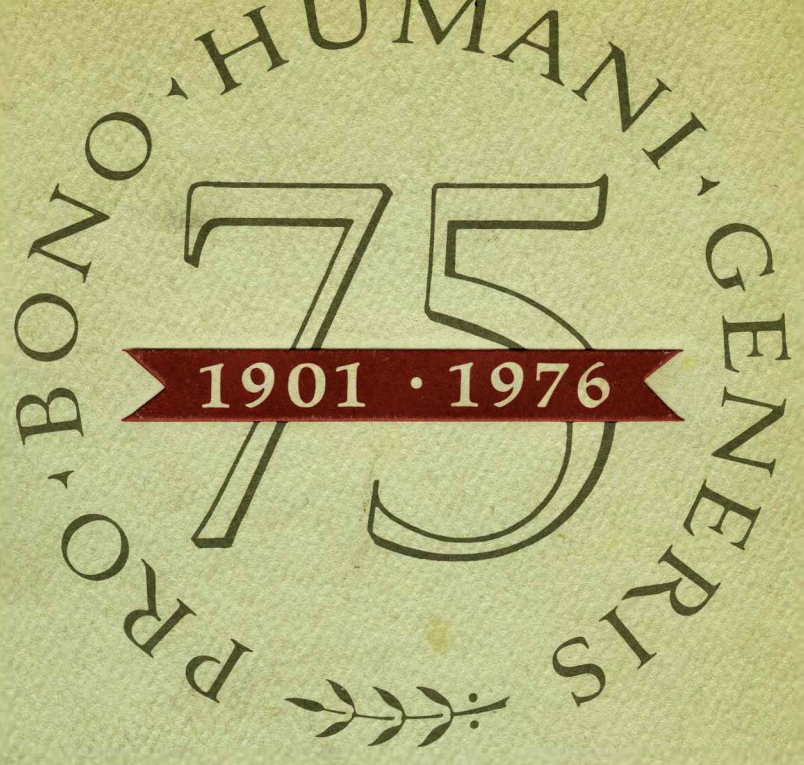
1976

1975-1976 Report of the President

The Rockefeller University



REPORT OF THE PRESIDENT • 1975-76

THE ROCKEFELLER UNIVERSITY

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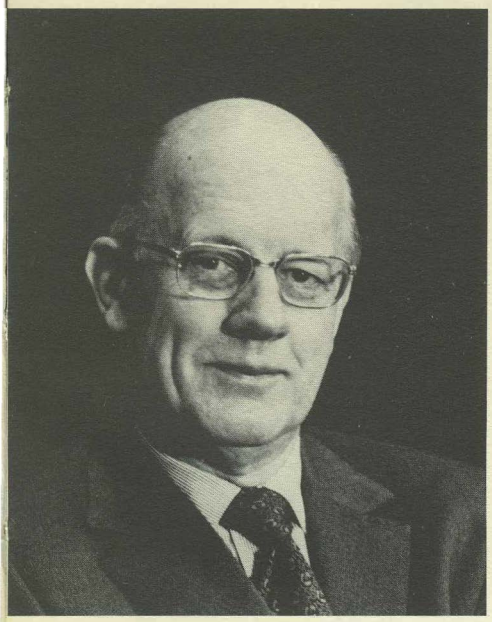


Frederick Seitz, President

ANNIVERSARIES are great occasions for congratulations and nostalgic looks at past achievements. Coinciding as it did with the nation's Bicentennial, The Rockefeller University's 75th Anniversary made for a festive and memorable year on our campus. We even had a University first—a major reunion of alumni and former faculty.

Drawing on many members of the University community for suggestions and assistance, the Anniversary Planning Committee, chaired by Vice President Carl Pfaffmann, provided us with many cherished moments of reminiscence and renewal, culminating in three days, June 7-9, when almost 300 alumni and former colleagues gathered on campus to share in colloquia, receptions, a history day, and the 18th Convocation.

At the convocation, 17 young men and women received their Ph.D. degrees. They shared the platform with nine recipients of honorary degrees, all of whom have played significant roles in the history of the University and in the advancement of science: Philip Bard, professor emeritus of The Johns Hopkins University School of Medicine and a leader in brain research, who served on the University's board of trustees for 17 years; George W. Corner, scientist, teacher, and author of *A History of The Rockefeller Institute 1901-1953;* Joseph S. Fruton, Eugene Higgins Professor of Biochemistry at Yale University, who began his research career at The Rockefeller in 1934; biophysicist H. Keffer Hartline, 1967 Nobel Prizewinner and a member of our faculty since 1953; Lindsley F. Kimball, a humanitarian who has served many organizations, including this University as trustee for 28 years; George E. Palade of the Yale University School of Medicine, who during his 27 years at The Rockefeller carried out pioneering work in cell biology which won him a Nobel Prize in 1974; Keith R. Porter, like Palade a long-time member of the University's world-renowned cell biology group, who is now associated with the University of Colorado; James

scientific heritage and leadership, that these are the things which, taken together, define the style of this institution.

A Look Beyond Tomorrow

THE BREADTH OF VIEW and the reach to the future intended for our major anniversary events were foreshadowed early in the year on March 8 by an international conference sponsored by The Rockefeller University Council on the theme "Beyond Tomorrow—Trends and Prospects in Medical Science." This all-day meeting—bringing together speakers, panelists, and participants from science, education, industry, and government—made it clear that the insights of the biological revolution of the last 50 years have barely been tapped, that the basic demands on scientists have not changed, and that the world of science bears a continuing responsibility to win understanding and support.

As Lewis Thomas, a University trustee and president of our neighbor institution, Memorial Sloan-Kettering Cancer Center, put it, "these are busy times for the students of human disease, and a good many of the mysteries are beginning to look penetrable. . . . It is simply inconceivable . . . that the kinds of insight we are now obtaining, at more and more profound levels of understanding, into the form and function of living tissues, cells, and the smallest parts of cells, will end with nothing more than an appreciation of the normal state of living."

Dr. Thomas predicts "that we will also come to an understanding of disease mechanisms, at the same profound level." But he voices an uncertainty we all share "that we or our masters may decide that disease-oriented research is all right to do, and worth supporting, but that fundamental biological science is something else, a luxury too costly or too frivolous, and that decision could turn the whole process off." These are themes to which I shall return.

For my own part, I had several opportunities during the year to review the outlook for the University, in particular, and the sciences, in general. My thinking on these subjects is reflected in this report. Both the University and the sciences with which it has been mostly concerned may be on the threshold of a

"Beyond Tomorrow" Conference. Panel, left, Adolf W. Jann, president and managing director of F. Hoffmann-LaRoche & Co., Ltd., Philip Handler, president of the National Academy of Sciences, Sir Peter Medawar of the Clinical Research Centre, Harrow, England, and Gerald M. Edelman, professor, The Rockefeller University. Below, audience in Caspary Auditorium.

"My message to those who are in a position to promote or impede research by granting or withholding funds is that it is no more than unworldly sentimentality and daydreaming to fund the investigation of some enterprise of immediate practical usefulness without making provision for the basic research upon which the solution of the problem will depend. The history of science shows that it is the shrewd, practical-minded, no-nonsense man of affairs who promotes the welfare of institutions like The Rockefeller University . . . ."

SIR PETER MEDAWAR

new era or, at least, of major transitions. The areas of most significant, and indeed continuing, change on our campus relate to the active fields on the moving frontier of research. But the social and political context in which these changes are developing is also shifting constantly. Inevitably then, this report, though reviewing the events of a busy year, has a definitely futuristic cast. Our commitment to scientific research for the good of humankind remains firm, and the future can be as exciting and full of achievement as the past. But change—predictable and not so predictable—increasingly tests our convictions, skills, and resources.

Patrick E. Haggerty and David Rockefeller

Transitions in Leadership

FORTUNATELY, this University finds itself ready for the testing because its leaders have never obstinately resisted change and have always been prepared to make necessary adjustments before events forced the issue. A continuity of purpose has been insured by carefully planned transitions in leadership at appropriate stages in the institution's development. This year several actions were taken in this tradition.

After 25 years as chairman of the board of trustees, David Rockefeller requested that he not be re-elected to the post he had filled with such dedication and distinction. He pledged, however, a continuing involvement in all major programs of the University and especially in the task of securing the broader private support it must have to maintain its traditional independence and excellence. In his new post, as chairman of the board's executive committee, he can concentrate on that important goal. The entire University community shares my pleasure that he will continue as an active partner in furthering the development

of the institution founded by his grandfather and served so ably by his father.

The University is fortunate to have found in his successor as chairman an individual with a broad personal knowledge of the intricate relations linking science and technology with government and society. As a founder and top officer of Texas Instruments, Patrick Haggerty has exhibited unusual executive abilities and a talent for bringing together and motivating individuals with the varied talents and skills required in an enterprise based on research and innovation. Having known Pat Haggerty for 15 years and having worked with him on a number of projects, I welcomed his election to the board, and I look forward to his support and counsel now that he is chairman.

Election of Five New Trustees

THE BOARD ITSELF has enhanced its effectiveness and breadth of experience by the election of five new trustees of highly diverse callings and backgrounds. They are Richard Furlaud, chairman and chief executive officer of Squibb Corporation; Seymour Kety, director of the Psychiatric Research Laboratories at Massachusetts General Hospital; Anne E. Reed, a trustee of the Charles Engelhard Foundation, with an active interest in the arts and in problems of energy and land conservation; John R. Stevenson, a partner in the law firm of Sullivan & Cromwell and a former legal adviser to the Department of State, and P. Roy Vagelos, senior vice president for research of the Merck Sharp & Dohme Research Laboratories.

Drs. Thomas, Kety, and Vagelos, together with two other trustees of strong scientific background—Alexander G. Bearn and Philip Handler—and myself, are members of a new Standing Committee on Scientific Affairs, headed by William O. Baker, vice chairman of the board. This group has several major functions, all vital to maintaining close communication on research goals and policies between the board and the University's faculty. The committee will be especially helpful in building up the board's awareness of the activities of our laboratories, reviewing long-range scientific opportunities, advising from time to time

on appointments, and providing advice to me and the board on the allocation of unrestricted funds available to support new initiatives in research. The committee members, all of them distinguished scientists in their own right, will be in a unique position to maintain a two-way flow of information between board and faculty and to foster creative interaction. I think this is not only in the spirit of The Rockefeller Institute for Medical Research, which began its existence under the guidance of a Board of Scientific Directors, but also in tune with the present time, when the decisions of science have implications that reach far beyond the laboratory bench or research campus.

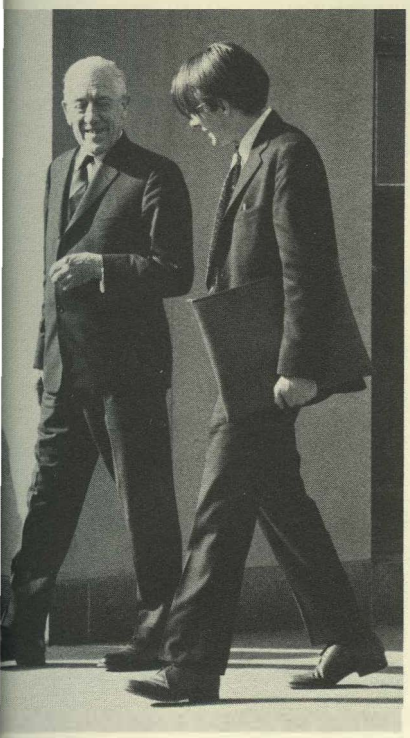
A Personal Decision

THIS WAS ALSO a year for a more immediately personal decision. In a letter to the board on June 8, I announced that I plan to retire from the presidency after a successor has been appointed by the trustees. My 65th birthday was on July 4, 1976, and I feel it is important to conform reasonably closely to the University's regulations with respect to the official retirement age. Chairman Haggerty and the board have formed a presidential search committee and anticipate that a successor might be ready to assume office by mid-1978.

In the meantime, I look forward to continuing to work with a faculty, student body, and staff who have made my eight years on this campus tremendously satisfying and rewarding. I shall miss the support of C. Eugene Sunderlin, who retired from his post as vice president in June. Prior to coming to the University, he was my close colleague at the National Academy of Sciences. The University benefited in many ways from the knowledge and experience he had gained in a career that spanned science, education, government, and industry.

The Legacy of Detlev W. Bronk

ON NOVEMBER 20, 1975, the entire University family was shocked by the death of former president Detlev W. Bronk, in the midst of an exceedingly active life. This unexpected loss again brought home to all what a highly remarkable individual he was. Among other things, he pioneered biophysical research



Detlev W. Bronk (left), president, 1953-1968

in this country, established a major laboratory at the University of Pennsylvania, introduced sweeping changes in undergraduate and graduate education at The Johns Hopkins University, headed the National Academy of Sciences for 12 years, advised three American presidents, produced a diverse array of scholarly writings, and had a mountain in Antarctica named after him. But in the history of this institution he will be remembered as the major architect of the transformation of The Rockefeller Institute for Medical Research into The Rockefeller University, without a break in continuity of achievement and without diminution of quality. His first connection with The Rockefeller was as a member of its Board of Scientific Directors, which he joined in 1946. Upon the retirement of Dr. Herbert Gasser as director, Dr. Bronk was chosen chairman of a committee to review the future of the Institute. So keen were his insights and so compelling was his vision of the future that our trustees persuaded him to leave the presidency of Johns Hopkins in order to implement his ideas for a graduate university of the sciences.

There was no one else in our time who came close to matching Detlev Bronk's gift of selecting unusual scientists to deal with the most challenging research problems. It was this gift that brought so many fine people to the University—graduate fellows and senior scientists alike. Out of our relatively small band of alumni, two have won Nobel Prizes (the first, Gerald Edelman, in 1972, and the second, David Baltimore, in 1975). Most of them are now scattered around the world in posts at major research centers and universities. I think that they are Dr. Bronk's greatest legacy. How he would have enjoyed the convocation activities this June with hundreds of returning alumni and former faculty to be greeted, many of them individuals he played a personal role in selecting and starting on their careers in science.

Bronk's concern for people was matched by his concern for creating the proper environment in which they studied and carried on their research. It was most appropriate, then, that on June 8, South Laboratory, one of the buildings erected during his

years as president, was renamed Detlev W. Bronk Laboratory. In the words of Patrick Haggerty: "We need only to look around us to appreciate how—under his enthusiastic leadership—this campus became a harmonious blend of old and new, of leaf and stone, of natural beauty and physical resources."

A Double Loss

THE UNIVERSITY also was saddened during the year by the deaths of two of the distinguished scientists who joined the faculty under Detlev Bronk—Edward L. Tatum and Theodosius Dobzhansky—each a central figure in a major area of modern genetics.

Dr. Tatum, who died on November 5, 1975, had been a member of our faculty for 18 years. Through his studies of the metabolism and the genetics of microorganisms, he helped to prove that individual genes encode the information specifying the function of different enzymes (proteins)—the one gene-one enzyme hypothesis. He did this work with George W. Beadle. With his student Joshua Lederberg, he discovered sexuality in the bacterium *Escherichia coli*. These historic collaborations brought the three a Nobel Prize in 1958. Professor Rollin D. Hotchkiss, himself a major contributor to molecular genetics, said of Tatum: "By bringing together the previously separate subjects of microbial nutrition and microbial genetics, Edward Tatum laid one of the important foundations of molecular biology. Throughout the burst of advances coming from this great step, he remained a warm person and an always helpful and generous scientist."

Dr. Dobzhansky, who joined our faculty in 1962, died on December 18, 1975, in Davis, California, where he had been serving as an adjunct professor at the University of California. Deeply versed in the cultural, as well as biological, aspects of genetics and evolution, Dobzhansky was internationally recognized as a gifted researcher, author, and teacher. In his genetic research, he used fruit flies both because they are simple creatures to study in the laboratory and, more important to him, because of the wide variety of species that exist in nature. His ma-

jor work was on the mechanisms of formation of races, subspecies, and species. Particular emphasis was put on ways in which species were isolated from each other, in an attempt to understand the contribution of their genetic composition to their adaptation to particular ecological niches. His books—most notably *Genetics and the Origin of Species*—have become classics in evolutionary theory and are the most important since Darwin's pioneering works.

Most significant for this report is that up to the very end both of these men were stimulating teachers and kind mentors for many younger colleagues and played an important role in training the next generation in their disciplines. A whole school of the leaders in their respective fields is descended from each of them; from Tatum molecular geneticists and from Dobzhansky population biologists.

Preparing the Scientists of the Future

As I HAVE NOTED in previous reports, the preparation of the scientists of the future has always been a major concern at this University. Before we became a University, this training was on a postdoctoral level, with young investigators coming to the Rockefeller laboratories to deepen their knowledge and sharpen their skills under the guidance of eminent seniors. Under our charter as a University, we began granting the Ph.D. degree, extending our facilities to the student taking his first formal step toward a scientific career. But our support of advanced training has not diminished. In fact, we have almost twice as many engaged in postdoctoral research on campus as we do candidates for the graduate degree. Our graduate students, as do their more advanced fellows, become scientists in the traditional Rockefeller way, by spending most of their time in the laboratory pursuing their own research projects.

Since the start of this University's first development program in 1971, one of the primary goals has been to obtain increased private resources to sustain our significant national role in providing first-rank predoctoral education and postdoctoral research training. Anticipating what has now become a serious national

problem, we felt that we should continue to maintain the University's unique environment for the training of tomorrow's leaders.

To date, we have been successful in receiving substantial support from individuals, foundations, and corporate donors for education and training on all levels. More than $3 million has been committed to fund a program of University Fellowships designed to support a small number of highly gifted young life scientists in independent research projects. A number of appointments have already been made under the program, which provides salaries and supporting research resources for promising investigators, usually at the nontenured rank of assistant professor, who are given a measure of the scientific independence characteristic of the work of more senior faculty. In addition, more than $2.5 million has been pledged toward the creation of other postdoctoral and graduate fellowships.

New Clinical Fellowship Program

HOSPITAL-AFFILIATED LABORATORIES provide unique opportunities for young scientists to train and work at the interface of the fundamental sciences and medicine. The history of our University Hospital affords many examples of the benefits to be derived from the interaction of basic science and medicine: contributions to biology and chemistry resulting from the direct study of disease in man, and contributions to clinical investigation traceable to the work of basic scientists.

To insure a continued flow of physician-scientists from the Rockefeller Hospital into academic medicine, we have initiated a major new postdoctoral training program for young M.D.'s who plan careers in clinical investigation. This program has been launched with grants from R. J. Reynolds, Inc., the Alcoa Foundation, and other private sources. We intend to provide funds for about a dozen appointments of selected physicians for several years of advanced training in one or more of the main programs of medical research in the University's Hospital.

Through this program, the University will help to satisfy the great need in American medicine for scientists thoroughly ac-

The Rockefeller University Hospital

complished as physicians and strongly trained in one or more of the basic sciences directly relevant to clinical medicine. These investigators will be dedicated to the direct study of disease mechanisms and improved therapies in patients, combined with work in the related laboratory disciplines.

The University Hospital offers an ideal setting for this program, as it has for 66 years. The Hospital's medical staff has developed clinical investigation as a formal and sophisticated discipline in which all the analytical powers of the modern sciences are focused on the problem of disease in specific patients. Because the Hospital is so well integrated into a creative University environment of great diversity in the fundamental life sciences, there has always been a continuous and highly productive exchange of ideas and collaborative research between basic scientists and clinicians.

The Need for Greater Support of Young Scientists

I WOULD LIKE to elaborate briefly on the context in which the University has been addressing itself to the crucial matter of support for our country's next generation of scientists. During the late 1950s and most of the 1960s, the federal government greatly increased funding of fellowships in the sciences, both predoctoral and postdoctoral. This prompted many private foundations to reduce or eliminate their fellowship programs. During the past five years, the government has drastically cut back on support of advanced training—overreacting, I believe, to demographic data pointing to a possible excess of Ph.D.'s for academic positions. As a result, even the best universities are trying frantically to make up the needed funds so that promising students will not be denied a chance in science.

Every recent survey of technical manpower has concluded that we will probably soon face severe manpower shortages in the sciences and engineering. Although national manpower planning is complex, there is little doubt that economic strength, improved medical treatment, and excellent education at all levels depend upon a continuing pattern of innovation in science, which can only be assured by a continuing supply of young and well-trained scientists, research physicians, and engineers for a wide variety of posts. Yet the opportunities for young scientists who could assume positions of responsibility in many organizations in the future are being constrained. I fear we are placing much too low a priority on the training of young scientists and on their support during the initial phases of their professional work. Clearly, we must be more selective and prudent in our funding than we were some years ago, but our present national course imposes a stiff mortgage on the future. As it moves into the final quarter of its first century, this University seeks to find ways to lift a part of that mortgage.

Importance of the Private Sector

THE PROBLEM I have just outlined is but one facet of the financial hazards faced by all private institutions in these days when inflation looms as a threat to solvency and independence. On looking over the current situation, we can recognize that the

federal commitment to basic science has at best reached a plateau. Therefore, I can only conclude that it is urgent to encourage private sources—foundations, corporations, and individuals—to review their own commitment to good scientific research and to give it once again something of the high priority it formerly held in their consideration. In fact, the rise of science in the United States to the preeminence it has enjoyed in the last half-century was influenced in an essential way by support from private foundations and individuals. In this anniversary year, we are vividly aware, for instance, how the standards of medical research and medical education were vastly transformed through the wise philanthropy of the Rockefeller family. Today, there is a great need for the private sector to provide a counterbalance to the attrition in federal support. Without it, our national scientific endeavor may face a decline toward mediocrity.

A Plan for Fiscal Balance

INSOFAR as the finances of the University are concerned, we are now in the first stage of a demanding three-year effort to achieve a balanced budget by fiscal year 1979. Because of such factors as soaring energy costs and economic uncertainty, we experienced several setbacks in reducing our budget deficit during fiscal year 1974-75. The table on page 16 gives general budget figures from 1972 through 1976. For the future, the outlook is highly encouraging, as we implement a general plan designed to restore flexibility in our programs. This comprehensive plan, developed in close consultation with the board of trustees, includes: continued emphasis on economies in supporting services and administrative areas; a vigorous energy conservation program; increased recovery from the federal government of overhead costs on grant-supported research projects; and an intensified fund-raising program. Trustees and administration are determined that, in sharpening over-all management and cutting costs, we must not risk altering the essential character of the institution.

Before a University audience on June 8, 1976, David Rockefeller posed the crucial question and provided the only answer.

SUMMARY OPERATING BUDGET COMPARISONS

FISCAL YEARS 1972 THROUGH 1976 (000's OMITTED)

	FY 72	FY 73	FY 74	FY 75	FY 76
REVENUES					
Educational & General —					
Investment income	$ 8,614	$ 8,879	$ 9,343	$ 9,244	$ 8,740
Gifts for budget support	—	—	—	660	755
Sponsored research & training					
Direct costs	8,814	10,923	11,230	12,969	14,444
Indirect cost recovery	1,792	2,470	2,782	3,020	3,241
Other educational & general	280	525	414	488	356
	$19,500	$22,797	$23,769	$26,381	$27,536
Auxiliary Enterprises —					
Off-campus housing	$ 1,958	$ 2,069	$ 2,202	$ 2,380	$ 3,535
Rockefeller University Press	1,388	991	1,043	1,199	1,326
Campus housing & food service	474	545	541	546	548
TOTAL REVENUES:	$23,320	$26,402	$27,555	$30,506	$32,945
EXPENDITURES					
Educational & General —					
Direct education & research —					
University budget funds	$ 5,968	$ 6,665	$ 6,883	$ 7,353	$ 7,396
Restricted governmental sources	7,553	8,178	8,341	9,166	10,049
Restricted nongovernmental sources	1,261	2,745	2,889	3,803	4,396
Restricted investment income	—	—	181	384	331
Other educational & general	5,858	5,896	6,847	7,849	7,894**
	$20,640	$23,484	$25,141	$28,555	$30,066
Auxiliary Enterprises —					
Off-campus housing	$ 2,018	$ 2,516	$ 2,742	$ 2,368	$ 2,954
Rockefeller University Press	1,164	911	964	1,030	1,116
Campus housing & food service	672	749	780	723	715
Total Expenditures	$24,494	$27,660	$29,627	$32,676	$34,851
Transfers to unexpended plant funds	144	—	—	—	—
TOTAL EXPENDITURES & TRANSFERS	$24,638	$27,660	$29,627	$32,676	$34,851
Excess of expenditures and transfers over revenues:	$ 1,318	$ 1,258	$ 2,072	$ 2,170	$ 1,906*

*The FY76 deficit included $437,000 in *nonrecurring* costs.

**The FY76 expenditure figure for "Other educational & general" included $4,459,000 for the operation of physical plant (including energy costs) and $3,435,000 for supporting services.

Can we continue to support excellent scientists and give them the independence and the climate to do their best work? The answer is, "We must and we will." No matter what the constraints upon us, we shall continue to do important things with distinction. But this can be accomplished only if we continue to support and encourage excellence in research and education. There are pressures in many universities and laboratories to water down standards. We here at The Rockefeller University must never allow that to happen.

Despite the uncertain outlook for federal funding of basic science, the amount of government grants awarded to University scientists has consistently increased. As I have noted frequently, this is an index of the quality of our research and its importance to the solution of major disease problems and to the improvement of public health. It is also a tribute to the efforts of our laboratory leaders to gain external support.

We are redoubling our efforts to increase revenues from private sources through our development program, and so far have achieved a good record. We have raised more than $52 million in pledges toward our goal of $120 million set for 1980.

THE ROCKEFELLER UNIVERSITY DEVELOPMENT PROGRAM

COMMITMENTS TO JUNE 30, 1976

Foundations	$33,831,665
Trustees	5,394,647
Other Individuals	2,492,862
Corporations	6,603,700
Government Construction Grant	1,725,047
Annual Giving Program	1,367,992
Bequests	1,180,947
Trusts & Annuities	183,250
	$52,780,110

If we add all support from private sources since 1971, the total is about $57 million.

I believe we can achieve our goals by the end of the decade. However, we are trying to accelerate our efforts in order to move even more quickly toward a balanced budget. We hope that this can be achieved in part through our new annual giving program, designed to enlist unrestricted support from prospective donors who do not have the financial resources, or who are not presently prepared, to contribute to our major capital goals.

We have also established a trust and estate gift plans program with the assistance of an advisory committee of 27 legal, accounting, and banking specialists. This long-range program for various types of deferred gifts will have an important impact on enlarging our base of endowment.

The University's success in acquiring federal funds and the warm responses received so far in the quest for private gifts and grants indicate that as long as we adhere to our traditional role as an institution devoted to the natural sciences with a major interest in the fields of biology and medicine, we will fare as well as any other private institution. It is a cause for regret that so much of the valuable time of our scientists must be devoted to the problems of research funding. However, that seems to be an unavoidable preoccupation for most members of the scientific community in our time. Perhaps one day our nation will develop more satisfactory ways of supporting its creative genius. Certainly the increased participation of the private sector would be a major ingredient.

To both the public and private sectors, I suggest a renewed awareness of the distinctively necessary roles played by each of our sources of funding. As Caryl Haskins, former president of Carnegie Institution, has written in his thoughtful paper for the Filer Commission's review of private philanthropy and public support of science in this country:

> . . . we have long taken for granted what it means to live in a society which has a strong private sector operating in parallel with a public one . . . . Living with it, almost as a matter of

course, we may not have pondered very deeply or extensively the diminution in the quality of our lives that might follow the weakening of the sector of private support—not only for science, but across the whole cultural front of the nation .... These are the larger reasons for maintaining the strength and significance of the private sector in the sciences: as complementary partner of, but also as bellwether to, the support of the public sector.

A Gap in Understanding

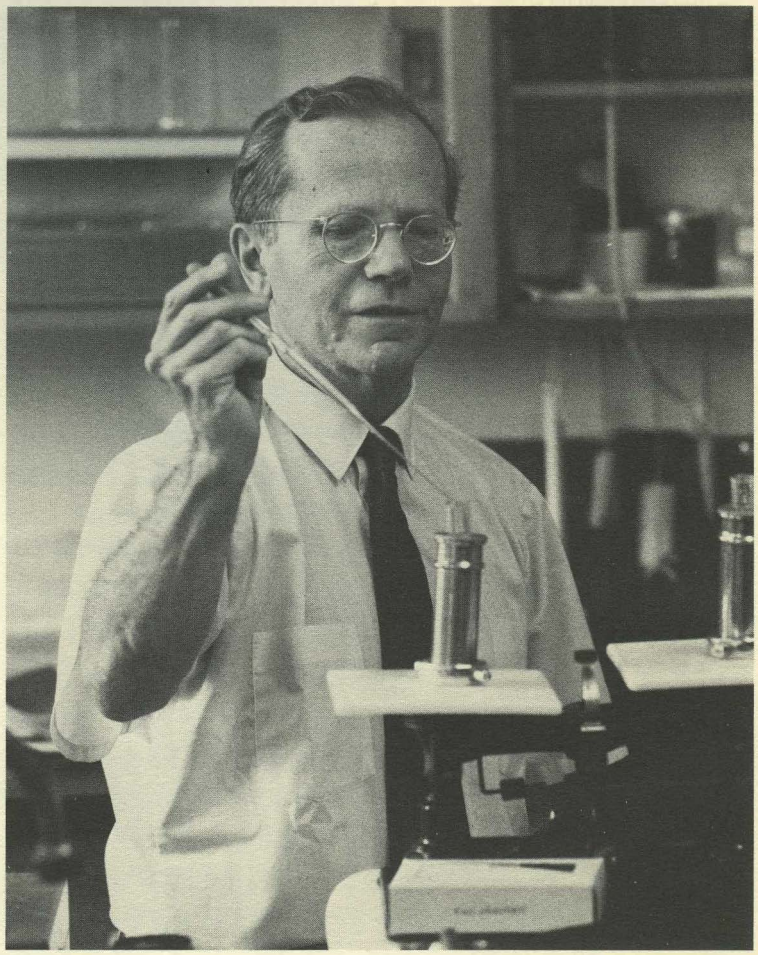
THE SUPPORT of the best science deserves a priority commensurate with the importance of science to modern society. Unfortunately, scientists have not been very successful in gaining public understanding of what it is they are about and how it relates to society. As Professor Gerald Edelman noted at our March conference: "In no age of Western history has a philosophical procedure been so tacitly accepted and used without understanding as has science by modern governments." The reasons for this are too complex to be gone into here. But the necessity and importance of building understanding are painfully clear, and we must in the years immediately ahead find better ways of communication between science and government, of interacting and sharing experiences, that will make it less easy for lawmakers and scientists to find inherent contradictions in each other's disciplines.

Continuity and Change in Research

AS THE UNIVERSITY begins its 76th year, it is appropriate to reflect on the interplay of continuity and change in research.

We still retain a profound interest in the infectious diseases, both bacterial and viral, and parasitic diseases, such as malaria. In fact, our scientists continue to make major contributions in these areas.

Most recently, for example, Professor William Trager reported the first continuous cultivation in a test tube of the parasite responsible for human malaria—the first such cultivation of any species of malaria parasite. This achievement opens the way for the development of a vaccine against the disease which af-



Professor William Trager

flicts 90 million people a year in Africa alone, resulting in a million deaths, mostly of children. The method developed by Dr. Trager and Research Associate James B. Jensen for cultivation of the parasite frees research into many aspects of malaria from previous dependence on human infections or on the availability of owl monkeys, the only suitable laboratory hosts.

Yet, there was a time between 1950 and 1970 when it appeared to some individuals that basic knowledge at the molecular level, such as that related to the structure of DNA, was unfolding at such a rapid rate that disease-oriented research could be

downgraded or dropped. Things have changed. We acknowledge now that the acceleration in the discovery of basic knowledge, to which the University is contributing, places more, rather than less, responsibility upon us to give renewed emphasis to clinical research.

Such research, in keeping with the long-range traditions we have evolved here, is really quite "basic" in nature. Not only does it employ all the techniques and concepts of the modern sciences to advance the study of disease processes, but it contributes greatly to the evolution of these basic sciences, as well. This is nowhere better demonstrated than in the work of Oswald T. Avery, Colin MacLeod, and Maclyn McCarty which, developing out of a sustained program of research on pneumonia, provided new scientific insights of the most basic kind relating to DNA. In his new book on Avery, Dr. Dubos reminds us, most vividly, that at the time of their historic discovery, these men were seeking to combat what was then one of the most deadly diseases known, and that it was their research on the pneumococcus which demonstrated the true nature of DNA.

Renovation and a New Clinical Program

OUR CLINICAL RESEARCH CENTER occupies the eight-story Hospital building and the contiguous Nurses' Residence, which now houses one wing of the in-patient unit, conference rooms, and other facilities for the Hospital. The Center comprises 40 beds divided into a 30-bed unit on the third floor of the Hospital and a 10-bed unit on the fourth floor. The third-floor unit was totally renovated in the past year. All open wards were converted to single rooms and, in addition, the unit was expanded into the Nurses' Residence wing. Patient rooms were also air-conditioned, and new staff conference rooms were provided so that individual laboratory groups could conduct case presentations and service chart-rounds separately. The 10-bed unit on the fourth floor is also a single-room facility. Thus the center now consists entirely of single patient rooms—a distinct advantage in light of the University's emphasis on long-term studies of chronic or degenerative diseases of man.

As a result of discussions started in the summer of 1974, The Rockefeller University and Beth Israel Medical Center started a joint program that could serve as a prototype of the way in which a research hospital like ours can interact more effectively with those hospitals primarily devoted to clinical care. Certain Beth Israel residents and postdoctoral fellows will participate in clinical investigations and research training at our Hospital and, in turn, a number of our senior and junior medical scientists will take part in clinical and teaching activities at Beth Israel. Both institutions foresee many mutual benefits deriving from this venture. We are particularly grateful to the Beth Israel staff — and to Herbert Singer and other members of the Beth Israel board—who have made this cooperative effort a reality.

Reproductive Biology

TWO OTHER AREAS of research symbolic of the changes taking place in our scientific interests are the program in reproductive biology and the work in ethology and ecology being carried out at the University's 1,000-acre field center in Millbrook, New York.

Since I last reviewed the Reproductive Biology Program in my 1973-1974 report, we have arrived at the mid-point of this 10-year effort, which the University launched in 1971. The general objectives—of extending fundamental knowledge relating to reproductive biology and of training predoctoral and postdoctoral students in the relevant basic sciences—are being achieved. More than 15 laboratories have been participating, engaging scores of faculty and students with a wide range of professional skills. Educational activities related to this field have been expanded to include a tutorial on the physiology of reproduction and the neuroendocrine mechanisms involved; a discussion group providing a format whereby our faculty and students, as well as staff at neighboring institutions, can meet to discuss their research; and a continuing program of seminars in reproductive biology. Most important, this long-range effort has already yielded major contributions to a thorough comprehension of the biological and behavioral forces that govern reproductive activ-

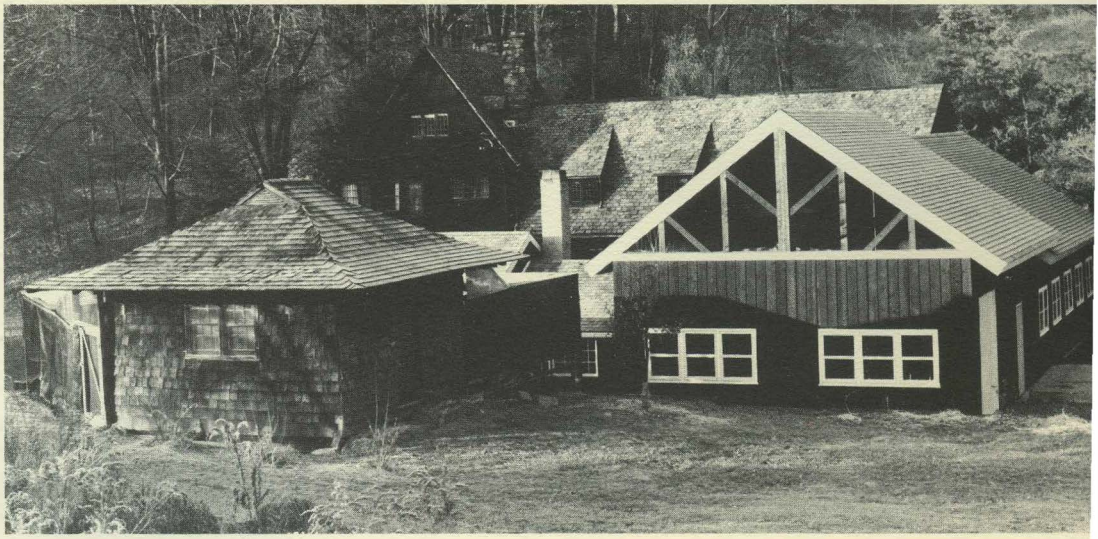
ity. In addition to federal support for individual projects, the Rockefeller Foundation and the Scaife Family Charitable Trusts have been providing the substantial private resources to strengthen and expand these studies on the most flexible, institution-wide basis.

Ecology and Ethology

THE UNIVERSITY'S CENTER for Field Research in Ecology and Ethology maintains a broad program of research and training on the behavior of animals in relation to their environments that has resulted in fundamental discoveries in several areas.

Several basic and long-standing problems in the understanding of animal communication have been resolved. Language is generally recognized as a unique attribute of humankind, and nothing remotely approaching its versatility and complexity has been found in animals. Yet what once appeared to be an almost infinite and unbridgeable chasm has begun to narrow in recent years as a result of modern scientific research on the communication behavior of animals and the patterns of social design it gives rise to in primates and other vertebrates.

Advances have also been made in analyzing the physiology of long-distance flights in birds and the mechanisms of how they

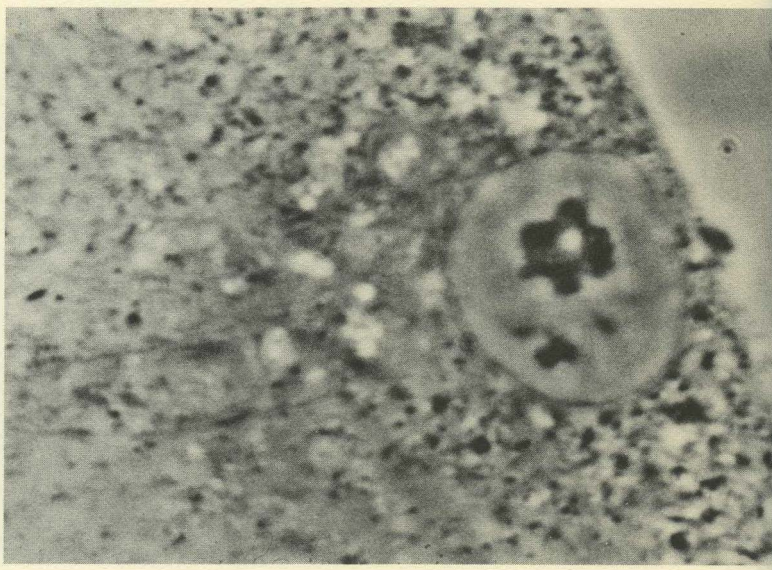


Field Research Center for Ecology and Ethology, Millbrook, N.Y.

orient themselves during migrations. In another area of study, song-learning in birds has been further established as a unique paradigm for getting at basic issues in animal learning, such as critical periods and other kinds of genetic constraints. This has led to important progress in understanding the neurophysiological and hormonal mechanisms underlying behavior and its modifiability. Of particular interest is the discovery that one side of the brain plays a dominant role in avian vocal behavior, just as it does in human speech.

Although much has already been accomplished, some research programs are only now reaching full impetus. But it is not premature to say that the University's Field Center is building the most substantial body of reliable information on animal behavior gathered by one research group anywhere in the world. The basic issues being investigated run straight to the connections between biological and behavioral phenomona; or, to put it another way, the relationships between genetic and environmental factors.

These research projects and related activities in ecology and ethology—and in environmental medicine—have been sponsored



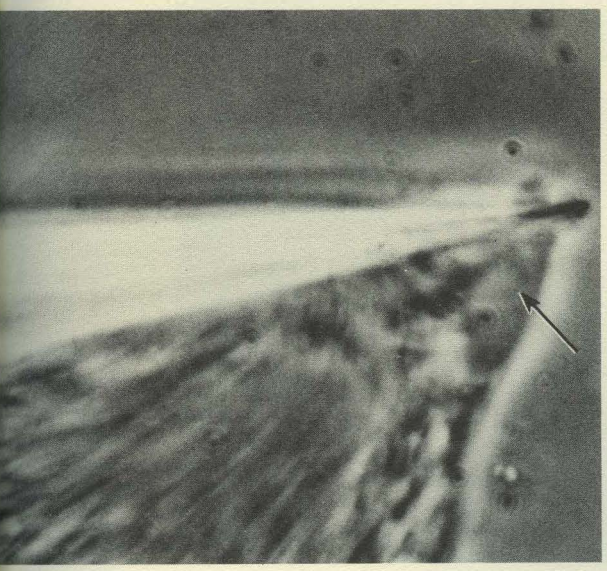
Removing the nucleus from a normal, living human cell is the first step in transplanting a different nucleus to that cell. These photographs, by Dr. Elaine G. Diacumakos, show the microoperation as seen through the phase contrast microscope at 2,000 magnification. Left, the nucleus appears as a lighter, circular region containing dark bodies, nucleoli, and it is surrounded by granular cytoplasm even though it appears near the cell border. Middle, a glass microneedle (light shaft) is pulling the impaled nucleus (arrow) out of the cytoplasm. Tension on the cytoplasm makes the organelles look blurred. Right, the cytoplasm is spreading on the cover slip and appears normal. The nucleus that has been removed (inset) is deformed by the operation.

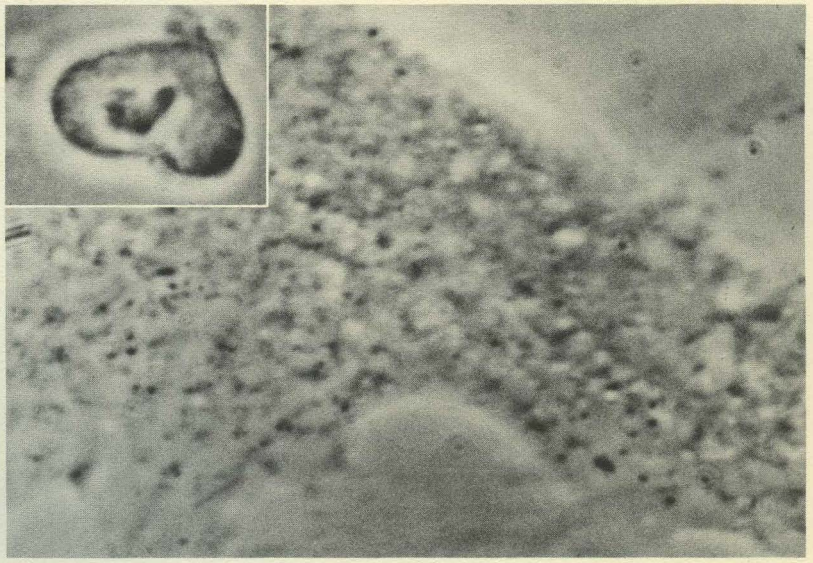
by major grants from the Scaife Family Charitable Trusts and the Mary Flagler Cary Charitable Trust.

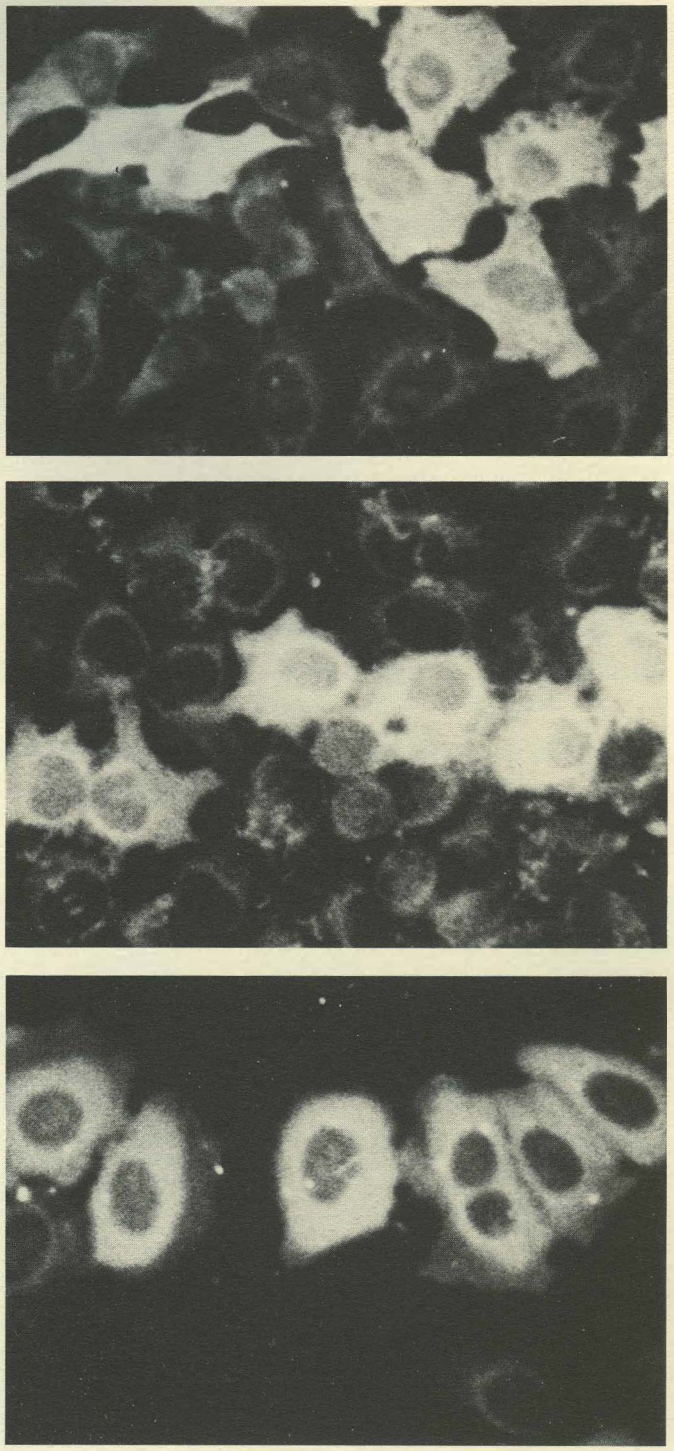
The Future of Cell Biology

AT THIS POINT, I would like to take a speculative look at the future of several other disciplines that have been at the heart of this institution's research for many years. It seems clear that cell biology, which is fundamental to the future of modern medicine, is entering a new phase as we move out from the very solid base provided by the innovations of Albert Claude, Keith Porter, George Palade, and Christian de Duve and gain further understanding of such matters as the role of the cell surface and the factors which determine cell differentiation. While it would be an overstatement to say that the central activity of our institution in the future will be the further exploration and clarification of cell biology at the molecular and microscopic levels, that work, through the use of all the tools and concepts science can provide, must clearly remain one of our major interests in the foreseeable future.

In the fall of 1971, the Andrew W. Mellon Foundation announced a major grant to the University for a broad-ranging







Biochemical, immunological, and microsurgical techniques are combined to study the factors that control protein synthesis within the cell. These fluorescence micrographs, by Dr. Dennis W. Stacey, show duck hemoglobin (bright fluorescent areas) being produced by cells of human origin within 25 hours after microinjection into them of polysomes (top), messenger ribonucleoprotein particles (middle), and messenger RNA (bottom), from immature duck red blood cells. Only the cells (near the center of the photographs) that received injections produce duck hemoglobin. (X 800)

research program to build on the accomplishments that have made this institution the "cradle of cell biology" and brought a Nobel Prize to Drs. Claude, Palade, and de Duve. It is impossible even to sketch the depth and breadth of our efforts and accomplishments under this program. Suffice it to say that the work is producing insights into the functioning of the cell membrane; the organization and regulation of cellular protein synthesis; the cell structures specialized for energy production, motility, and degradation of foreign materials; and the control of genetic information and transport of messages from the nucleus to the rest of the cell. The insights will continue to be applied to pressing unsolved problems in medicine. Research on many varieties of cell types and organisms, as well as clinical studies in human patients, are proceeding with a large array of experimental models.

New Developments in Immunology

We have an equally abiding involvement in the field of immunology, in which so many new developments are occurring. To take but one example, the successful research and clinical efforts of Professor Henry G. Kunkel's laboratory have been recognized by a number of major scientific awards in the past several years. This work includes investigations of systemic lupus erythematosus (SLE) and rheumatoid arthritis, two related diseases, which between them affect possibly 5.5 million people. In such disorders, the immune system, which ordinarily helps to ward off microbial invaders, is markedly altered and damages the body's own tissues. In rheumatoid arthritis, the primary targets are the joints. In SLE, any organ may be affected, but immunological injury to the kidneys is the most serious and is often lethal. Although many aspects of these diseases remain unknown, substantial progress is being made.

Fundamental advances are also being made through the utilization and application of recent discoveries about the basic mechanisms of the immune system. Some of these great advances have come from University laboratories, including that of Gerald Edelman, which is a center for diverse studies of the

molecular aspects of the immune system. Beginning with the elucidation of the structure of an antibody molecule, this research has opened up new vistas on how cells "communicate" and respond to changes in their bodily environment, and it adds to the practical knowledge of both medicine and basic science.

More than ever before in biology, the distinction between disciplines is difficult to define, a situation that is not at all disadvantageous to institutions like this University, where interdisciplinary endeavor has always been a way of life.

The Neurosciences

FINALLY, I come to the vast domain of the neurosciences, to which we have had a strong commitment ever since Herbert Gasser, neurophysiologist and Nobel laureate, succeeded Simon Flexner as director. Our base was broadened and strengthened during Detlev Bronk's administration with the addition of a number of laboratories, including those devoted to the physiological aspects of psychology, animal behavior, and human cognition.

Here we come up against the mystery and miracle of the brain. As Professor Neal E. Miller, one of the nation's leading physiological psychologists, points out: recent research is giving us a new picture of the brain. The brain controls a vast variety of functions, ranging from the regulation of the glandular and visceral reactions essential to our life all the way up to the highest mental processes involved in scientific and artistic creativity.

At this University, we are engaged in the neurosciences on a broad front. Besides continuing research on the structure and function of nerves and the transmission of information to and from the various areas of the brain, our scientists are exploring hormonal functions and the biochemical components of behavior, including the effects of certain drugs. Another area of research attempts to delineate the process of language, the complexities of learning and memory in man and animals, and the effects of environmental influences on the intellectual development of children.

Beyond this is an increasingly important line of research that

has a bearing on pathological conditions that are strongly influenced by the brain in its central regulatory role and by its responses to stressful conditions of life. It has long been believed that the mind affects the body. Recent research is supplying objective evidence for an increasing number of such psychosomatic relations.

It is quite obvious from this incomplete survey that the strengths of this institution in the basic sciences are again giving us a key role in one of the most rapidly expanding areas of research. At some time in the future, science will enter a period in which the groundwork has been laid for understanding the working of the brain and diseases of the central nervous system. Surely this is the most challenging of all the problems of biology and medicine, one which will bring together many disciplines—neurophysiology, behavioral biology, cell biology, biochemistry, genetics, communications theory—into what will undoubtedly prove to be a most remarkable concert.

A Full Agenda and Some Questions

WHEN THIS ASSIGNMENT is added to the research agenda I have been itemizing in this report, I find it hard to take seriously the pessimism in some quarters that the halcyon days of discovery in biology are about over and that we are approaching a dull era of "mopping-up" operations. My concerns are of quite a different order and bring me to what, I hope, is a more satisfactory, although tentative, conclusion.

The complexities involved in the exploration of the brain and nervous system raise questions with profound implications for the science of tomorrow. Are we approaching a new stage in biological research where the basic concepts that have guided us up to now will be challenged by the very phenomena under study and by the questions we seek to answer?

One may grant that there probably is a physical-chemical basis for understanding the routine operation of the brain as a device which receives, stores, processes, and reads out information. One may wonder, however, if the finer sensitivities of the mind, which we associate with the terms conscious and sub-

conscious, and with realization of self—as well as countless other nuances which guide our actions and mean so much to us as part of the process of being alive—will find a ready explanation in terms of the coldly beautiful scientific facts. Will we instead, even when armed with the basic knowledge of the functioning brain derived from present approaches, still be far from comprehending what the poet might call the real issues of life?

Probably the only other problem in the field of the life sciences which offers a comparable challenge is that centering on the origin of life on earth. It is difficult for me, at least, to believe that anything resembling the final word has been said on the topic, even though there is now good reason to believe that amino acids existed or were generated in the primordial waters of the primitive earth. The gap which separates our present conceptions of the state of matter on the surface of the primitive earth, with its essentially inorganic composition, and the delicately complex structure of a living cell of our time, displayed in the cell biologist's remarkable electron micrographs, is simply much too vast to be passed off without scientific concern of the first magnitude. Closing that gap of understanding must remain a major objective of the basic biological sciences.

The field that is now termed physics was the first of the areas of science to intrigue the philosophers as, in the historical evolution of science, they attempted to put the universe in order. The science of physics stayed very close to its speculative philosophical origins during much of its initial phases, probably because the awakening scientific mind was deeply awed by the overpowering concept that the world is subject to universal natural law.

However, some members of the physics community became overconfident of their powers of analysis and conceptualization in the decades after Newton and had the temerity to move several steps ahead. They envisioned the universe in terms of a deterministic clock-work structure which had been wound up and made to run in accordance with the prescriptions of Newtonian law.

This classical structure came apart and to a crashing end early in the present century, when it became necessary to grapple with completely new concepts. This experience has brought the more contemplative physicists back much closer to their philosophical roots. Even today, 50 years after the discovery of the Heisenberg-Schroedinger formulation of classical quantum mechanics, the physicist stands in awe of the principle embodied in that formulation, which requires that the human observer and his measuring equipment be taken into account in interpreting the atomic laws.

The Greatest Challenge

IF THERE IS a basic weakness in the life sciences at the present time, I believe it is associated with the almost universal, overconfident acceptance of a mechanistic conceptual framework, analogous to that exhibited by classical physics in the last century. I grant that it may be the proper outlook for our time because we are, with the use of tools both old and new, erecting a magnificent and useful edifice in a heroic attempt to understand the most remarkable and awesome phenomena in the segment of the universe that lies within our ken, namely life. In pursuing the present course we shall undoubtedly uncover many enlightening and beneficial facts concerning the properties of living systems. All this is well and good. However, while pushing ahead with all the speed our resources and imagination permit, we must preserve—along with our elan—an element of cautious humility in relation to the subject we pursue.

For it may well be that issues will arise in the systematic study of living systems that will be far more subtle and revolutionary than our present conceptual framework, with its deterministic notions of a chemical clock-work, now suggests. At that point, the biologist will find himself on the same fascinating frontier as the physicist. This opens up the most challenging prospect of all—a true fraternity of the sciences, much deeper than anything we know today, at the outer reaches of mankind's imagination.

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On behalf of our faculty, graduate fellows, and trustees, I would like to express our warmest thanks to the following donors who have contributed to the University during the years since the first comprehensive effort in our history was launched to broaden our base of private support.

The first list includes the donors whose assistance is helping to fulfill the goals of the University's over-all Development Program, which seeks $120 million by the end of the decade. The Program's goals continue to emphasize additional endowment and long-term operating support for basic research in selected life sciences, for the clinical programs of our Hospital, for professorships, and for predoctoral and postdoctoral fellowships. Several major donors also have aided the construction of the new Animal Research Center, a high-priority objective for which the remaining funds are still being sought.

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*Elected May, 1976; term begun October, 1976