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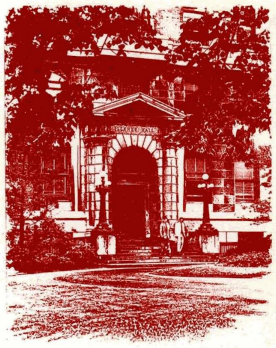
It is intended that there should be six issues of this publication during 1963, the first of them to appear at the beginning of February. There will also be some changes in both format and content, principally so that future issues may be a more topical record of events at the Institute, and a more faithful reflection of the activities of its members. Loyal readers need not fear that they will fail to recognize the refurbished journal.



Cover illustration: entrance to Flexner Hall

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Electron Microscopy at the Institute

BY RAYMOND B. GRIFFITHS *Executive Editor of The Journal of Cell Biology*

THE DEVELOPMENT within the past two decades of the electron microscope and of techniques for using it to study biological structure has ushered in an epoch of new discoveries. With the high resolving power of this instrument, which is over one hundred times greater than that of the light microscope, biologists have explored the architecture of the cell in the submicroscopic realm (2000 Å down to 20 Å and below) and have found this to consist of a richly differentiated fine structure of great complexity. From the systematic study of the fine structural organization of cells, new concepts of morphology have emerged, and these bear on the fundamental principles of all biological disciplines. Such studies, together with those employing biochemical techniques in the analysis of the functional activities of cell components, have begun to elucidate basic structural-functional relations within cells and even to make possible their interpretation in molecular terms.

At The Rockefeller Institute pioneering efforts in the biological exploitation of electron microscopy were made in the early 1940's by Albert Claude and Keith R. Porter, then working in the Laboratory of Cancer Research under J. B. Murphy. Over the years this work has prospered, and one result has been the growth of a vigorous school of cytology. Much of the technique evolved within this school has now been adopted in other laboratories, and by other groups at The Rockefeller Institute. The historical account which follows is concerned only with the work of the school of cytology and its development since the early forties.

CELL FRACTIONS

For some time Claude had been developing techniques for separating cell components by differential centrifugation and had isolated from homogenates of liver and other tissues a mitochondrial fraction and a "small granule" (later called microsomal) fraction. The opportunity to examine his fractions with the high resolutions of electron microscopy was presented to Claude in 1943 by Albert E. Gessler, then Director of Research at the Interchemical Corporation, New York, where a research laboratory was equipped with one of the earliest models of the electron microscope. In his first studies, carried out with Ernest F. Fullam, an engineer at the Interchemical Corporation, Claude succeeded in obtaining electron micrographs of fractionated material sprayed onto the specimen grid of the microscope, but the resulting images were not satisfactory enough for an accurate interpretation of structural details. Though this preliminary work yielded meager information on fine structure, it did indicate the potential value of electron microscopy and also defined some of the basic requirements for the preparation of specimens.

CULTURED CELLS

One of the most important considerations was that specimens should be thin. It occurred to these investigators that tissue culture cells which spread out extensively when grown on a flat surface might be thin enough for the differential scattering of electrons and the formation of useful images. Keith Porter, who was working with cultured tissue cells, collaborated with Claude and Fullam in trial studies. In preparing specimens for examination, Porter employed a fixation with osmium tetroxide and worked out an ingeniously simple method for transferring the cultured cells from coverglasses, on which they had grown, to the specimen grid of the microscope. Both the selection of specimens and the method of their preparation proved to be favorable, as electron micrographs were produced in which clear images of cell structures were discernible.

The results of the work of Porter, Claude and Fullam were reported in 1945, and their paper was the first demonstration that intact cells could be examined by electron microscopy. The electron micrographs revealed all the cellular entities known from light microscopy including the ground substance, nucleus and mitochondria. Distortion was not excessive despite the extreme dryness and thinness of the specimens, and details were revealed of submicroscopic structure never before seen. The paper noted that osmium tetroxide fixation gave the most truthful images and that in the best osmium preparations the ground substance of the cytoplasm had a "lace-like reticulum" with "vesicle-like bodies, i.e., elements presenting a center of less density, and ranging in size from 100 to 150 mμ . . . arranged along the strands of reticulum." This discovery, evidence of "invisible" organization in the cell ground substance, was to have important implications for the future course of cell research.

In 1945 an electron microscope obtained by The Rockefeller Foundation was set up in the Institute and was made available to Claude and Porter for their continuing work on cultured cells. In one of their studies, carried out in collaboration with Edward G. Pickels, Claude and Porter examined cultured chicken tumor cells to determine the nature of the filtrable agents responsible for transmission of these tumors to new hosts. Previous filtration studies had indicated the transmitting agent to be particulate and of small size, but confirmation of its character had been unobtainable by the limited resolutions of the light microscope. Using the new techniques, these investigators were able to demonstrate in the tumor cells the presence and distribution of "small bodies" of the size estimated for the transmitting agents. From this work came the first microscopic description of the Rous sarcoma virus.

MICROTOMY

By the late forties it had been amply demonstrated that the electron microscope was an effective means of examining cells grown *in vitro*, but its application to the study of cells *in situ*, in their normal surroundings within tissues, was hampered by the difficulty of preparing thin sections. Claude and Fullam, like investi-

gators at other laboratories, turned their attention to the problems of microtomy. With Joseph Blum, a talented instrument maker at the Institute, Claude developed a "single-pass" microtome in which a specimen was fixed to the edge of a revolving disc or wheel and thus carried past a knife, but this was not entirely satisfactory. Eventually the chief contribution to the technique of microtomy emerged in the form of the Porter-Blum instrument, in which by mechanical control a specimen is brought against a knife. This device has now become the standard microtome for electron microscopy.

While his associates were attempting to prepare tissues for electron microscopy, Porter continued to utilize cultured cells in his work and, with the assistance of his students, he examined the fine structure of various cultured materials, including tumor cells, blood clots, fibroblasts, and other cell types. He demonstrated the virus-like particulate bodies (thought to be milk agent) associated with the epithelial cells of transmissible mammary adenocarcinomas in mice, and described the origin and development of collagen fibrils in fibroblasts. Particularly significant in the course of this work was his observation that "endoplasmic strands" arranged in a complex reticulum of vesicular or canalicular elements are characteristically present in the ground substance of all cells. To this system of elements, which he observed to be a feature of the endoplasmic region of the cytoplasm, he was to apply the term "endoplasmic reticulum."

The year 1949 was an eventful one for the future development of electron microscopy at the Institute. Knowing the progress already made, and being convinced of the importance of the method in cell research, Dr. Herbert S. Gasser, then Director of the Institute, established a Cytology Laboratory and appointed Keith Porter to direct its work. Two rooms in the basement of Theobald Smith Hall were designated for the laboratory and were fitted very soon with a new RCA electron microscope, purchased by the Institute, and the "old" RCA instrument bought by the Foundation. Within the year, Porter was joined by George E. Palade, a colleague from J. B. Murphy's Laboratory, who had been conducting cell fractionation studies in collaboration with Claude and with Walter C. Schneider and the late George H. Hogeboom. Thus began the association between Porter and Palade that fostered and gave leadership to the development of electron microscopic research in cytology throughout the world. Their independent and collaborative works, together with those of their associates and students, laid the foundation for the rapid advances that were made in cellular research over the next decade.

FINE STRUCTURE

By 1951 methods were available for preparing tissue sections for examination in the electron microscope, but it was soon apparent that the electron micrographs were not satisfactory because of structural alterations in the cells caused by poor preservation. Palade first studied the fixation of cell preparations with osmium tetroxide, and defined the optimum conditions for using it. As a result he was able to resolve in fine detail the structure and spatial relationship of cell components in thin sections of cells. Palade used his improved technique for the study of mitochondria. He examined the mitochondria in the cells of a variety of mammalian tissues and found that they have a characteristic pattern. Each mitochondrion was observed to possess an outer limiting membrane and a second inner membrane from which a system of regularly spaced ridges (which he termed *cristae mitochondriales*) projects into a structureless matrix. In the most favorable micrographs, the cristae appeared as folds of the inner membrane. Palade interpreted these structural details as the expression of a more complex organization at the molecular level. In correlating his findings with the known biochemical data, he postulated that the framework of the internal membrane is probably the site of chains of oxidative enzymes and that the matrix is made up of soluble proteins including enzymes.

Having explored the fine structure of numerous types of cells *in vitro*, Porter then saw the opportunity to extend his observations on the endoplasmic reticulum to cells *in situ*. Independently, and in association with Palade, he carried out comparative studies on the fine structure of various kinds of avian and mammalian cells *in vitro* and *in situ* and demonstrated conclusively that a reticulum similar to that previously described in cultured cells is present in the ground substance of all cells studied *in situ*. In the latter, the reticulum appeared to consist of a network of cavities, commonly in the form of broad, flat vesicles *(cisternae)*, bounded by a continuous limiting membrane. It was evident that the reticulum has characteristic patterns of organization. Variation in the appearance of the reticulum among different cell types was interpreted as the expression of cell differentiation, while differences in its appearance within

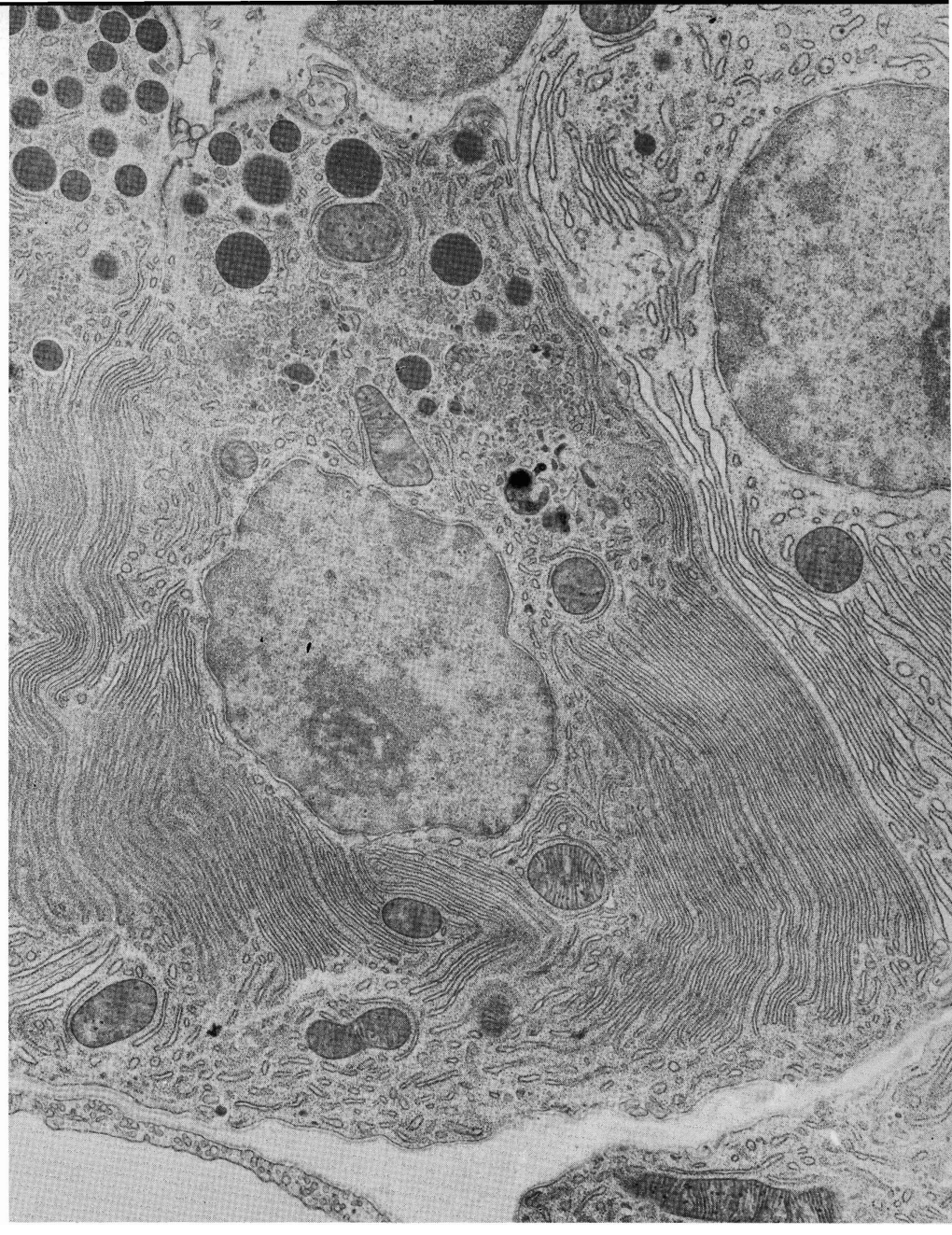
Bat pancreas acinar cell, showing a mitochondrion and elongated profiles of endoplasmic reticulum, whose membranes are covered externally by ribosomes. x 48,500.

a given cell type were considered to be functional variations of the system.

In the course of these studies, Palade discovered another cytoplasmic entity, a small particulate component (100 to 150 Å) of high density, which appeared in the form of small, round particles. These particles appeared to have an affinity for the membranes of the endoplasmic reticulum, since in many cells the outside surface of these membranes (facing the cytoplasmic matrix) is covered with them. As well as the particles attached to the membrane, there were found free in the cytoplasmic matrix a large number of similar particles. From their location and characteristics, Palade postulated that the particles, rather than elements of the reticulum, are responsible for the basophilia of cytoplasm, i.e., contain most of the cytoplasmic ribonucleic acid. Cell fractionation studies which he carried out later with Philip Siekevitz established that the particles (ribosomes) are involved in protein synthesis.

FUNCTIONAL RELATIONS

The further analysis of these two basically distinct components, the reticulum and the ribosomes, became an important focus of the work of the laboratory. A broad survey of the endoplasmic reticulum in many kinds of cells contributed further evidence of the varying patterns of organization of the system and revealed important relationships between the reticulum and other cell structures. It was noted, for example, that the particle-associated membranes of the reticulum, the so-called "rough-surfaced" membranes, are in continuity with membranes having no attached particles, the smooth-surfaced membranes, in a common system. It was observed by Michael Watson, working in the laboratory, that the reticulum is continuous with the outer nuclear membrane, indicating that a pathway of exchange exists between the reticulum and the perinuclear space (enclosed within the inner and outer membranes of the nuclear envelope). In skeletal and cardiac muscle, it was found that the reticulum (here called sarcoplasmic reticulum) appears as a lacework of smooth vesicles around the myofibrils and is patterned with respect to the bands of the myofibrils, suggesting that the system may be concerned with intracellular conduction of the excitatory impulse. Observations such as these made it possible to begin to comprehend the functional role of this ubiquitous system.



Bat pancreas acinar cell, with a nucleus, mitochondria, and showing extensive parallel arrays of endoplasmic reticulum. x 9,500.

Particularly important were the studies in which electron microscopy was utilized in conjunction with cell fractionation procedures to determine chemical composition and biochemical activity of cell components. In this work, differential centrifugation was used to separate from tissue homogenates the various particulate components of the cytoplasm according to their size and density. The microsome fraction was of special interest because earlier biochemical work by Claude and his colleagues had shown that it has a high content of ribonucleic acid and is therefore probably concerned with protein synthesis. In their studies on this fraction from liver and pancreas cells, Palade and Siekevitz demonstrated that it consists of fragments of membranes of the endoplasmic reticulum with attached small, dense particles. They found that the small particles are associated with ribonucleic acid whereas the membranes are associated with most of the protein and phospholipid and with certain enzymes. These studies established that the small particle, rather than the "microsome," is the functional unit in protein synthesis. They also suggested that the limiting membrane of the endoplasmic reticulum provides appropriate surface for the arrangement of the particles and that the cavities of the system are possibly a stor-

age place for a cell product.

Additional information on the roles played by the various cell components in the synthesis and subsequent handling of protein products was supplied by biochemical studies on pancreatic exocrine cells. It was possible, for example, to isolate a fraction of zymogen granules and to demonstrate the presence of proteolytic enzymes within them. The appearance and chemical composition of these granules are similar to those of large, dense granules (intracisternal) which were found to develop within the cavities of the reticulum. These studies, together with others which dealt with the analysis of the distribution of proteolytic enzyme activity in the microsomal and zymogen fractions, under varying dietary conditions, contributed important data on the possible sequence of events in protein synthesis. The hypothesis was thereby established that the protein secretory product (enzymes) is produced by the rough-surfaced elements of the endoplasmic reticulum, is temporarily sequestered in the cavities of the reticulum as intracisternal particles, is packaged in the smooth-surfaced membranes of the Golgi region, and is finally stored as zymogen granules in the apical region of the cell from which it is discharged. Verification of this hypothesis has been accomplished through experiments employing radioactively labeled amino acids to study *in vivo* the time course of amino acid incorporation into the proteins of the various cell fractions.

TRANSPORT MECHANISMS

Continued improvements in techniques made it possible to extend electron microscopy to the study of structural changes associated with physiological processes in cells. With the use of tracer molecules (ferritin and colloidal gold), which are easily recognizable in the electron microscope, Palade and his co-workers, Steven L. Wissig and Marilyn G. Farquhar, were able to study the mechanism of transport of the molecules across the wall of blood capillaries of the myocardium and of the renal glomeruli. This work showed that tracer molecules enter the endothelium of the muscle capillaries in small pockets and vesicles formed by the invagination of the cell membrane, and that they are carried in vesicles across the cell to the basement membrane and pericapillary spaces. From these observations it was suggested that the small vesicles of the endothelium serve in the transport of water and solutes from the capillary lumen to the pericapillary spaces. In the renal glomerular capillaries, the tracer molecules appeared to penetrate the openings *(fenestrae)* in the endothelium so as to reach the basement membrane, in which they become embedded, and also the visceral epithelium, where they are engulfed in invaginations of the plasma membrane. It was concluded that the basement membrane is the principal structural element of the glomerular filter and that the epithelium provides a further check on the filtrate by removing from it, through pinocytotic activity, protein molecules that pass through the filter.

FURTHER DEVELOPMENTS

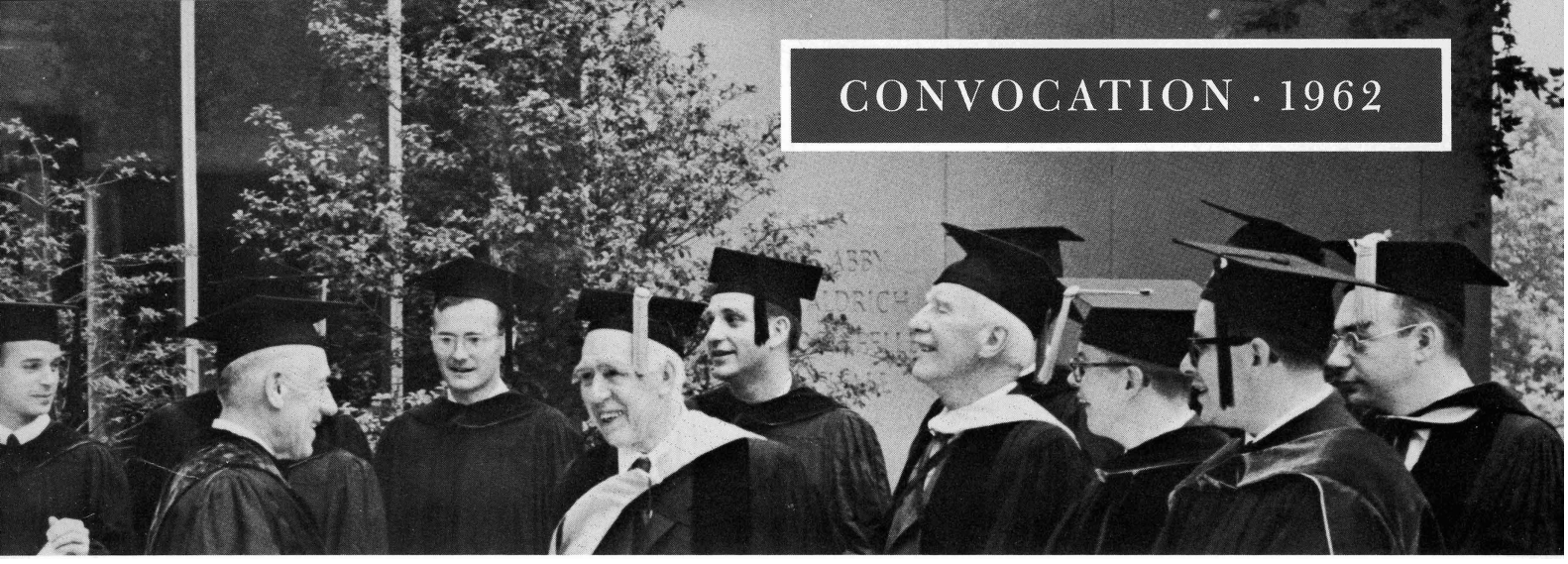
In experiments devoted to an analysis of the fine structural alterations induced in rat liver cells by the administration of a carcinogen (aminoazo dye), Porter and his co-workers found that the predominant change consisted of hypertrophy of the smooth-surfaced elements of the endoplasmic reticulum associated with areas of glycogen storage. On the basis of this response and an apparent interruption of glycogenesis brought about by the carcinogen, the assumption was made that the smooth membranes of the reticulum may be involved in glycogen storage and mobilization. Further investigation of the behavior of these elements, under varying conditions of nutrition, tended to support this concept. Later studies involving the use of hormones (glucagon and epinephrine) to effect the release of glucose in rat livers contributed further evidence to suggest that the smooth-surfaced membranes are involved in sequestering glucose from glycogen stores and transporting it to the cell surface and extracellular space.

Porter and his collaborators also carried out a number of electron microscopic studies on the fine structure of plant cells, particularly of the root meristematic cells of onion and bean plants. This work identified in plants the equivalents of the various cell components described for animal cells, as well as other components specific for plant cells, and demonstrated the structural changes occurring in the nucleus and chromosomes during the various stages of the mitotic cycle. New information was gained with respect to the organization of the chromosomes and of the nucleolus, the behavior of spindle elements, the disposition of the nuclear membrane, and the fate of the endoplasmic reticulum.

The large number of scientific papers from this and other laboratories taxed existing outlets. In 1954, Dr. Detlev W. Bronk, President of the Institute, recognizing the need for a vehicle of communication for cytologists, took steps to publish a new journal. This was known as *The Journal of Biophysical and Biochemical Cytology,* and the first issue appeared in January 1955. Since then, the JBBC has played an outstanding role in the furtherance of cell research. To accommodate an increasing supply of deserving manuscripts, it was made a monthly publication in 1961. In 1962, its title was changed to *The Journal of Cell Biology.*

In the last decade the Cytology Laboratory has enlarged its research program, and has moved from the basement of Theobald Smith Hall to the new South Laboratory. Keith Porter has joined the faculty of Harvard University, and George Palade has become the director of the laboratory. Over the years the school of cytology at the Institute has established a reputation as one of the foremost centers for training in electron microscopy, and as a result a large number of students and established investigators, from the United States and from abroad, have gained experience in it. The participants in the work of the laboratory have included: T. P. Ashford, R. J. Barrnett, C. Bruni, L. Caro, J. B. Caulfield, S. Dales, H. G. Davies, A. D. Deitch, M. A. Epstein, L. Ernster, M. G. Farquhar, D. W. Fawcett, A. Glauert, G. C. Godman, L. J. Greene, C. Grégoire, J. A. Jacquez, F. L. Kallman, R. C. King, J. F. Kirsch, J. G. Lafontaine, M. C. Ledbetter, D. J. L. Luck, J. Luft, R. D. Machado, R. Maggio, G. Majno, I. Manton, H. Meyer, F. Miller, G. Millonig, G. Miroff, D. H. Moore, M. J. Moses, S. L. Palay, G. D. Pappas, L. D. Peachey, G. W. Richter, S. Rosen, J. Rothschild, M. A. Rudzinska, R. Sager, P. G. Satir, A. W. Sedar, P. Siekevitz, D. S. Smith, R. J. Sotelo, W. Stoeckenius, R. S. Stone, N. Takahashi, H. P. Thompson, P. Vanamee, J. Vial, M. L. Watson, S. L. Wissig, J. J. Wolken, and E. Yamada.

[Electron micrographs courtesy K. R. Porter]



CONVOCATION · 1962

1962 GRADUATES AND THEIR PRESENT POSITIONS

DAVID LESLIE EAKER, A.B. Hamilton College
U. S. Public Health Service Postdoctoral Fellow, Institute of Biochemistry, University of Uppsala, Sweden.

LEWIS JOEL GREENE, B.A. Amherst College
Assistant Biochemist, Biology Department, Brookhaven National Laboratory, Upton, New York.

ARTHUR KARLIN, B.A. Swarthmore College
Research Assistant, Columbia University College of Physicians and Surgeons.

TIMOTHY ROBERT LOEB, B.A. Reed College
Assistant Professor, Facultad de Medicina, Universidad Del Valle, Cali, Colombia.

DAVID J. L. LUCK, S.B. The University of Chicago, M.D. Harvard Medical School
Research Associate, The Rockefeller Institute.

LEONARD EUGENE MINDICH, B.S. Cornell University
Research Associate, Public Health Research Institute, New York.

EDWARD REICH, B.Sc. McGill University, M.D. The Johns Hopkins University School of Medicine
Research Associate, The Rockefeller Institute.

ROBERT RUSH TRAUT, B.A. Haverford College
Fellow, The Jane Coffin Childs Fund for Medical Research, Medical Research Council Unit for Molecular Biology, Cambridge, England.

JOSEPH WILLIAM VANABLE, JR., B.A. Brown University
Assistant Professor, Department of Biological Sciences, Purdue University, Lafayette, Indiana.

DAVID CLEAVELAND WHITE, A.B. Dartmouth College, M.D. Tufts University School of Medicine
Assistant Professor, Department of Biochemistry, University of Kentucky School of Medicine, Lexington.

TWO NOBEL LAUREATES became honorary Doctors of Science of The Rockefeller Institute at the Fifth Convocation held on the morning of June 5th last. They are Dr. Niels Bohr, the Danish theoretical physicist (who died unexpectedly on November 18th), and Dr. A. V. Hill, the British physiologist renowned for his classical researches on the mechanism of muscle action. At the same ceremony ten students of the Institute graduated as Doctors of Philosophy. The degrees were conferred by the President, Dr. Detlev W. Bronk.

In his presentation Dr. Bronk described Niels Bohr as the "founder of modern physics." His name will be known, Dr. Bronk said, "as long as knowledge of nature is preserved. For it was he who laid the foundations of the modern concepts of the structure of matter. He has been the architect and the builder, too, of concepts that are noble in their scope and grandeur. His questing search for understanding has opened new vistas to the mind of man, new pathways to be followed forever by the adventurous human spirit. This all men know."

Bohr had been the Director of the Institute for Theoretical Physics at Copenhagen since 1920, and during that time the institute had become a Mecca for theoretical physicists. His first outstanding personal triumph was the demonstration, in 1913, of how the nuclear model of atomic structure could be made intelligible by means of a quantum theory. With the elaboration of that doctrine, Bohr became a profound analyst of the philosophical basis of the laws of physics in a way which inspired a great many of the later successes of theoretical physics.

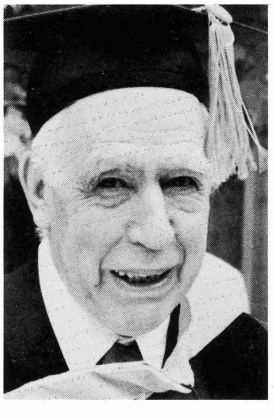
Bohr's interests had not been confined within institutes of theoretical physics, however. Thus, in January 1939, he played an important part in persuading United States scientists that nuclear fission was practicable. He became chairman of the Danish Atomic Energy Commission, and had been extremely active in the creation of international institutions such as the European Centre for Nuclear Research (CERN) at Geneva.

In his presentation of Dr. A. V. Hill President Bronk used the description "founder of the science of biophysics." Hill had begun his professional career as a mathematician, Dr. Bronk said, and had always kept his feet firmly grounded "in the sciences which are fundamental to all else." As a result, in forty years at University College, London, he had taught students not merely techniques but "the heartening belief that there is a unity of all sciences."

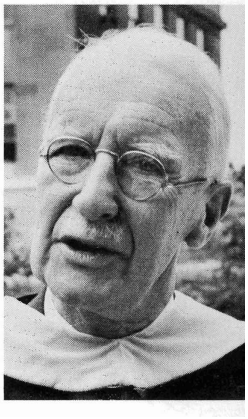
For his research on the mechanism of muscle action Dr. Hill was awarded a Nobel Prize in 1922. He was Fullerton Research Professor at University College, London,

(continued overleaf)

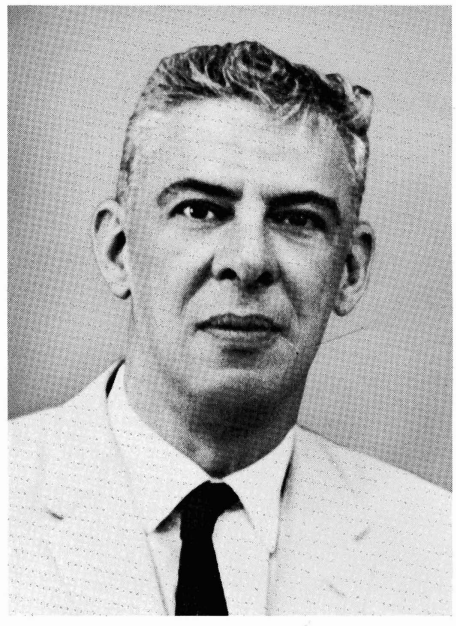
NIELS BOHR



A. V. HILL



THEODORE H. BERLIN · 1917-1962



THE SUDDEN DEATH of Professor Theodore Berlin, on November 16th, came as a shock to the Institute. Berlin, who was forty-five, was one of the most recent recruits to the company of professors at The Rockefeller Institute. He died in Baltimore, and the funeral was held at Towson, Maryland, on November 19th. President Detlev W. Bronk was among the large group of Berlin's colleagues and students from the Institute present on this occasion.

Berlin was a distinguished theoretical physicist, and has been described by President Bronk as "one of the outstanding theoretical physicists of the United States in the younger generation." By a cruel coincidence, of which many who attended the funeral were painfully aware, Berlin's death had come within hours of that of Dr. Niels Bohr of Copenhagen, the grandest survivor from the Homeric age of theoretical physics half a century ago.

Berlin's connection with The Rockefeller Institute dates from February 1961, when he was appointed professor. He then joined with Professor George Uhlenbeck (also a physicist) and Professor Mark Kac (a mathematician) in the development of a school of physics and mathematics at the Institute. Brief though this period may have been, Berlin's influence on the work of the Institute will be felt for many years to come.

By birth Berlin was a New Yorker, and he was born in the city on May 8th, 1917. He began his professional career at the Cooper Union Institute of Technology, where he obtained a B.S. degree in chemical engineering. Concern for the foundations of his subject drew him into theoretical science, however, and at the end of the thirties Berlin began postgraduate work at the University of Michigan.

There, in turn, he obtained the degrees of M.S. and Ph.D. With the coming of World War II, and while still a graduate student, Berlin found himself caught up with the development of the proximity fuse. His academic work concerned the electronic structure of molecules, and the interest thus fostered in theoretical chemistry remained alive even when Berlin turned his main attention to the problems of theoretical physics proper.

From Michigan Berlin went to The Johns Hopkins University in 1946, and was promoted to Assistant Professor in 1947. He then became an Associate Professor at Northwestern University, spent two years as a Guggenheim Fellow at the Institute for Advanced Study in Princeton, and returned in 1955 to The Johns Hopkins University where he was appointed professor of physics.

Berlin was a fellow of the American Physical Society, and served for a time as associate editor of the *Journal of Chemical Physics*. He performed the same service for the *Physical Review*, and more recently was editor of the *Physical Review Letters*. In matters like these Berlin's capacity to get things done was acknowledged to be an asset to the profession as a whole.

Berlin's association with Professor George Uhlenbeck was especially close, and dated back to the time when Berlin had been one of Uhlenbeck's research students at the University of Michigan. At the time of Berlin's death the two men were collaborating to write a book on statistical physics.

During his stay at The Rockefeller Institute Berlin had quickly won for himself a reputation as a warm and generous person. Students and other newcomers to the Institute recall with gratitude his helpfulness. Also memorable is the vigor with which he carried out his work at the Institute.

Berlin's home is at Scarsdale, New York, and he is survived by his wife, Mrs. Patricia May Cleary Berlin, and his family of four children, all of them boys. Their names are Geoffrey N., Dennis A., Michael K., and Alexander L.

CONVOCATION — 1962 *continued from page five*

from 1926 until his retirement in 1951.

The most dramatic, though not perhaps the most important, part of Dr. Hill's work outside laboratories arose out of his membership in the British Air Defence Research Committee in the late thirties. This body, also known as the Tizard Committee, was that on which a clash between Sir Henry Tizard and Lord Cherwell (then F. A. Lindemann, and Churchill's protégé) led to the latter's temporary exile from public service. This breach was brought to a head by the resignation from the committee of four of Dr. A. V. Hill and P.M.S. Blackett, its two independent members.

During the decade from 1935 Dr. Hill was also the Secretary of the Royal Society of London. During the war he served for a time as Member of Parliament for Cambridge University.

Dr. Bronk went on to speak of the friendship and the essential humility of both the honorary graduates of the Institute, and commended their example to the ten new Doctors of Philosophy. "They have what we often—too often—forget when we think of the vicarious power we have from science."

The Reverend Henry P. Van Dusen, President of the Union Theological Seminary, delivered the Invocation and the Benediction at the Convocation.

MISCELLANY

AN EPOCH in the history of the National Academy of Sciences-National Research Council ended in June of this year. In January, President Bronk had written to each of the 650 members of the Academy that he would not, in April, serve a third four-year term as President because he felt the growing importance and demands of the Academy would encroach too much on his responsibilities to The Rockefeller Institute, to which he wished to devote his full energies. Despite hundreds of letters of regret and protest against his decision, he declined to abandon his resolve. He agreed, however, to serve as Chairman of the Academy Centennial in 1963 and to complete the building program he had begun.

Academy President

Accordingly, on June 30th, there came to an end Dr. Bronk's twelve years as President. These followed his four years as Chairman of the National Research Council and five years as Foreign Secretary. During that time the Academy multiplied its services to science, the federal government, universities and industry, and revealed the potentialities of the Academy to an entirely new degree. Under Dr. Bronk's leadership the Academy aided greatly in the creation of such federal agencies as the National Science Foundation and the President's Science Advisory Committee, together with institutes such as the American Institute of Biological Sciences and the American Geological Institute.

At its annual meeting in April, and following the election of Dr. Frederick Seitz, Professor of Physics in the University of Illinois, as Dr. Bronk's successor, the Academy adopted with a standing ovation the following resolution:

"The members here present wish to record their deep appreciation of President Bronk's achievements during his term of office. Because of his vision, energy and devotion, the National Academy of Sciences has become a more effective spokesman for the scientific community and a more persuasive counselor of government."

At a farewell reception, the officers and staff of the National Academy of Sciences-National Research Council presented Dr. Bronk with this memento: "Leader of vision, boldness, insight—seeker of the right and good—pursuer of excellence—servant of science and human welfare—wise counselor in matters great and small—In Appreciation Of—your faith in the supremacy of God and the high destiny of man—your sense of the true, the beautiful, the just—your courage when the issue is drawn—your power to lift the eyes of men to the hills—your expectation of much from us all, but more from yourself." On the last evening of his Presidency, June 30th, several hundred members of the Academy and those associated with its manifold activities gathered at the Academy Study Center in Woods Hole to honor him at a dinner dance.

Rockefeller Forum

The Calendar of Events will be still further lengthened, but in a manner which has been widely welcomed, by the decision of a group of graduate students to form an organization known as the Forum. Their intention is to bring to the Institute lecturers on subjects not at present represented in the teaching program or by the Rockefeller Institute Lectures. One of the organizers of the first meeting (held on November 13th) explained that it was hoped to avoid scientific or philosophical subjects. "There is already plenty of talk at the Institute about weapons and fall-out and things like that," he said, "but not nearly enough about the arts and contemporary politics, such as UN affairs."

The intention is that there should be a meeting at 8:00 p.m. on the second Tuesday of each month, and the first lecture on "The Neglect of Intellect" was delivered by Professor Richard Hofstadter of Columbia University to an audience of more than sixty people. At the same meeting the Temporary Program Committee of Barry Bloom, Joan Kent, Daniel Rifkin and Lawrence Sturman was replaced by a Permanent Committee of James H. Schwartz (Chairman), W. Carey Parker and Alexander Kessler.

Christmas Lectures

The Rockefeller Institute Christmas Lectures for high school students will be given this year by Professor Mark Kac, the mathematician who joined the faculty a year ago. The lectures are open only to students nominated by their teachers at school, and will be held daily from December 26th through 29th, under the title "Chance and Regularity." Professor Kac says it is his intention to show how mathematical considerations ubiquitously assist in the understanding of the real world, but his reputation as a lecturer and as a conversationalist is a promise that the coming lectures will be enthralling as well as instructive.

An earlier series of Christmas Lectures has now appeared in print, with the publication in October of "The Unseen World" by Professor René Dubos. This is the third volume to have been issued by the Rockefeller Institute Press, and is remarkable not merely for its contents but also because it is an unusually handsome book. Though the text closely follows the lectures which Professor Dubos delivered to high school students in 1959, he and Mr. Biemiller at the Press have worked hard to produce a volume which is something of a model of how science should be presented to the general public.

Caspary Music

The reputation of the Caspary Auditorium as a musical center was further enhanced during the last academic year, when no fewer than seventeen concerts were held at the Institute. Sixteen of these made up the two series of subscription concerts organized by Professor Theodore Shedlovsky. In addition the Amor Musicae concert, which has become something of an annual event at the Institute, was given on Wednesday, January 17th, by Claudia Lyon, recorder; Reba Paeff Mirsky, harpsichord; Janos Scholz, viola da gamba; and Walter Trampler, viola d'amore.

Among the subscription concerts the visit of the Juilliard String Quartet on January

(continued overleaf)

THOMAS RIVERS · 1888-1962

DR. THOMAS RIVERS, who had been intimately associated with The Rockefeller Institute for more than forty years, died on May 12. He was 73, and only a few months before his death had been described as "the recognized leader of the golden period of American virology."

Chance rather than deliberate design seems to have been chiefly responsible for guiding Rivers along the first few steps of his distinguished career. For one thing, at Emory College he began by studying the humanities. Then, as a medical student at The Johns Hopkins University School of Medicine, he was thought to be suffering from Aran-Duchenne progressive central muscular atrophy. Mercifully, events did not follow their usually disastrous course, and within two years Rivers was able to return to Johns Hopkins where he was graduated in 1915.

It is not, of course, surprising that an encounter with a supposedly fatal disease should profoundly influence a man's life, but with Rivers the consequences of his enforced absence from medical school turned out to be most fortunate for medical science. Idealism drew him to the San Tomás Hospital in Panama, and, on the strength of his having been a medical student for two years, he was soon in charge of a ward. This interlude, which lasted two years, seems to have converted an undistinguished student into one who could graduate at the top of his class in 1915.

Rivers came to The Rockefeller Institute in 1922, when he joined the hospital staff as an associate. In the twenties his research did more than that of any other American scientist to demonstrate convincingly that viruses are, indeed, distinctive agents of infectious diseases.

At the beginning of the thirties he took into his laboratory a research program on psittacosis (parrot fever) which had been under way at the New York City Board of Health Laboratory until four out of six workers there died of the disease.

In the thirties Rivers was drawn increasingly into the formulation and the administration of public health policies in the United States, and it was during this period that he threw his ability and his prestige behind the National Foundation for Infantile Paralysis (now the National Foundation-March of Dimes). As chairman of the Virus Research Committee from the start of the foundation's work, Dr. Rivers played a most influential part in the guidance of its research program.

Rivers became Director of the Rockefeller Institute Hospital in 1937 and retained that post until his retirement in 1955. During the last two years of his full-time association with the Institute, he served as Interim Director of the Institute. After retirement he devoted himself increasingly to the affairs of the National Foundation, and served in turn as medical director and vice-president for medical affairs.

During his long life Dr. Rivers was repeatedly honored for his contributions to science and to society. He became a Fellow of the National Academy of Sciences in 1934 and was awarded an honorary degree as Doctor of Science at the Rockefeller Institute Convocation in 1961. For his service during World War II as the commanding officer of the U. S. Naval Medical Research Unit No. 2 on the island of Guam, Dr. Rivers was appointed to the Legion of Merit.

MUSIC *continued from page seven*

24th was especially memorable, if only because a few days previously it had been announced that this distinguished group of musicians was to be Quartet in Residence at the Library of Congress. The audience at The Rockefeller Institute may correctly have identified in the Quartet's performance of Mozart, Bartók and Schubert a trace of exhilaration occasioned by that honor. The American String Quartet, which performed at the Institute in December 1961, will return during the coming season, as will the New York Chamber Soloists. This will not, unfortunately, be true of the Boccherini Quintet and the Zimbler Sinfonietta, both of which took part in the 1961-62 season. The former will, however, return in 1963-64.

International Prize

One of the first United Nations Prizes for cancer research was awarded to Dr. Peyton Rous, Member Emeritus of The Rockefeller Institute, on October 10th this year. Altogether seven awards of $10,000 were made to scientists from the United States, the United Kingdom, France and the Soviet Union. Dr. Rous was specifically honored for his discovery of the transmissible sarcoma now known by his name, and it is a wry comment on the pace of development in cancer biology that this work should have been carried out more than half a century ago. This year's awards are the first to be made under the terms of a resolution of the United Nations Assembly in 1959, which accepted a proposal of Byelorussia to recognize "outstanding scientific research work in the causes and control of cancerous diseases."

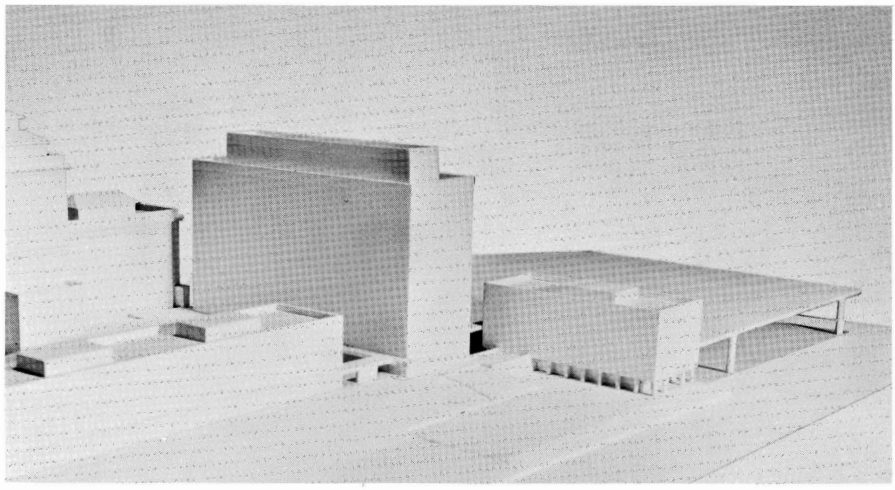
Sigma Xi

The final meeting of the Rockefeller Institute Chapter of the Society of the Sigma Xi for the academic year 1961-1962 was held on April 26 and featured an address by Professor Daniel I. Arnon. Dr. Arnon is Professor of Cell Physiology and Biochemistry in the Experiment Station in the University of California at Berkeley. His chief research interest centers on photosynthesis and energy conversion phenomena. His topic for the Sigma Xi lecture was "The Role of Light in Photosynthesis."

Sophie Fricke Hall

Work has already begun on a new hall of residence at the southwest corner of the South Laboratory, and may be completed in about a year. Eventually there will be 74 rooms for housing students on the campus, but until plans for building a faculty residence hall have matured, it is intended that two floors of the new building should accommodate members of the faculty. The new building will be named Sophie Fricke Hall in acknowledgment of the bequest of about $1,000,000 to be used in paying for the new residence.

When completed, the new building will further transform the southern end of the campus. In appearance it will match the present students' residence, and in particular, its roof will rise to the same height. Because of the fall of the ground towards York Avenue, however, it has been found possible to fit five rather than four floors into the new building. Extending southwards over the southern parking lot and the greenhouse will stretch a concrete apron that will serve as an open piazza.



Model of part of the campus, with the new building ↑ next to the South Laboratory.

Professors Emeriti

Philip D. McMaster and John Howard Northrop were appointed Professors Emeriti by the Board of Trustees at their spring meeting. The seventieth birthday of Professor Northrop, who shared the Nobel Prize in chemistry with Wendell Stanley and James B. Sumner in 1946, was marked by publication this spring of a special supplement of the *Journal of General Physiology*. Dr. Northrop was a student and close friend of Jacques Loeb.

Dr. McMaster came to the Institute in 1919 as an assistant to Peyton Rous when he was investigating the physiology of the liver and bile. Later, McMaster's own research contributed significant new understanding of the functions of the lymphatic system and of the role of the lymph nodes in antibody formation.

Royal Society

Professor Fritz Lipmann has been elected a Foreign Member of the Royal Society, and so has become only the twenty-third living United States citizen to hold this high honor. His election brings to five the number of members of The Rockefeller Institute faculty received into the Society. The names of Bronk, Corner, Gasser, Lipmann and Rous make a longer list of Foreign Members of the Royal Society than could be compiled from the faculty of any other university in the United States. Indeed, there are many British universities which cannot boast of as many Fellows of the Royal Society.

ARRIVALS AND DEPARTURES

Faculty Appointments since 1 April 1962

AFFILIATE

JOHN MADDOX
Science Editor of *The Manchester Guardian*.

ASSISTANT PROFESSORS

JOHN H. FRENSTER (General Physiology)
Formerly with the Walter Reed Army Institute of Research in Washington.

BERNICE GRAFSTEIN (Developmental Biology)
Assistant Professor, McGill University, on leave.

GEORGE J. JACKSON (Parasitology)
Former Guest Investigator.

RESEARCH ASSOCIATES

HIROSHI ASANUMA (Associate Professor Brooks)
Former Guest Investigator.

H. BEAUFAY (Professor Palade)
Assistant Professor, Catholic University of Louvain, Belgium, on leave.

ZOFIA BOROWSKA (Professor Craig)
Assistant Professor, Institute of Marine Medicine, Gdansk, Poland, on leave.

LEE EHRMAN (Professor Dobzhansky)
Fellow, American Association of University Women, former Research Fellow, Columbia University.

LORENTZ ENGSTRÖM (Professor Lipmann)
Lecturer, Institute of Medical Chemistry, Uppsala, on leave.

WILLIAM FERDINAND (Professor Stanford Moore)
Former Research Assistant, Department of Chemistry, University of Oxford, England.

J. S. GORDON (Professor Archibald)
Former Lecturer in Chemical Pathology, University College, Ibadan, Nigeria.

NORMAN B. GROVER (Professor Weiss)
Former Junior Assistant, Hebrew University, Jerusalem.

SIDNEY HALPEREN (Associate Professor Tamm)
Former Postdoctoral Fellow, University of Michigan School of Public Health.

LARS A. HANSON (Professor Kunkel)
Assistant Professor of Immunology, University of Gothenburg, Sweden, on leave.

RONALD D. HINSDILL (Professor Goebel)
From University of Wisconsin College of Agriculture.

ALAN F. HOFMANN (Professor Ahrens)
Former U. S. Public Health Service Postdoctoral Fellow, University of Lund, Sweden.

MIRIAM I. JACOB (Associate Professor Granick)
Former Research Associate, Columbia University College of Physicians and Surgeons.

JOHN W. LAMPERTI (Professor Kac)
Former Visiting Assistant Professor, Dartmouth College.

THOMAS A. LANGAN (Professor Lipmann)
Former Postdoctoral Fellow, Wenner-Gren Institute, Stockholm.

DAVID J. L. LUCK (Professor Palade)
Graduate of the Institute, June 1962.

PHILIP D. LUNGER (Associate Professor Dan H. Moore)
Former Guest Investigator.

MICHAEL J. LYONS (Associate Professor Dan H. Moore)
Former Guest Investigator.

P. R. MAHADEVAN (Professor Tatum)
Former DeWitt Sterry Fellow, Princeton University.

A. MOURAD (Professor Dobzhansky)
Former Fellow, Columbia University.

TOKUMASA NAKAMOTO (Professor Lipmann)
Former Research Associate, University of Chicago.

ULF NILSSON (Professor Kunkel)
Former Guest Investigator, Department of Clinical Chemistry, University of Malmö, Sweden.

A. BEATE OESTREICHER (Associate Professor Perlmann)
From The State University, Utrecht, Holland.

SHOSHI OTA (Professor Stanford Moore)
Instructor, Yamaguchi Medical School, on leave.

OLGA PAVLOVSKY (Professor Dobzhansky)
Former Research Assistant, Department of Zoology, Columbia University.

JOHN H. PRUNIER (Associate Professor Bearn)
Formerly with the U. S. Army Medical Corps.

EDWARD REICH (Professor Tatum)
Graduate of the Institute, June 1962; Helen Hay Whitney Foundation Fellow.

DENIS SHAW (Professor Stanford Moore)
From the University of Cambridge, England, on leave from the C.I.S.R.O. (Australia) Wool Research Laboratories.

SELMA SILAGI (Professor Tatum)
Former U. S. Public Health Service Postdoctoral Fellow, Columbia University.

BORIS SPASSKY (Professor Dobzhansky)
Former Research Associate, Columbia University.

H. OLIN SPIVEY (Professor Shedlovsky)
From the State University of New York at Buffalo.

YUTAKA TASHIRO (Professor Palade)
Former Guest Investigator.

Faculty Promotions

TO PROFESSOR

NORMAN STOLL

TO ASSOCIATE PROFESSOR

ZANVIL A. COHN
LAURA GARNJOBST
HANS J. MÜLLER-EBERHARD
RUSSELL W. SCHAEDLER
LEONARD B. SPECTOR
VICTOR J. WILSON

TO ASSISTANT PROFESSOR

JAMES L. GERMAN III
BRUCE R. VOELLER
HENRY N. WOOD
JOHN B. ZABRISKIE

Guest Investigators arriving since 1 April 1962

JAMES C. ALLEN (Professor Kunkel)
Former Felow in Medicine in The Johns Hopkins University School of Medicine.

GORDON T. ARCHER (Professor James G. Hirsch)
U. S. Public Health Service Postdoctoral Fellow, former Assistant Director, Blood Transfusion Service, Australian Red Cross Society.

R. N. CAMPAGNE (Professor Mirsky)
Fellow, Netherlands Organization for Pure Research; Chief Scientific Officer, Biochemistry Laboratory, University of Groningen.

RANDOLPH M. CHASE, JR. (Professor McCarty)
Instructor, New York University School of Medicine.

HARISH C. CHOPRA (Associate Professor Dan H. Moore)
Former Visiting Research Fellow of the Institute for Muscle Disease in New York.

JEAN A. CORTNER (Associate Professor Bearn)
Visiting Fellow in Pediatrics, Columbia-Presbyterian Medical Center.

ETIENNE DE HARVEN (Professor Palade)
Associate, Sloan-Kettering Institute for Cancer Research.

ELAINE G. DIACUMAKOS (Professor Tatum)
Associate, Sloan-Kettering Institute, and Research Associate, New York University.

STUART D. ELLIOTT (Professor Lancefield)
Assistant Director of Research, Department of Animal Pathology, University of Cambridge, England, on leave.

JØRGEN GLIEMANN (Professor Dole)
From the University of Copenhagen.

NORBERT HILSCHMANN (Professor Craig)
Fellow, Fritz-Thyssen Stiftung; former Research Associate, Max-Planck Institute for Biochemistry, Munich.

ALBERT HIRSCHMAN (Associate Professor Dziewiatkowski)
Assistant Professor, State University of New York Downstate Medical Center.

RENÉ E. HUMBEL (Professor Palade)
Helen Hay Whitney Foundation Fellow.

STUART M. KRASSNER (Associate Professor Trager)
Former Research Fellow, The Johns Hopkins University-Calcutta School of Tropical Medicine.

PHILIPPE MATILE (Professor Palade)
Fellow, Swiss National Science Foundation; former Research Assistant, Institut für Allgemeine Botanik, Zurich.

PAUL G. QUIE (Professor James G. Hirsch)
John and Mary R. Markle Scholar; Assistant Professor of Pediatrics, University of Minnesota Medical School, on leave.

ROBERT P. RHEA (Professor Weiss)
U. S. Public Health Service Postdoctoral Fellow; former Lecturer and Instructor in Biology, Western Reserve University.

ROGER ROBINEAUX (Professor Palade)
Fellow, Organisation Européenne de Coopération Economique; Associate Director, Centre de Recherches d'Immuno-Pathologie, Association Claude-Bernard, Paris.

WASIM A. SIDDIQUI (Associate Professor Trager)
Lecturer, Muslim University, Aligarh, India, on leave.

BELLA STRAUSS (Professor James G. Hirsch)
Investigator, Health Research Council, City of New York; Assistant Professor, New York University School of Medicine.

ENG M. TAN (Professor Kunkel)
Arthritis and Rheumatism Foundation Fellow; former Senior Instructor, Western Reserve University School of Medicine.

RAYMOND C. VALENTINE (Professor Hotchkiss)
U.S. Public Health Service Postdoctoral Fellow; former Research Assistant, University of Illinois.

EDITH WIENER (Associate Professor Cohn)
Research Assistant, Laboratory of Microbiological Chemistry, Hebrew University Hadassah Medical School in Jerusalem, on leave.

F. PETER WOODFORD (Professor Ahrens)
Lecturer, University of Leiden; Research Fellow, Dutch Medical Research Council.

Newly Appointed Graduate Fellows

WYATT WHEATON ANDERSON, B.S., M.S. University of Georgia

HELEN HOLBROOK ARNOLD, A.B. Radcliffe College

WILLIAM LEE BUCK, B.S. Case Institute of Technology

ALBERT HUDSON CASS, JR., A.B. Dartmouth College

ANTHONY CERAMI, JR., B.S. Rutgers University

DEAN LEE ENGELHARDT, B.A. Amherst College

RACHEL RICHENDA GILLETT FRUCHTER, B.A. University of Oxford

SCOTT MONTGOMERY GRUNDY, B.S. Texas Technological College, M.S., M.D. Baylor University College of Medicine

VINCENT CHARLES HASCALL, JR., B.S. California Institute of Technology

BERTIL HILLE, B.S. Yale University

DAVID IAN HIRSH, B.A. Reed College

KATHRYN VOELKER HOLMES, A.B. Radcliffe College

ALAN MITCHELL KAPULER, B.S. Yale University

HARVEY FRANKLIN LODISH, A.B. Kenyon College

JOHN JACOB MARCHALONIS, A.B. Lafayette College

GARLAND ROSS MARSHALL, JR., B.S. California Institute of Technology

HARRY MEINARDI, M.D. Leiden University Medical School, Ph.D. Leiden University

FRANCES MESSIK, B.A. Cornell University

DANIEL B. RIFKIN, A.B. Princeton University

DAVID DOMINGO SABATINI, M.D. University of Litoral School of Medicine

LARRY PHILIP SIMPSON, A.B. Princeton University

PATRICIA CAROL SPENCER, B.A. Pomona College

ALAN BURR STEINBACH, A.B. The University of Rochester

DANIEL WYLER STROOCK, A.B. Harvard College

JAMES THOMAS TIDWELL, B.S. University of Alabama, A.M. Columbia University

ROBLEY COOK WILLIAMS, JR., B.A. Cornell University

Departures from the Faculty since 1 April 1962

ASSOCIATE PROFESSORS

MAURICE S. FOX left in September to become Associate Professor in the Department of Biology at Massachusetts Institute of Technology.

RICHARD M. KRAUSE left in September to become Professor in the Department of Preventive Medicine at Washington University School of Medicine, St. Louis.

S. WILLIAM PELLETIER left in September to head the Department of Chemistry at the University of Georgia, Athens.

ASSISTANT PROFESSORS

EDWIN L. BIERMAN left in September to become Assistant Professor of Medicine at the University of Washington School of Medicine, Seattle.

ULRICH NÄF left in August to become Associate Professor (Research) in the Department of Biology, Manhattan College.

RESEARCH ASSOCIATES

RAJINDRA ANEJA left in September to join the Department of Chemistry at the University of Georgia, Athens.

M. A. ATAMER left in August and is at the Veterans Administration Hospital, Coral Gables, Florida.

NOEL DE TERRA left in August to join the Zoology Department of the University of California at Los Angeles.

ANNE GEISMAR left in May and worked for several months at Columbia University College of Physicians and Surgeons. In September she returned to Hôtel Dieu, Paris.

JOSIAH B. GOULD, JR., returned in September to American University, Washington, where he is an Assistant Professor.

FRANZ JAISLE left in June to return to the University of Würzburg, Germany.

HENRY E. KYBURG, JR., left in June to become Associate Professor of Mathematics and Philosophy, University of Denver.

MAKOTO MATSUMOTO left in September to return to The Institute for Infectious Diseases, Tokyo.

FRITZ MILLER left in October to return to his post as Associate Professor in the Department of Pathology, University of Munich, Germany.

JANE MORSE left in June to become an Instructor in the Department of Medicine of Columbia University College of Physicians and Surgeons.

JACOB NEEDLEMAN left in June to become Assistant Professor of Philosophy at San Francisco State College.

MICHIHIKO OGATA left in June to return to Kyushu University, Japan, where he is a Lecturer in the School of Medicine.

P. C. PARTHASARATHY left in September to join the Department of Chemistry of the University of Georgia in Athens.

JOHN PHILIP returned in June to Copenhagen, where he will join the staff of Rigshospitelet.

ELIZABETH M. PRESS returned in May to St. Mary's Hospital Medical School in London where she is a Lecturer.

JOHN H. ROCKEY left in June to become Assistant Professor of Microbiology at the University of Pennsylvania School of Medicine.

ERWIN RUDE left at the end of April to return to Germany.

DEREK G. SMYTH left in August to return to England as a Research Associate at the National Institute for Medical Research in London.

ALAN J. SOLO left in August to become an Assistant Professor in the Department of Medicinal Chemistry in the State University of New York at Buffalo.

TOM T. STONIER left in August to become an Associate Professor (Research) in the Department of Biology of Manhattan College.

SEIZO TSUDA left in July to return to Japan.

ELLIOT S. VESELL left in June to become Resident in Medicine at Peter Bent Brigham Hospital in Boston.

Guest Investigators leaving the Institute since 1 April 1962

MIHOKO ABE left in June to return to the National Institute of Health in Tokyo.

FRANCOIS CHAPEVILLE left in April to return to the Biology Department of the French Atomic Energy Commission.

JOSEF FENDRICH left in October to return to the Israeli Institute for Biological Research, Ness-Ziona.

ULRICH GERLACH returned in April to the University of Münster, Germany.

JAMES T. HAMLIN III left in June to become Assistant Professor of Medicine and Director of the Cardiovascular Research Laboratory at the Medical College of Georgia, Augusta.

MORTON HARBOE left in September to go to the Institute for Experimental Medical Research, Ullevaal Hospital, Oslo.

CHARLES H. HILL left in April to return to North Carolina State College where he is Professor of Poultry Nutrition.

JACQUES LIPETZ left in August to become Assistant Professor (Research), Department of Biology, Manhattan College.

MARTIN LIPKIN left in June and is continuing work on Electronic Data Processing in Hematology at New York University.

DANIEL NATHANS left in August to become Assistant Professor in the Department of Microbiology of The Johns Hopkins University School of Medicine.

JAMES OFENGAND left in September to become Assistant Professor in the Department of Biochemistry, University of California Medical Center in San Francisco.

C. KIRK OSTERLAND left in June to go to the Pasteur Institute in Paris.

ALBERT L. SHEFFER left in August to work at the Leahey Clinic in Boston.

IRWIN W. SHERMAN left in August to become Assistant Professor in the Department of Zoology, University of California at Riverside.

ROBERT P. VAN TUBERGEN left at the end of May because of ill health.

MAX A. WOODBURY left in June and is continuing work on Electronic Data Processing in Hematology at New York University.

SOPHIE FRICKE FELLOWS

GLYN JONES left in September to return to The Rowett Research Institute in Aberdeen, Scotland, where he is now Senior Scientific Officer.

PHILIPPE SENGEL returned in August to his post as Sous-directeur de laboratoire, Laboratoire d'Embryologie expérimentale, Collège de France, Paris.