chemistry, for example, last year saw 90 prospects; nine of them ultimately joined the labs. The visitors also go to the company's central per-

NEWS IN BRIEF

• **UNITED STATES–SOVIET RESEARCH:** The first of two joint fisheries research cruises by Soviet and American scientists got under way 18 September from Woods Hole, Mass. The cruises mark the first time the two countries have undertaken cooperative marine research. During the voyages, scientists from both countries will work in teams aboard the Soviet vessel, *Albatros*, and the American research ship, *Albatross IV*. By the end of both cruises it is hoped that all scientists involved in the undertaking will have worked on both vessels. Plankton studies will be undertaken during the initial 5-day voyage which will be followed by 3 to 4 days of conferences prior to the start of the second voyage. Both cruises will take place in the Atlantic between Cape Hatteras and Cape Cod. The purpose of the second voyage, which will last about 1 month, is the study of groundfish resources. Groundfish are species which feed on the bottom of the ocean. Robert L. Edwards, assistant director of the Bureau of Commercial Fisheries Biological Laboratory at Woods Hole and head of the U.S. end of the cooperative program, said the cruises evolved from a series of negotiations between the U.S. and the U.S.S.R. that began in June 1966. Arkady Noskov is head of the eight-member team of Soviet scientists taking part in the effort. The Soviet team, which includes two women, arrived at Woods Hole on 11 September. Noskov is director of the Western Atlantic Laboratory, one of the laboratories at the Soviet oceanographic institute Alantniro, located in Kaliningrad on the Baltic Sea.

• **HEAD START TRAINING:** Five colleges and universities have been awarded contracts totaling $190,000 by the Office of Economic Opportunity (OEO) to conduct pilot training programs for staff members employed in year-round Head Start programs. OEO announced that the contracts are the first of about 70 that will be awarded during the coming year. The entire program is expected to cost about $2.5 million. Head Start staff members in the program may receive either precollege or college-level training. Institutions receiving the pilot contracts were: Wheelock College, Brookline, Mass., $22,000; Goddard College, Plainfield, Vt., $36,000; Texas Women's University, Denton, $29,000; Memphis State University, Memphis Tenn., $73,000, and Kansas State Teachers' College, Emporia, $30,000.

• **URBAN RESEARCH DIRECTORY:** A directory of university-sponsored and nonprofit urban research centers has been prepared by the Joint Congressional Subcommittee on Urban Affairs of the Joint Economic Committee. The directory, which contains brief descriptions of nearly 100 such centers in 29 states and the District of Columbia, was issued in conjunction with a series of urban studies now being carried out by the subcommittee. Titled *A Directory of Urban Research Study Centers*, copies may be obtained for 25 cents from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

• **TEXAS A&M CHEMISTRY EXPANSION:** The Chemistry Department of Texas A&M University has announced the appointment of 13 new faculty members as part of a general expansion of its graduate research program. Five of the appointees will be professors, one will be an associate professor, and seven will be assistant professors. A university official said that the expansion is part of a comprehensive graduate-level expansion throughout the university's College of Science. A statement issued by Arthur E. Martell, head of the Department of Chemistry, and Clarence Zener, dean of the College of Science, said that the new faculty appointments would "help form the beginning of five new chemical research institutes as well as bolster the research activity of the Department in the traditional areas of chemistry." The new appointments bring the total number of faculty in the department to 37. The department's graduate enrollment this fall is 96 compared with 72 students a year ago. The total graduate enrollment for the department is projected at more than 200 by 1970. The departmental expansion is being financed through the Texas State Coordinating Board of Education. Texas A&M is one of four Texas universities selected by the board for increased graduate level emphasis. The others are the University of Texas, Texas Tech, and the University of Houston.

sonnel offices in Eindhoven, where another assessment is made and such crass details as salary and housing problems are discussed. If the verdict on the visitor is favorable, an offer is made. An offer from Philips is a professional compliment in Holland, and the percentage of acceptances is high.

In joining the labs the young man enters an atmosphere which will have a strong effect on his attitudes. Research at Philips is understood to have practical ends, even if these may be remote. People may come in with a "purely scientific attitude," but, as one executive put it, "that changes here."

What changes it is, in part, the fact that in Holland the linking of research to applications seems to be regarded as more natural and desirable than it is, for example, in Britain, where the professional premiums are on "pure" research. Perhaps more to the point, the Philips tradition discourages work on which the long-term payoff is obscure. Those who watch the system operate say the typical researcher, as he marries, has children, and grows familiar with the operations of a big firm, becomes aware that his salary is being paid by the sale of something, and he wants to make a practical contribution rather than be an ornamental "goldfish." The Philips world is a rather self-contained one, and this has its influence. Eindhoven has a population of 180,000, and 30,000 people work at Philips plants and labs there. Philips is a paternalistic employer on an enlightened European model, and most researchers are company men, not least in the sense that they expect to work for Philips all their lives.

Within the labs, great efforts are made to see that scientific initiative is not stifled. Researchers are encouraged to propose and carry out their own projects. An individual need not work in the narrow field in which he took his degree but may follow his interests into quite different fields. Research groups often include a mixture of physicists, chemists, and engineers drawn from differing specialties. Researchers are encouraged to publish, and all results are reviewed for patent possibilities. The expectation is that work done at the labs will wind up either with a patent or in a first-class international journal.

Philips research work in Holland is concentrated at Eindhoven, and more than half the total company budget for research, foreign and domestic, is spent there. The research budget now runs

at about 1.5 percent of Philips's annual sales, or a total for research of about $30 million a year. About 4 to 5 times as much is spent on development.

Outside Holland complications arise in the administration of research, particularly when Philips's other European labs are conducting "third party" research financed by local governments. The results of military work are kept secret, and the central research organization has no access to such results. A Philips lab in one of the other European countries may be doing contract military work, research financed out of the central research budget, and projects paid for by the national company. Conflict over lines of authority occurs, but Philips people have learned to live with it.

There would appear to be a temptation to have Philips labs specialize according to national research strengths—chemistry in Germany, perhaps optics in France, solid-state research in Britain. But Philips takes the view that the host countries would dislike such a policy, and it has tried to base research fairly broadly. Research is carefully coordinated, however. Philips, for example, contemplates entering the highly competitive computer field sometime in the future. Philips now owns one small Dutch computer company, and research work on "memories" is being carried out at the Philips British research laboratories; on peripherals, at the Hamburg labs; and on software, in Belgium.

In the United States, Philips development has a special history. When Holland was invaded in 1940, control of Philips properties in North America passed to a trust under provident prearrangement by the management. After the war, whereas in Britain a similar trust was turned back to the full control of Philips, it was decided that North American Philips would be in a better position if the trust were continued and the company were more "American." Government contracts were one consideration. The Philips research lab at Briarcliff, New York, is covered by the arrangement, and its research results are normally not available to the Philips central research organization.

Philips research policy, which seems to work well enough in practice, is not easy to state in principle. But Philips research director H. G. Casimir, in an anniversary anthology of research, of which he was an editor, put it this way. "For the future of a single industry it

Handler Statement on Smale Case

Philip Handler, chairman of the National Science Board, has issued the following statement, reprinted in part, concerning the relationship between Stephen Smale, the Berkeley mathematician, and the National Science Foundation, of which the board is the highest-ranking advisory body. The statement was delivered to Science *following completion of an article on the Smale case for the issue of 15 September, but prior to publication.*

September 12, 1967

1) The Director of the National Science Foundation has kept the National Science Board informed of the successive events relating to the Foundation's support of the research of Dr. Stephen Smale. . . .

2) Last fall the Board discussed the activities of Professor Smale on the occasion of his attendance at the International Congress of Mathematicians in Moscow . . . and agreed that Dr. Smale's political activities did not, to the Board's knowledge, warrant any change in the relationship between the Foundation and the University of California with respect to Dr. Smale.

3) The Board . . . concurs with the Director that management of this (Smale's) grant has been relatively loose and has not conformed to appropriate standards.

4) The Board understands that Professor Smale is a mathematician of exceptional competence whose research fully warrants support from public funds.

5) . . . Were the two or more applications suggested by the Foundation found to be scientifically meritorious, the magnitude of the support . . . provided to Dr. Smale as well as to his colleagues would be determined by the magnitude and merit of these proposals as well as by the funds available to the Foundation. . . . These would certainly suffice to enable Dr. Smale to continue his productive career in mathematics. In short, the relationship between the Foundation and Dr. Smale would be similar to that between the Foundation and any other independent investigator on a university faculty.

6) The Board does not regard this as a punitive action. In view of the record of Professor Smale's administration of the current research grant, this action would merely limit his administrative responsibilities to management of the funds entrusted to the University of California for support of the research of his own immediate research group, a pattern consistent with the overwhelming majority of all research awards by the Foundation.

7) Those of the Board who have been apprised of the events of the last several days deplore the actions of those who have sought to conduct in the public press negotiations between the Foundation and the University concerning a purely administrative matter. (*End of statement*)

While NSF maintains that no final decision has been reached in the Smale case, Representative Richard L. Roudebush (R–Ind.) is claiming victory in his efforts to block an extension of support for the Berkeley mathematician. A press release issued 18 September by the congressman's office stated that Roudebush "has won a two-year battle with the National Science Foundation to bar a leftist California professor from receiving a quarter million dollar Federal grant." The press release stated that last year, after Smale protested U.S. foreign policy during a visit to Moscow, "Roudebush acted . . . to rescind Smale's $91,500 grant, but the National Science Foundation refused. Last June," the press release continued, "Roudebush learned that the NSF was planning another $247,900 grant to Smale, and Roudebush again objected and the NSF took the award of taxpayer funds to Smale under advisement. Roudebush learned this week that NSF has decided not to grant the $247,900 to Smale."

NSF's view of the matter is that Smale's application has not been rejected; rather, it has been returned with a suggestion that it be rewritten and resubmitted.—D.S.G.

is essential that it be broadminded with respect to its own research; for the community as a whole and for all its industries, it is essential to support also the most abstract type of fundamental research."

This does not mean that research in particle physics is likely to be undertaken at Eindhoven. But there is a biology group of about a dozen researchers —critical size, according to local opinion—working on enzymes. This work doesn't fit obviously into the scheme of things at an industrial lab. The justification is that the work is in a field which is sure to grow even more important in the future, and at any rate it provides background research for the company's pharmaceutical wing.

To an American observer the Eindhoven labs in scale and spirit resemble Bell laboratories in the United States. Part of the original inspiration of the Philips "Physical laboratories," as they are still called in the Dutch, seems to have been the Schenectady labs of General Electric. But if the Philips lab looks like something of a transatlantic hybrid, the European strain is very strong. This is particulary clear in respect to personnel policies. Philips researchers, as has been noted, are hired with great care, and employment is, to all intents, permanent. Layoffs are regarded as unmentionable, and departure of employees to establish "spin-off" subcontractors or competitors is practically unheard of.

The Philips lab differs from most of its American counterparts in being a truly private lab. Its contract work for outside customers such as Euratrom and the European space program amounts to only about 1 percent of the budget. Company money is heavily invested, and results are expected ultimately to be worth the expenditures.

Nobody at Philips claims the system works perfectly. There is concern, as there is elsewhere, about the lag in applying the findings of research. And in recent years it has proved difficult to recruit a sufficient number of people of the required quality to maintain a constant rate of expansion in the labs. For some years the labs staff expanded by about 7 percent a year, but for the time being, at least, the period of rapid expansion seems to be past.

This has been one of the reasons for the growth of the Philips research laboratories in other European countries. These now employ more than 1500 people. An advantage for Philips, which draws its Eindhoven staff from Dutch universities almost exclusively, is that the dangers of scientific inbreeding are mitigated through contacts with researchers in other laboratories.

The relative scarcity of top-quality graduates in Holland is, as might be expected, a matter of demand. Before the war many university graduates in physics, for example, took teaching jobs in the secondary schools. Now Philips faces stiff competition from smaller Dutch companies and international companies with operations in Holland for the services of these graduates, particularly the most promising ones. A new element has been injected, with some companies, especially those with American ties, beginning to seek senior scientists of proved ability and experience. Whether this will cause significant changes in European career patterns remains to be seen. Philips, for its part, while aware of the competition, doesn't seem to fear the challenge.—JOHN WALSH

Paying for College: Loan Plan Receives Chilly Reception

Ships, upon launching, have been known to slide down the ways, hit the water, and sink out of sight.

Such was not exactly the fate of an ingeniously devised, long-labored-on educational finance plan that was launched from the White House science office early this month. But the plan, known as the Educational Opportunity Bank (EOB), is far from making a *bon voyage*. This is what happened.

In recent years the strains of financing higher education have inspired attention toward the development of relatively painless borrowing plans. Last year, under the direction of Jerrold R. Zacharias, an MIT physicist long influential in government science circles, a White House panel focused its interest on one particular borrowing scheme for assisting undergraduate education. This was a sort of reverse insurance plan, in which the benefits come first and the payments, geared to income, are spread over a long period, with disability, low income, or death reducing or canceling the obligation to repay.

As conceived by the Zacharias panel, the plan would work as follows. The EOB would establish a pool of loan funds by borrowing money from the federal government at going interest rates. Any student, needy or rich, could borrow perhaps $3000 a year from this pool to meet the costs of tuition and subsistence. Repayment would be linked to the borrower's annual gross income over the next 30 to 40 years. Though the panel reported that calculations are yet to be completed, it estimated that if repayment were on the basis of 1 percent of gross annual income each year for 30 years, the bank would break even. Thus, a borrower with an $8000 debt would repay $266 in the year in which he had a $10,000 income. If his income rose to the point where annual repayments of 1 percent per each $3000 borrowed exceeded the financial benefits he had received, he could pay off his debt in one lump, plus 6 percent compound interest. On the other hand, if he had a bad year financially he would be obliged to repay little or nothing for that year.

The advantages cited for the scheme are numerous, the principal ones being that, since it is attached to the on-going income tax system, it would be administratively simple; it avoids means tests, helps meet the costs of tuition *and* subsistence, and would tend to free the student of financial consideration in selecting the institution he wishes to attend; also, it links repayment to the financial fortunes of the borrower, and, finally, it opens a new source of revenue for financially strapped institutions, especially those that are not tax-supported. Clearly, there is a case to be