That sentiment was endorsed by Hans Mark, director of NASA's Ames Research Center, who commented:

> I have noticed in the past eight or ten years a distinct drift of our very best people away from the basic fields . . . the quality is not as good as it once was.

The industrial leaders felt especially deprived, since the best of this poorer crop of students seem oriented toward academic careers. "If graduate training conditions the best scientists and engineers to disdain an industrial career, then I believe the universities are not making an adequate contribution to the productivity of technically based industry," wrote Leonard Swern, director of technical programs for the Sperry Rand Corporation.

Both the universities and the federal laboratories report difficulty in absorbing "new blood" into their systems. In the universities, declining enrollments and the tenure system have combined to reduce the number of positions open to young scientists, with the result that aging faculties are being frozen into place. In the federal laboratories, few people are leaving voluntarily in the face of a tight job market, and personnel ceilings make it difficult to hire new staff.

There was little consensus on what to do to enhance the vitality of the system. Various administrators offered suggestions ranging from a complete overhaul of the academic world to providing fellowships for bright students.

A third problem involves infringement of the freedom of inquiry—"the right of the scientist to choose his own line of research and follow it wherever it may lead." Some industrial administrators complained that economic factors were interfering with their ability to conduct basic research. But most administrators portrayed government, at the federal or state levels, as the chief villain in curbing their freedom. They complained that government funding is accompanied by pressures to do targeted or applied research rather than basic research. And they expressed resentment about overmanagement or overregulation of research by the government.

University officials lamented that the red tape involved in federal reporting requirements is reducing researchers to paper shufflers and sending them scurrying to other fields where the reporting burden is less onerous. Industrial executives charged that government regulations and controls are driving the cost of developing new products to prohibitive levels and forcing companies to divert funds from basic research to "defensive research" designed to insure compliance with the regulations. But probably no administrators were more upset than those who head government laboratories and must report directly to higher administrative layers in the bureaucracy. Harold M. Agnew, director of the Los Alamos Scientific Laboratory, predicted, somewhat apocalyptically, that:

> The ever increasing bureaucracy composed of managers who require more and more detail, justification, and guaranteed schedules, will in the not too distant future completely eradicate our Nation's world position in research and technology.

The remedies suggested were variations on three themes: fund more basic research, give researchers more freedom in their choice of projects, and bring applied and basic research into better balance.

The final concern highlighted by the research administrators is an alleged decline in confidence in science and technology. Many of the administrators asserted that both the public and the government in recent years have lost confidence in research and those who perform it. Some even professed to find negative attitudes toward research within the universities themselves. This negative attitude was held to be a major factor in reducing financial support for science, driving young people away from research careers and causing most of the other problems cited in the report. "It may not be too extreme to say that in three decades the scientist has gone from the role of hero to villain in our society," commented Dexter P. Cooper, Jr., vice president of Bell & Howell.

That view may represent the fears of the laboratory directors, but it does not find much support in the results of recent opinion surveys that are summarized in one section of the report. Those surveys indicate that public esteem for a variety of institutions and professions has dropped since the mid-1960's and that scientists have shared in that drop. But in relative terms, scientists have held their own or even gained in comparison with other professions. The surveys show that scientists command "a high degree of respect," that science is "highly regarded," and that technology is "widely supported," despite concern over its side effects. Young people do not appear "generally disaffected with either science or technology."

The report has been transmitted to the President and Congress, where it is apt to be widely ignored. In the coming months the National Science Board plans to hold regional forums in different parts of the country to gather additional views that may prove useful in reaching "general agreement on solutions and how best to put them into effect."

—PHILIP M. BOFFEY

West German Science: Trends Mirrored in a Max Planck Institute

The Max Planck Institute for Biophysical Chemistry stands in white and pristine aloofness on a hill overlooking the old university town of Göttingen, West Germany. But it has not been able to escape the pressure and strains that have recently begun to be felt in German science both within and outside the Max Planck Society. These include financial cutbacks, the call by politicians for a more "people-oriented" brand of research, and demands by younger scientists for more say in an institution which by tradition has not placed much stock in a democratic approach to research problems.

The Max Planck Institute for Biophysical Chemistry is largely the brain child of Manfred Eigen, who received the Nobel Prize for Chemistry in 1967 for developing "relaxation techniques" for following the course of extremely rapid chemical reactions. Eigen felt that there was a need for an institute in Germany which would integrate the most advanced ideas and techniques of physics, mathematics, laser technology, and computer sciences with the expansion of new research frontiers in the areas of molecular biology, biochemistry, neurobiology, and neurochemistry. Putting many scien-

tific disciplines under one roof would, he believed, further his own growing interests in the physical and biological mechanisms that underlie the evolution of life.

Eigen's idea started toward fruition about 10 years ago when, after a pleasant Sunday walk through the Göttingen countryside, he decided that a stretch of land on a hill overlooking the town would make a perfect setting for the proposed institute. He had no difficulty convincing the administration of the Max Planck Society at its Munich headquarters to buy the land at a price which Eigen says was about one tenth of what it would now cost. When the array of research towers, administration building, and their accessory buildings finally appeared on the hillside in December 1970, it brought together personnel and equipment from two preexisting Max Planck institutes based in Göttingen. One was primarily concerned with spectroscopy, and the other, to which Eigen was attached, was concerned with physical chemistry.

Unlike the situation in many American research institutions, scientists at the MPI for Biophysical Chemistry appear to spend little time worrying about where the next batch of money or piece of apparatus is coming from. In 1976, the Göttingen-based institute had an operating budget of 26.0 million Deutschmarks ($6.5 million)—enough to provide salaries, equipment, and a comfortable scientific life-style to the institute's 358 scientific personnel. Because most of that money comes—by way of the Max Planck Society—from federal and state coffers in Germany, everybody who works at an MPI is, in effect, a civil servant.

Because they know that a certain amount of money will be available each year, most scientists at the MPI at Göttingen spend essentially no time formulating the individual research proposals which occupy so much of an American researcher's efforts. Although that situation could change, it means that the Göttingen scientists are not continually forced to justify what their research means in terms of human health or the greater needs of society.

"One of the enormous strengths is that we don't have to camouflage basic research as if it were appplied," says Victor Whittaker, an English neurochemist who brought his entire research group with him to Göttingen when he was appointed a Scientific Member. "We are free to pursue basic research without all that mission-oriented window dressing."

Not that the subject of money is not broached from time to time in the halls and laboratories of the Göttingen institute. Although the Scientific Members generally maintain that the yearly routine of determining who gets what part of the budgetary pie is resolved in a "gentlemanly manner," younger scientists observe that the deliberations are accompanied by a considerable amount of armtwisting and political posturing. Their observation is seasoned with the lament that the research needs of the younger scientists are sometimes overlooked in the maneuvering for position that erupts among the senior scientists at the annual scramble for funds.

The attitude of the younger scientists stems from their seeming dissatisfaction with how the echelons are arranged at the Göttingen MPI for Biophysical Chemistry. Topping the system are the 12 Scientific Members, followed by some 13 tenured scientists at the associate professor level, 12 at the assistant professor level (who are on contract and may or may not get tenure), and about 55 postdocs and graduate students. On the other hand, some younger scientists insist that there are really only two levels operating at the institute: the Scientific Members and everybody else. Even some Scientific Members agree that there is very little likelihood that scientists below their level can hope to reach the top rung of the organizational ladder.

Upward Mobility Lacking

The lack of upward mobility has something to do with the way the Scientific Members are selected in the first place. Names of potential candidates are circulated for evaluation by the reigning Scientific Members to five other distinguished scientists throughout the world. Only if a candidate receives a unanimous vote will he be invited to come on board. On the other hand, a few Scientific Members have come up through the ranks, but not always directly. For example, Albert Weller (the present acting director) left the old Institute for Spectroscopy, took a position at the University of Stuttgart, and then reentered the MPI at Göttingen as a Scientific Member. A more direct jump to the top was made by Thomas Jovin, a molecular biologist who worked at Stanford University for several years with Arthur Kornberg, came to the institute as a postdoc, and rapidly moved to the top rank.

"That was a *very* rare occurrence," Jovin admits.

Mired in a comfortable, well-appointed limbo, as far as advancement is concerned, many younger scientists maintain that the institute is still holding on to the old senior-junior caste system which characterized German science for so long, but which was recently purged from many German universities. In fact, it was that kind of revolution at Marburg University which induced Hans Kuhn to give up his position there in favor of becoming a Scientific Member at the MPI, where vestiges of the old system apparently still survive.

For his part, Eigen believes that there are few workable alternatives to the present system at the Max Planck Institute for Biophysical Chemistry. The younger scientists should be glad that they can pursue their research interests with considerable freedom without having to undergo the distractions associated with teaching at a university, he says. Further, if everyone had tenure, he argues, the institute would become hidebound and less innovative, close itself off to new young talent, and eventually cease to grow.

Whether or not the present system does change, there is no doubt that the growth of the Max Planck Institute for Biophysical Chemistry (as well as at other MPI's) has begun to slow down. About 4 years ago, the German government declared a 37 percent cutback in the Max Planck Society's budget and an embargo on new hiring and construction. The restrictions still allow the Göttingen institute to build a new research tower and to fill it with a new biology group and expanded computer facilities, but for the next 4 years at least, the growth curve of the past will have reached a definite plateau.

The belt tightening goes well past the walls of the institute on the Göttingen hillside, according to Eigen. It evolved from a more buttoned-down trend in the German economy and new political attitudes which demand some kind of human justification for research which had previously been its own justification. It's a familiar tune to American scientists, but in Eigen's opinion, the new attitude is a serious mistake. It comes from a feeling among some members of the ruling Social Democratic Party that science, as well as art, should throw off its role as prima donna, step back from stage center, and make itself more available to the people.

"I translate that to mean that they prefer children's toy flutes to Rubinstein and that they would like to deemphasize innovative basic research in favor of a more broad 'equalized' approach," he says. "For a country with Germany's limited resources, lowering research standards could be disastrous. Without a fresh stream of new ideas, we just couldn't compete."

Although Göttingen—with its university—has played a key role in the evolution of the Max Planck Society and its institutes, relationships between the university and the institute on the hill are currently in a state of strain. Max Planck, Otto Hahn, Werner Heisenberg, and other top German scientists came to Göttingen after World War II to recoup some of the momentum German science had lost during those cataclysmic years. The university was founded in 1734 by George II of England when Göttingen was part of the electorate of Hannover. Planck and his colleagues saw it and the town as an excellent backdrop for the formation of what they called the Max-Planck-Gesellschaft für Forderung der Wissenschaften. The new society would replace the old Kaiser-Wilhelm-Gesellschaft, many of its institutes deeply scarred by the physical and psychological wounds of the war.

The current strain between university and institute is illustrated by a "joke" which circulated through Göttingen after Manfred Eigen won the Nobel Prize. It must have been a mistake, the joke went, because Eigen was not a member of the university faculty at the time. He still isn't, except for an honorary appointment in the university's medical school. To become an active member of the faculty he would have to undergo the "habilitation" procedure traditional in German universities. It involves, in effect, preparation of another doctoral thesis, Nobel Prize or not, and for Eigen, who now makes little of the entire matter, it has never been worth the trouble involved.

Part of the tension arises from the fact that the university scientists feel underprivileged. They realize that the researchers on the hill have everything they need to carry out research projects which they are not required to justify. They, on the other hand, must limp along with inferior equipment and support, while teaching students in the process. A small number of graduate students *do* work for their degrees at the institute (which itself does not award degrees), but some of the students remark that the length of time it takes to get a Ph.D. can depend on whether relationships between the two institutions and their respective faculties are blowing hot or cold.

On the other hand, Klaus Weber, a German biochemist who came to the institute by way of Harvard, believes that the MPI's should and do carry out the kind of frontier research that the German university system is not capable of handling. Unlike American universities, where there might be a great center for molecular biology or physical chemistry, research in any given area is spread so thinly through the entire German university system that its quality is diluted. This has left such a dent on graduate education, says Weber, that whereas an American professor can expect to find about 15 excellent performers in a batch of 50, the proportion in German graduate schools is more like one in 50.

Amid the various political streams that sweep—albeit not very violently—around the white towers of the MPI for Biophysical Chemistry in Göttingen, research under way there increasingly reflects Eigen's original notion of melding physical and biological approaches to problems of mutual interest. Eigen himself is chiefly interested in how molecules have organized themselves into living organisms, and believes strongly that nucleotides—and not proteins—have the full potential for doing so.

Currently Eigen is using game theory, computers, and mathematical analysis to set up simple model systems for molecular self-organization that can be tested in the laboratory in cell-free systems. In that way he hopes to select and compress key elements of molecular translation processes—which are the product of millions of years of evolution—into a time span which can be handled in a researcher's life time. As he sees it, the ultimate translation system—the genetic code—is the optimized end product of a universal "hypercycling" system in which some self-reproductive molecules develop, survive, and interact, while others with no useful message to convey become extinct. Eigen believes that RNA viruses under study in his lab which rely on the enzymes of the cells they infect to achieve translation that leads to their own reproduction are analogous to the hypercycling systems, which through eons of trial and error, led to the genetic code.

Just how well the institute's various scientific groups interact and whether or not they are contributing, as originally intended, to the formation of a new discipline called biophysical chemistry, is still a subject of debate among the Göttingen scientists. Weller says the experiment hasn't worked as well as it should have, in that the different laboratories, for scientific and organizational reasons, are becoming highly specialized and growing away from each other. Otto Creutzfeldt, who preceded Weller as acting director, disagrees and says that cooperation among the labs is just about what it should be. Eigen is somewhere in the middle. After all, the institute is only 5 years old, he points out, and institutions, like people, cannot be expected to develop fully in that space of time. He believes that the emphasis on biology, which will grow even stronger when the occupants of the new tower arrive, will almost certainly help broaden and solidify contacts among the individual laboratories. He acknowledges that political pressures both inside and outside the Max Planck Institute for Biophysical Chemistry sometimes cloud the vision he dreamed of 10 years ago on the Sunday morning walk. But if the dream and reality do not yet reflect each other perfectly, he still believes in their ultimate congruence.—JOHN F. HENAHAN

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RECENT DEATHS

John L. Dunkle, Sr., 92; former president, Frostburg State College; 26 July.

Brooks F. Ellis, 78; retired chairman, geology department, New York University; 11 July.

Samuel P. Harbison, 67; former chairman of surgery, Medical School, University of Pittsburgh; 19 July.

Bernard Haverback, 50; professor of medicine, University of Southern California; 28 July.

Henry T. Hutchins, 59; director of environmental health, University of Maryland; 17 July.

Lloyd J. Jewett, 42; president, University of Maine, Augusta; 27 July.

Leonard S. Kogan, 57; professor of psychology, Graduate Center, City University of New York; 28 June.

Robert W. Long, 49; professor of botany, University of South Florida; 21 July.

Hazel B. Weakly, 64; professor of education, Drake University; 6 July.

Lavinia R. Wenger, 83; former chairman of education, Notre Dame College; 10 July.

Seymour Werthamer, 51; professor of pathology, Downstate Medical Center, State University of New York; 3 July.

Erratum: The cover legend of the 24 September 1976 issue should have read "The average length of the figurines is 13 centimeters." The measurement refers to the group and not to a single figurine.

Erratum: In a recent article on psychosurgery (*Science*, 15 October) we inadvertently referred to Senator J. Glenn Beall (R–Md.) as a "former" Senator. Beall is, in fact, a present member of the Senate. We regret the error.—B.J.C.

Erratum: In the Appointments column, 17 September, the listing for Edward C. Heath should read, chairman, biochemistry department, University of Pittsburgh School of Medicine, to chairman, biochemistry department, University of Iowa College of Medicine.