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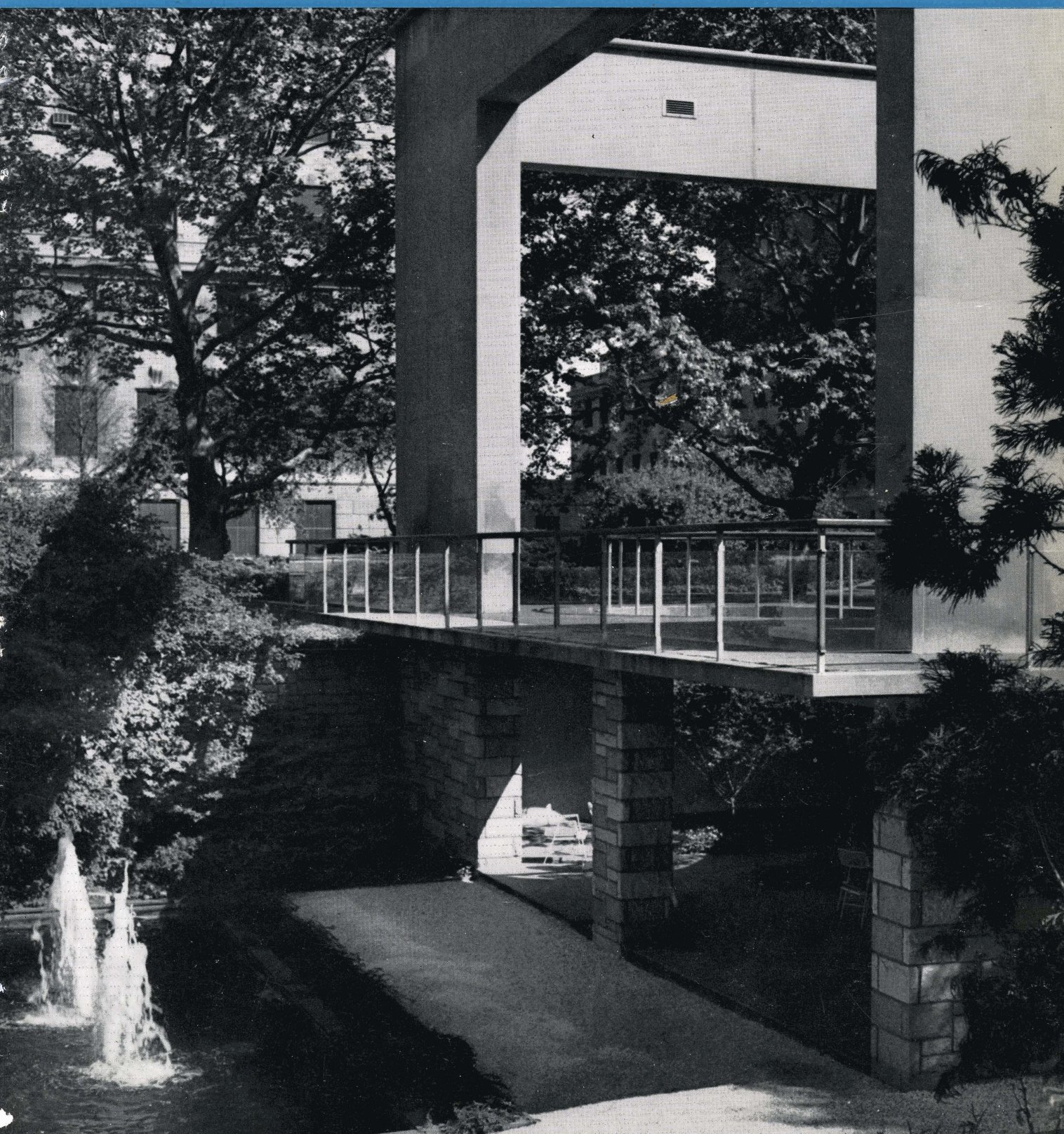
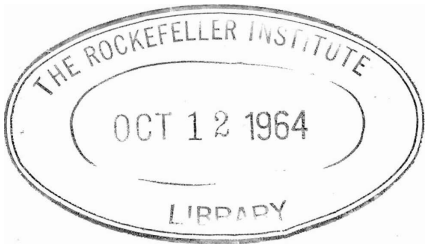
The Rockefeller University

THE ROCKEFELLER INSTITUTE REVIEW

JULY • AUGUST 1964





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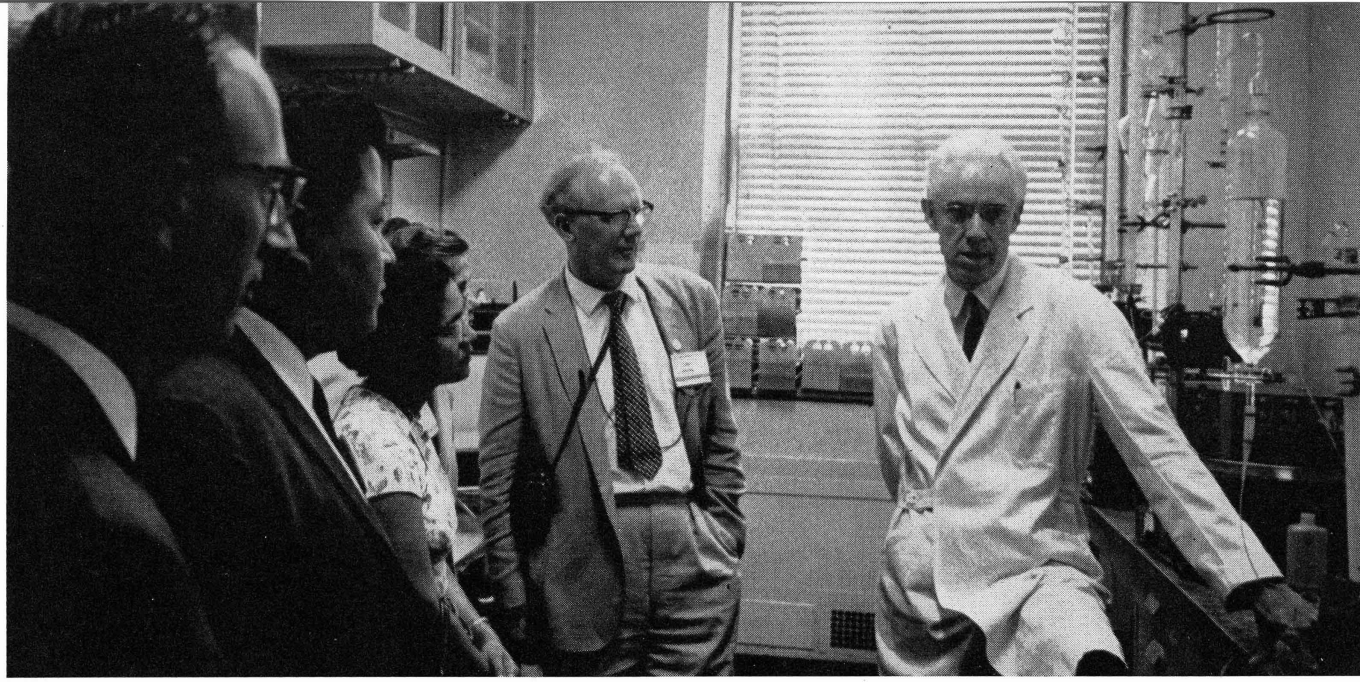
OPEN HOUSE FOR BIOCHEMISTS

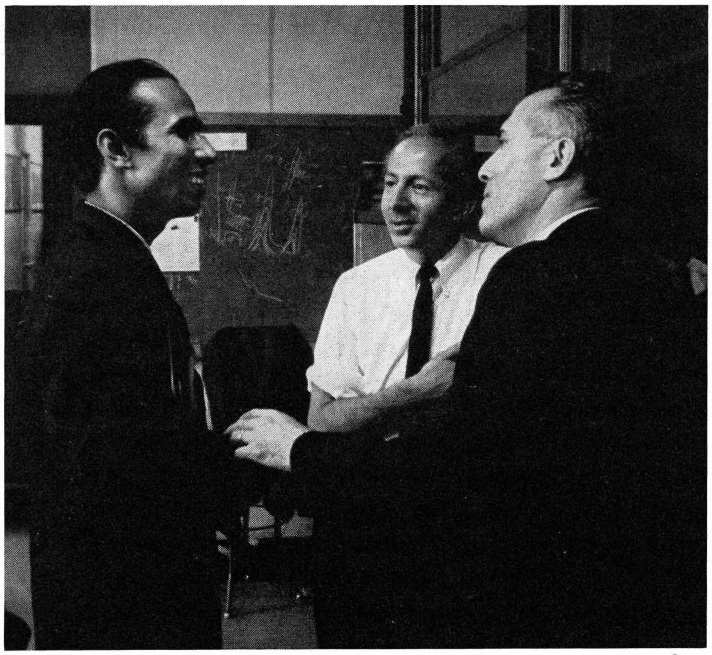
On some calendars the last week of July, 1964, was set aside a full four years in advance, and it is safe to assume that every biochemist at The Rockefeller Institute had July 29 and some other days thereabouts marked off for many months. When this long-anticipated week finally arrived, New York City, the International Union of Biochemistry, ten local research centers, and an uncounted number of individual New York City scientists and their wives were ready to serve as hosts to the gathered biochemists from 60 different countries who arrived here for the Sixth International Congress of Biochemistry. Among scholars well accustomed to large professional gatherings, this one was generally agreed to be remarkable for its true and pervasive spirit of international cooperation, for its genuine and open friendliness, and for the smoothness of the whole complex operation.

As Professor Severo Ochoa, President of the International Union of Biochemistry, noted in his opening address, attendance at the Congresses has grown apace during the fifteen years since the first was held in Cambridge. In that year, 1949, about 1600 attended; three years later, in 1952, about 2500 registered for the Paris Congress; 3000 or more were present at the Brussels meeting in 1955; upwards of 4000 at Vienna in 1958; 5000 in Moscow in 1961; and this year in New York City, a record 6300. This growing interest is a direct measure of the success of these meetings which are gaining an international reputation as focal points for the synthesis and exchange of new ideas. The next Congress will be held in Tokyo in 1967.

The heart of the New York meeting was the daytime schedule of 480 research papers presented in the conference rooms at the New York Hilton and the Americana. Professor Edward L. Tatum was Chairman of the section on Biochemical Genetics, and other members of the faculty also served as committee members of the various sections, of which there were ten in all. Papers were presented by a number of staff members on a wide variety of subjects. In addition to the new data on the enzymatic production of RNA, the structure of proteins, and similar primary concerns, one of the facts to emerge from the present conference is that an awe-inspiring amount of planning is required to provide for the physical and intellectual well-being of several thousand out-of-towners. Professor Stanford Moore, who was Chairman of the Organizing Committee and thus involved in all these activities about as much as anybody else, recalls that the first negotiations with the Americana and the New York Hilton were undertaken some four years ago. Actually, he says, seven years of advance planning is usually necessary to make hotel arrangements in New York City but this was done on short notice simply because at the time the accommodations were reserved, neither hotel was yet built. During this period, more than 100,000 letters were written from the Washington office of the Congress.

From the local standpoint, work on the design insignia and the publications of the Congress were begun some two years ago in consultation with Mr. Reynard Biemiller of The Rockefeller Institute Press. Professor William H. Stein became Chairman of the Publications Committee and Professor Edward H.





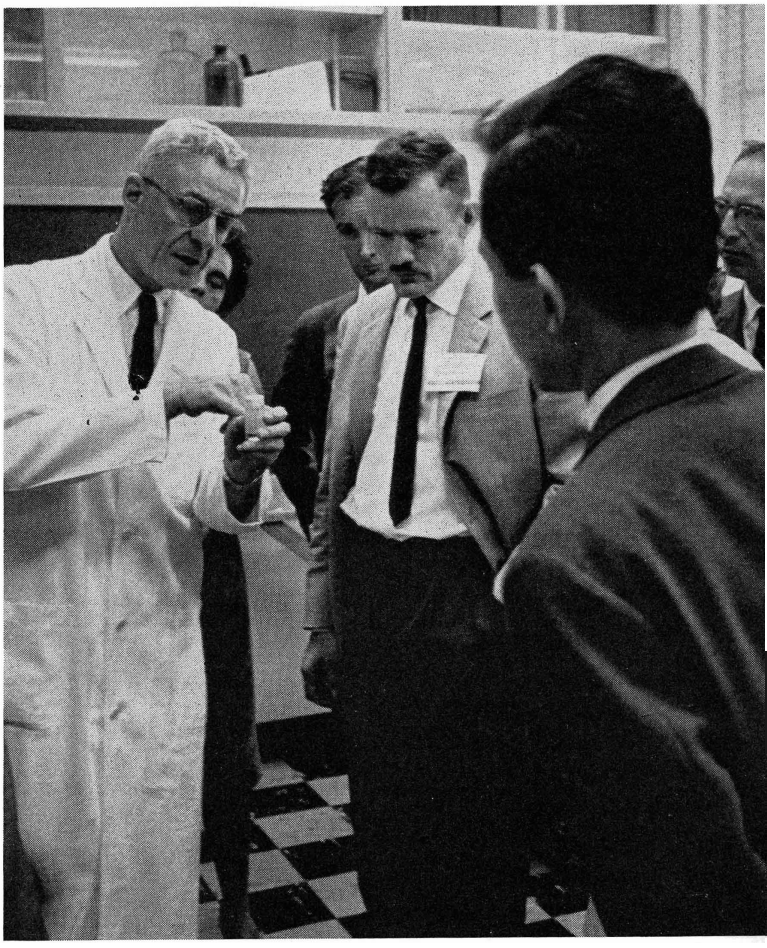
Ahrens, Jr., assumed the Chairmanship of the Press Committee. The Organizing Committee as a whole consisted of 100 biochemists representing the profession on an across-the-nation basis, with Professor John T. Edsall of Harvard University as President of the Congress.

From the point of view of the Institute, the biggest day of the week was July 29, which in the initial planning of the Congress had been set aside to give biochemists from various parts of the world an opportunity to visit some of the laboratories in the New York area. Under a program organized by Professor Abraham Mazur of City College, each registrant to the meeting was sent a card on which he could indicate the institution he would like to visit and, if he knew, the specific investigator he would like to see. Some 1500 persons elected to spend all or part of the day visiting one or more of ten different research centers in the New York area, including the three neighboring institutions at 68th Street and York Avenue, The Rockefeller Institute, Cornell University Medical College, and the Sloan-Kettering Institute for Cancer Research.

Friendly Host

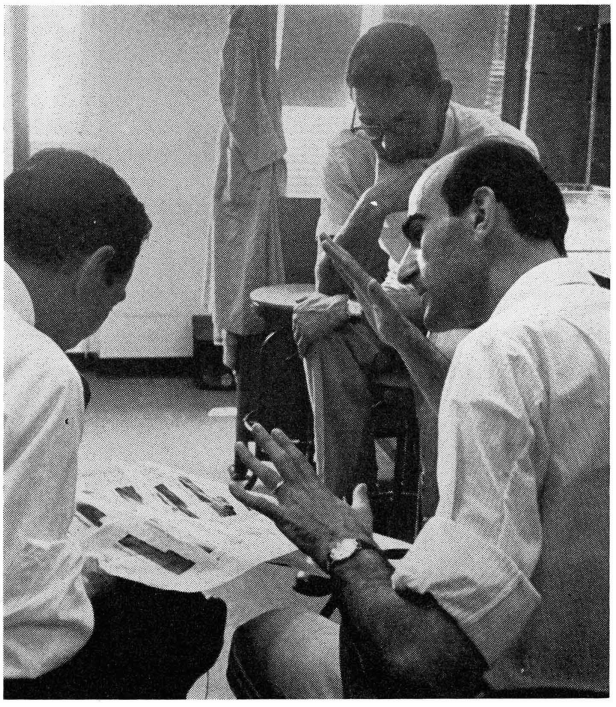
At The Rockefeller Institute Professor Vincent Allfrey not only made the local visiting-day arrangements but personally greeted almost every visitor to the scene. By the end of the day, he had clicked off 637 on his automatic counter and he estimates another 100 or more slipped past him. Dr. Allfrey was ably assisted by a well-organized squad of eighteen graduate students. As each visitor arrived, he was assigned to a student who served as his guide to the person of his choice or the laboratories of his particular interest. Nearly forty members of the Rockefeller faculty, investigators in biochemistry or closely related fields, were hosts to the visiting scientists and nearly all the members of the laboratory staffs participated in the tours and demonstrations.

Among the most active hosts were Drs. Stein and Moore who conducted 15 to 20 complete tours of their laboratories that were even more popular for including a brief visit to their large cold room which was a welcome 4°C. Drs. Stein and Moore lost count by the end of the day, with a cumulative total of about 150 visitors. Another especially active guide was Professor Ahrens, who took scores of visitors



through the Hospital, and Professor Lyman C. Craig whose countercurrent apparatus was, as always, a particularly popular attraction. In South Laboratory, there were many gatherings at the quarters of Professors Fritz Lipmann, Gerald Edelman, and Philip Siekevitz who spent most of the day engaged in animated conversations in a variety of languages. Woman of the day was Mrs. John Cooper who managed to accommodate an extra 250 for luncheon.

In addition to the Open House at the laboratories, a variety of other special activities were planned for the guests of the Congress. On the Sunday night before the official opening, President and Mrs. Bronk gave a dinner in honor of the organizers of the Congress, and their wives. A hundred guests attended including members of the Council of the International Union and heads of the Congress committees, the official delegates from foreign countries, Frederick Seitz as President of the National Academy of Sciences, and Professors Edsall, Ochoa, and Moore.

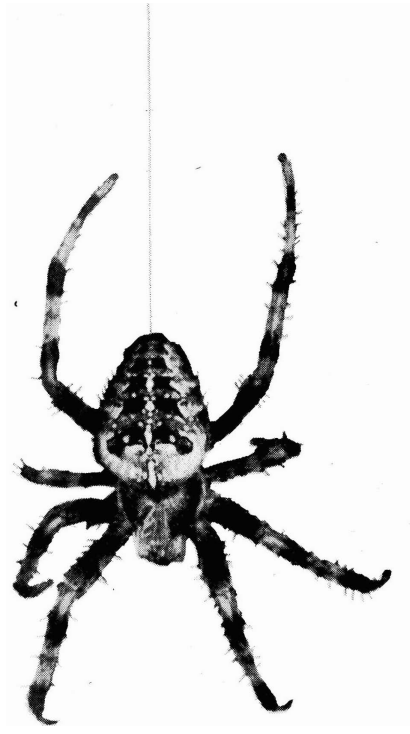


On Monday evening, every foreign scientist was invited to be a guest at the home of an investigator from New York City and environs; the prodigious organization required to accomplish this gracious gesture was the work of Dr. George Brown of the Sloan-Kettering Institute, and almost every Rockefeller Institute faculty member volunteered to participate. On Tuesday night, through the efforts of Professor Edelman, consulting with Professor Theodore Shedlovsky, the Boston Symphony Orchestra came to New York City to give a special performance under the direction of Erich Leinsdorf, for the members of the Congress at the Philharmonic Hall in Lincoln Center. Other special events included private viewings of the galleries of the Metropolitan Museum of Art, the official Congress reception and buffet dinner for all participants, and the National Academy of Sciences reception for the officers of the Congress and the official delegates from foreign countries.

Apart from these extracurricular activities planned for the active participants in the Congress, the Ladies' Program Committee, chaired by Mrs. Edward L. Tatum, made a number of special arrangements for the wives who had accompanied their husbands to New York for the meetings. These included a tour of the city, a fashion show at the Waldorf, visits to the Cloisters, the Planetarium, Hyde Park, Vassar, the World's Fair, a boat ride around Manhattan, and a day at Jones Beach. In addition, a special program in the field of health, education, and welfare was planned by Mrs. William H. Stein. The orientation program for this meeting was held at The Rockefeller Institute on the morning of July 28th at which the group was addressed by Acting Commissioner of Health John R. Philp and Deputy Commissioner of Welfare Philip Sokol. About 100 women attended, most of whom stayed for lunch as guests of the Institute. On the following days, the group visited various educational institutions, the Columbia-Presbyterian Medical Center, and health, welfare, and child care centers in the city.

As the week drew to a close it is certain that many of its organizers, although too modest to admit it, must have felt a quiet glow of satisfaction in having seen the long months of planning come to such a successful fruition and at having been able to convey, as a result, such a genuine feeling of welcome to so many who were receiving their first impressions of the United States. Also, it perhaps pleases them to know that somewhere in Japan an earnest group is working on the plans for the next International Congress of Biochemistry.

SPIRALS, SPIDERS AND SPINNERETS



The Developmental Biology Discussion Group of The Rockefeller Institute was founded in 1959 by a group of faculty members and students. At first an intra-Institute undertaking, it soon enlarged its scope to include speakers from other campuses and subjects other than embryology. On March 31, 1964, at the invitation of Dr. Harry Meinardi and Mr. Paul Burgess, chairmen of the Group, Drs. Peter N. Witt and Charles F. Reed of the State University of New York spoke in Abby Aldrich Rockefeller Hall on "Quantitative Evaluation of Behavior Patterns: Computer Analysis of Spider Webs." The following article is based on their presentations that evening.

IF THIS SUMMER'S occupants of beach cottages and other vacation residences eyed the corners of their habitations and the nether surfaces of their furniture with more interest and respect this season, it may be attributable to Drs. Peter N. Witt and Charles F. Reed. These two Upstate Medical Center investigators, one a physician and pharmacologist, the other a psychologist, have made a series of studies and reports, including one in March at The Rockefeller Institute, on the ways in which spiders, particularly *Araneus diadematus,* fashion their webs and the effects of various manipulations on this complex behavior pattern.

As is familiar to all who have probed the subject, even if only with an inquiring broom, there are many different types of spider webs. Most house spiders build mesh webs, irregular, fine-spun three-dimensional structures that tend to collect dust and artifacts as well as anticipated prey. These are usually maintained by colonies of spiders and are under constant repair and enlargement, sometimes attaining an alarming size. Some spiders, usually of the outdoor variety, make sheet webs which they rig like sails from the masts of grasses or tall flowers. Others spread flat webs, like firemen's nets or trampolines, to catch crawling insects; and some make domes or funnels or tubes or pouches, each cleverly contrived to fit into cracks or to stretch between far-distant and improbable supports. The making of any particular type of web is an innate function, specific for each species and among all the webs. The acclaimed favorite of spider fanciers, including Drs. Witt and Reed, is the beautiful orb web of the common garden spider, a group which includes *Araneus diadematus.*

Araneus, like other orb weavers, makes its web of several different types of thread or silk which range from about .03 to 0.1 microns in diameter. The viscous material for the threads is formed in a group of glands located in the ventral portions of the abdomen and extruded through spinning tubes which pass out of the body in the finger-like spinnerets, of which there are six in number. The spinnerets are found at the caudal end of the abdomen, below, but quite

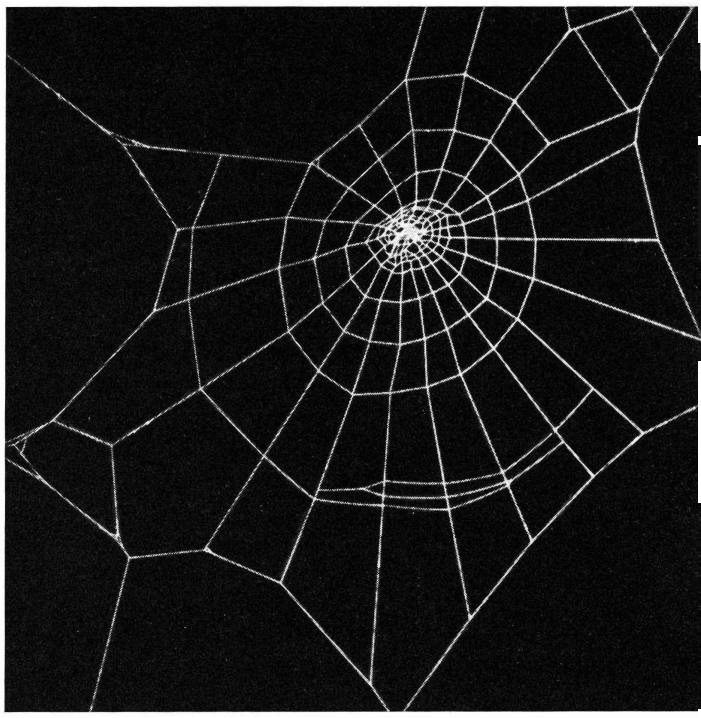
distinct from, the opening of the alimentary canal. In this respect, spiders differ from caterpillars which spin their silk from salivary glands, and from ant lions in which it is produced in the Malpighian tubes and played out through the digestive tract. Once outside the body, the liquid protein is hardened into thread by the mechanical stretching imposed upon it by the spider.

The heaviest all-purpose thread of the orb-weaver is known as the dragline. It is produced constantly as the spider crawls from place to place and is fastened down at strategic intervals by "attachment discs" which actually are not discs at all but mats of minute looped threads. When a spider wants to undertake space explorations, it simply lowers itself on its dragline, which it can run right back up again if prudence so dictates.

Orb webs, according to Dr. Witt, who has been studying them for more than fifteen years, always start with a horizontal bridge. This can be produced from the dragline which the spider may carry the long way around from one point to another and then pull tight on arrival at its destination. In situations in which this is impossible — as in those puzzling webs that stretch across a brook — the spider raises its abdomen and spins out a line which is carried by the air currents. As soon as this line catches on a twig or leaf, the spider stops spinning, pulls it taut, and fastens it down. This bridge then can be reinforced by more dragline as the spider runs back and forth across it.

Once the spider has laid down the foundation, which is usually irregular in shape since it is dictated by the building site, construction of the orb itself begins. The orb of any species of spider is always essentially the same and is characteristic for the species. The great advantage of working with spider webs, according to Drs. Witt and Reed, apart from their intrinsic biologic interest, is that they provide a permanent record of a complex behavior pattern which is predictable and reproducible and can be measured in entirely objective terms.

Webs chosen for study by the investigators are first sprayed with white paint and then photographed against a black background. With the photograph enlarged to life-size, the various segments and angles of the web are measured and, by a method worked out by Dr. Reed, the figures committed to IBM



Early stage in web construction showing provisional or guy spiral which spider later replaces

punch cards. In this way, it is possible to store and compare data for large numbers of control and experimental webs and so be able to detect and pinpoint even very slight behavior changes.

To start the orb, the spider selects its center and pulls a line through it. Then the radii are fashioned, the arachnid returning each time to the hub to begin a new radius. When these are completed, a total of about 25 radii being average, *Araneus* then weaves a guy spiral, working from the hub out, to hold the radii in place. The turns of this spiral are as far apart as the spider can conveniently reach, holding out the new line at leg's length as it crawls along the one that it has already just laid down.

When this guy spiral is completed, the spider switches to a sticky and much more elastic thread, and with this weaves another spiral, this time working from the outside in. Just before attaching the sticky thread on each radius the spider gives it a little jerk with one of its hind legs so the line has a little play in it. This ensures that an insect that gets caught in one thread will bounce around until it becomes entangled in several others.

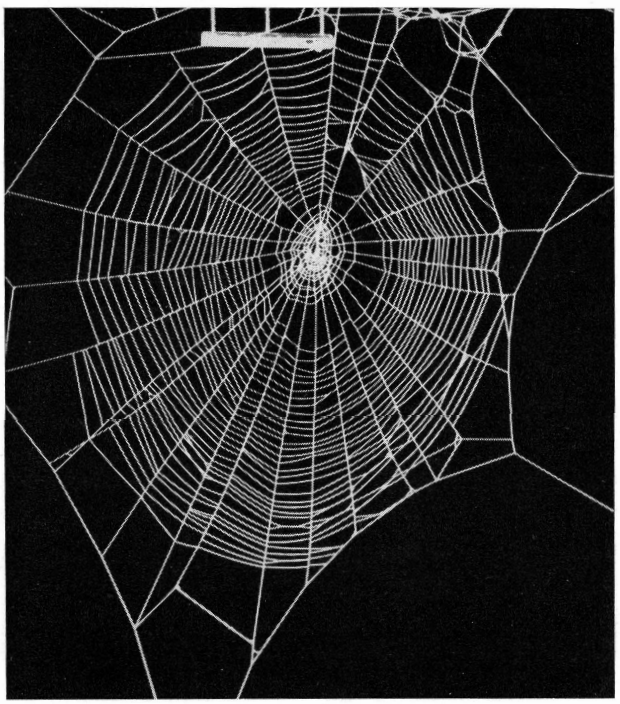
As the spider spins the sticky spiral, it cuts away

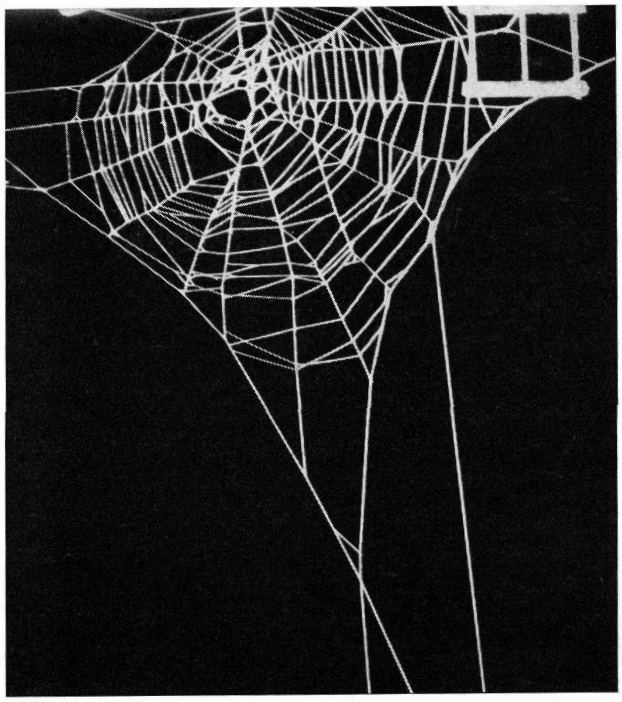
the guy lines and then, on finally reaching the center, eats the bundle of threads that have accumulated in the hub. Then, with its web all tidied up and ready for business, one species of spider, *Zilla x-notata,* runs out of the web along one of the radii that it selects as its guideline. This guideline vibrates when anything comes near the web and so keeps the spider in close touch with events throughout the whole structure. When Dr. Witt wants to catch a *Zilla*-spider, he says, he throws a fly into the center of the web and while the spider is enjoying this bounty, he carefully detaches the guide wire and runs it into the bottom of a paper bag. When the spider is finished, it runs back along its line right into the waiting receptacle. Most spiders do not see very well, but electrical responses to flickering light in the eye of the wolf spider were the subject of some interesting studies by Dr. Robert DeVoe while a Fellow at the Institute in 1956-61. Dr. DeVoe is now at the Hopkins.

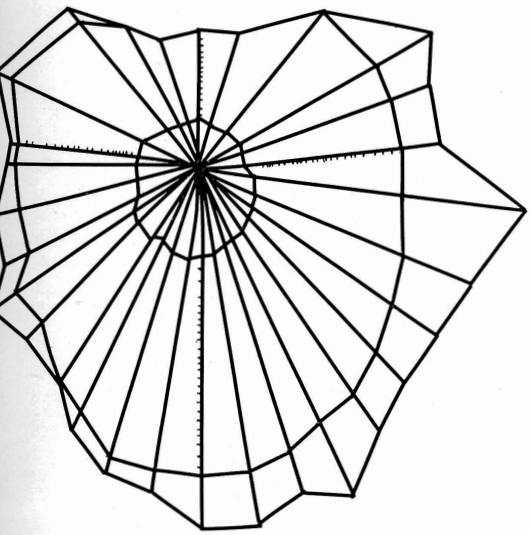
Drs. Witt and Reed are among the few biologists who have studied orb-weavers in the laboratory. They confine them in aluminum frames with glass walls and supply them with houseflies twice a week. Under these conditions, spiders will make a new web almost every day, although a housefly feast may turn off the web-building instinct for a day or two. Webs are built at the coldest point in the diurnal cycle; in Dr. Witt's laboratory this is just before 5:30 a.m. when the lights and heat are turned on. The entire process takes a remarkable twenty to thirty minutes.

No step in web building is learned behavior. Baby spiders make baby webs which were thought at one time to afford them the necessary practice for large ones, but Russian investigators have found that if a spider is kept in solitary confinement from egg to adulthood and never permitted to spin even a line, it can, upon its release, make a perfect adult-sized web on the first attempt. There are a few variables. For example, they have found a spider seems to plan its web on the basis of the amount of silk available for manufacturing purposes. During lean periods, when protein is in short supply, the spider will economize, making the web smaller and the threads finer; after a force-feeding of physostigmine, which increases silk secretion, larger webs are built. Heavier spiders build heavier webs, and if a tiny piece of lead is stuck onto a spider, it will make a web with

Final stage in web construction showing sticky spiral LEFT *and web of same spider* RIGHT *following laser lesion*







Spider web as the computer "sees" it.

Spiders of history and legend have given aid to man, even as *Araneus diadematus* today. Mahomet's life was saved on his flight from Mecca because of an orb woven across the mouth of his cave that led his nonentomological pursuers, the Koreishites, to pass by his hiding place. Robert Bruce, who failed six times to regain the kingdom of Scotland, watched a spider six times fail in attempts to fix its web to the ceiling and vowed to follow its example. The spider of course tried again and this time succeeded whereupon Bruce left the island of Rathlin and took Turnberry Castle in triumph. Frederick the Great, in the first recorded pharmacological use of an arachnid (so named for Arachne of Lydia who made the mistake of beating Athene at a weaving contest and was turned into a spider), observed one fall into his hot chocolate. He called for a fresh cup and the next moment, from the kitchen, heard the report of a pistol. His cook had been bribed to poison him and supposing that his treachery had been discovered, committed suicide forthwith. It is difficult to imagine one of Dr. Witt's spiders failing six times to establish its dragline or lowering itself into a coffee cup, but just as pharmacology has come a long way in the past few decades, perhaps spiders have, too.

a heavier thread and, to compensate, will reduce the number of radii and spiral turns.

Web weaving obviously requires the smooth, coordinated function of a number of different systems. Disturbances in any of these cause distinct, and what is most important, regularly repeated changes in the web pattern of the individual. For example, in one pathfinding experiment, a foreleg was removed from each of a group of sixteen spiders and the webs they produced were subsequently analyzed by computer and compared to control webs. All of the webs made by any one spider following the amputation were the same; no subsequent adjustments were made for the injury. In all the webs built by the seven-legged spiders, the angles between the radii were highly irregular. Some of the webs had irregular spirals, while some did not, and all were the same over-all shape as the control webs. So, the investigators conclude, the front leg is essential for the measurement of radial angles; there are alternate mechanisms for measuring spiral turns, and web shape is determined by a totally independent system.

Recently, the investigators have been using a laser to produce minute lesions, each a fraction of a millimeter in diameter, in the cephalothorax of the spider. Distinct changes have been observed in the web-building patterns of spiders with these small areas of brain damage and it is believed that these changes, recorded and analyzed, will be a useful guide to drawing a functional map of the relatively huge and almost uncharted central nervous system of the spider.

Drugs that affect the central nervous system of man also have effects on web construction which, according to Dr. Witt, are far more subtle, sensitive and reproducible than, for example, the alterations in the brain waves of the cat. For instance, mescaline and psilocybin both affect the spider's "judgment" in regard to the weight of threads that should be used for its web construction. Mescaline and pentobarbital seem to interfere with motor behavior; spiders on these drugs make webs that are smaller and less regular in construction. On the other hand, spiders taking chlorpromazine or psilocybin make completely regular webs as long as they make webs at all but, when the dose reaches a certain level, simply lose all interest in the entire activity for a day or two. Drs. Witt and Reed believe that the orb-weavers' reactions to various drugs will perhaps some day provide useful criteria for predicting pharmacological effects in man. There is already general agreement that they could not have a more diligent or talented laboratory assistant than *Araneus diadematus.*

PETER K. OLITSKY

1886-1964

BY WALTHER F. GOEBEL

Dr. Olitsky had been at The Rockefeller Institute some six or seven years when I first joined the staff and I came to know him well. During the forty years of our friendship I learned to know him for the considerate, gentle and modest person that he was. We shared the vicissitudes of the same community, Greenwich, and of the capricious New Haven Railroad. We came in and out of New York together for years. We also shared what we called the "Poor Man's Club Car," the last car on the now extinct Second Avenue El, which left 125th Street at 9:02 each morning. I do not know how often I received his gentle reprimand when I slyly opened the lower draft of the coal-burning pot-bellied stove which warmed us at the 125th Street station on freezing winter mornings. But I always opened it and I was invariably reprimanded, no doubt because of a sense of frugality instilled in him by Dr. Flexner. When I would take him in my car to his home on Milbank Avenue from the Greenwich railroad station, he would say without fail "it's the first drive on the right opposite the light on the corner." These were fine days and I and my older colleagues will miss them sorely.

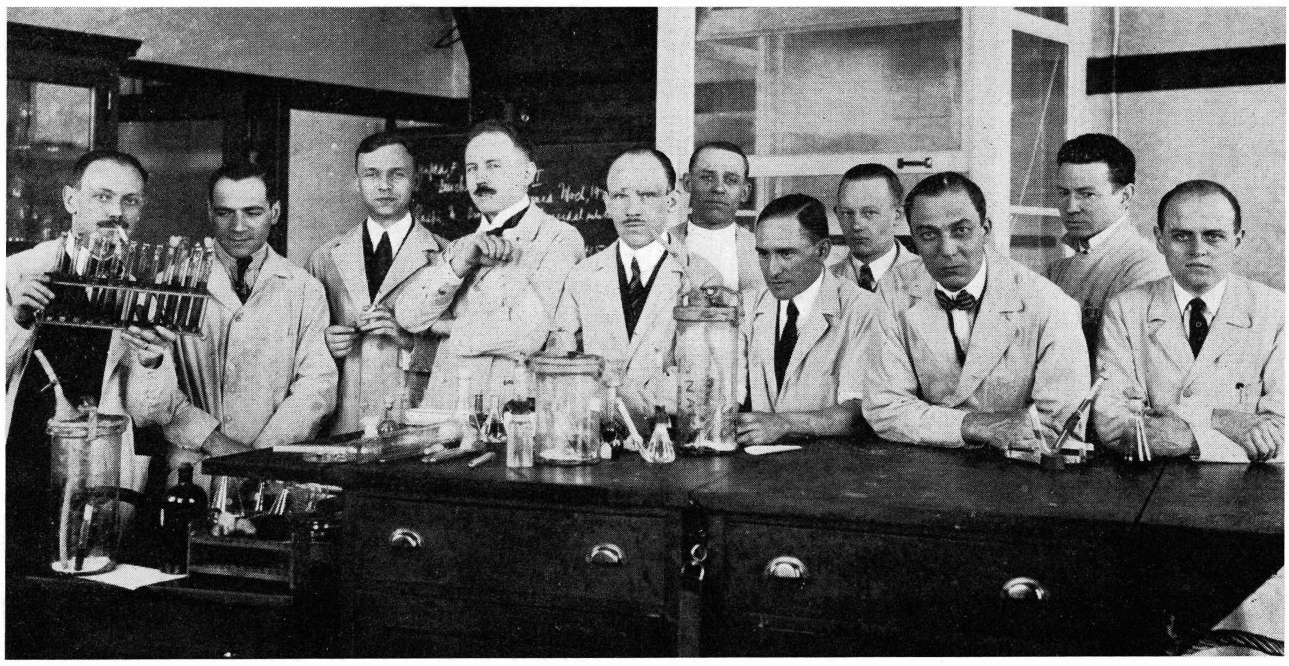
On the 20th of July 1964 The Rockefeller Institute suffered the loss of one of its oldest and most revered emeritus members, Dr. Peter K. Olitsky. He died very suddenly in Greenwich, Connecticut, his home for many decades. For those who knew him over the years, his colleagues at the Institute and the younger men and women who served in his laboratory, this is a loss which strikes deep in our hearts.

Dr. Olitsky was born in New York City in 1886. He received his early education at the DeWitt Clinton High School in New York City. In 1909 he was awarded the M.D. degree from Cornell University Medical College, and after serving his internship began to practice medicine here in the city, but this was not for him. After only a year his innate curiosity led him to the laboratory of Dr. William Park, Commissioner of Health of New York City, where he worked for two years without compensation. During the ensuing four years he was at the Mt. Sinai Hospital, again in the laboratory, and while there he was asked to head a commission to investigate an outbreak of typhus fever in Mexico. He contracted the disease, which proved almost fatal; in fact his death notice appeared prematurely in *The New York Times*. This misadventure whetted his appetite, no doubt, for after his recovery and return to New York he presented himself to Dr. Simon Flexner and asked if he might work at The Rockefeller Institute.

In 1917 Peter was appointed Assistant in Pathology and Bacteriology under Dr. Flexner's personal direction. Shortly thereafter, like many of his colleagues, he joined the Army, and served as First

PETER K. OLITSKY

Lieutenant in a branch of the Medical Corps stationed at The Rockefeller Institute. At this time one of the serious health problems among military personnel was the control of meningococcal infections. Dr. Olitsky developed a procedure for the rapid recovery and identification of meningococci in the human nasal pharynx. The war's pressing need also led to his discovery of a method for the speedy identification of dysentery bacilli and an attempt to develop an effective vaccine. When the war was over he resumed his study of typhus fever, because he



A group of young microbiologists, known in those days as bacteriologists, invited by the Director of the Institute, Dr. Simon Flexner, to work with Dr. Olitsky for the purpose of learning "modern" techniques in virology. This photograph was taken in 1925 in Dr. Olitsky's laboratory in what is now known as Flexner Hall. The group was called "the league of nations" by the staff members of the Institute. From left to right: Walter Levinthal, Berlin; Dino Nai, Milan; Sved Larsen, Copenhagen; Louis Boez, Strasbourg; Leon Muller, Liège; technician; Peter Olitsky; technician; Ronald Canti, London; technician; technician.

wished to clarify the conflicting ideas of the time as to the etiology of this disease.

In 1925 he was appointed chairman of the United States Foot and Mouth Disease Commission, a signal honor. His epidemiological discoveries directed toward the diagnosis and control of the disease in the field took him to Europe. Not long after, at the request of Dr. Flexner, Peter continued the studies on trachoma initiated by Noguchi who had recently died – studies which he eventually pursued in Egypt.

Neurotropic Viruses

Although Dr. Olitsky devoted the decade following the First World War primarily to viruses other than neurotropic viruses, it was to the latter that his interest now turned. With some fifteen years of experimental research behind him he had reached great intellectual maturity. A succession of young and very competent investigators came to his laboratory. Under his wise, patient, and critical guidance, they made remarkable contributions to our understanding of the pathogenesis and diagnosis of the encephalitides and the immunity mechanisms underlying them. Among his distinguished co-workers during this interval were Drs. Herald Cox, Isabel Morgan Mountain, Perin Long, Walter Schlesinger, Jordi Casals-Ariet, and Albert Sabin.

This of necessity is but a brief and cursory account of the achievements of one of our pioneer staff members at The Rockefeller Institute. His publications are the tangible proofs of his distinction as a man of science. His mark as a human being is indelibly engraved in the hearts of those who were his friends and coadjutors, so eloquently attested to in these words of Walter Schlesinger on the occasion of the presentation to the Institute of a portrait of Dr. Olitsky:

"To all those who had the good fortune of being associated with Peter Olitsky, he has been a wise mentor and a fatherly friend. Those of us who came

to him young in years and experience, ready to go out conquering the world with speculation and intellectual muscle-play, soon learned – or should have learned – the greater merits of wisdom, humility and patience. He shared his knowledge, his experience, his plans and problems with us as a father would. He shared with us credit for the work done in his laboratory, on equal terms, often pushed us into the limelight where he should have been. He made our problems and worries and our joys, both personal and professional, his own, and never tired of being drawn into whatever preoccupied us."

As for Dr. Olitsky's feeling for the great institution which fathered him, and which he helped to make great, a diary he kept while working on a mission for the United States Bureau of Agriculture and Animal Industry in Strasbourg, is deeply expressive. This entry, shown me but a few days ago by his devoted wife Frances, is dated April 15, 1926:

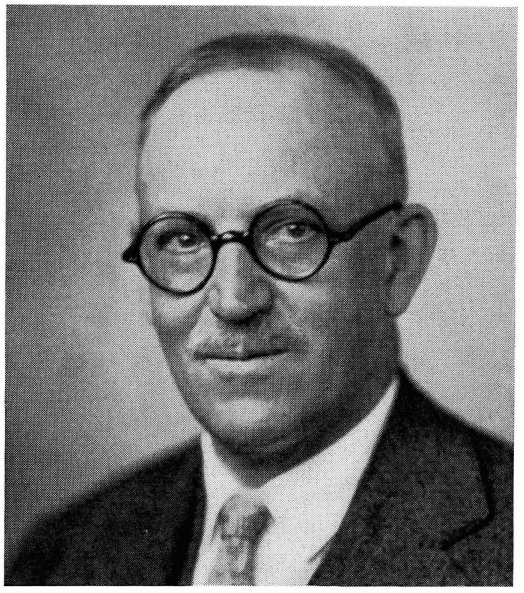
"This is the ninth anniversary of my connection with The Rockefeller Institute – more important to me than my birthday."

W. J. V. OSTERHOUT

1871-1964

BY THEODORE SHEDLOVSKY

On August 2, 1871, Winthrop John Vanleuven Osterhout was born in Brooklyn, New York, the son of a Baptist minister whose ancestors came to America in the seventeenth century from the town of Osterhout in Holland. On April 9, 1964, Dr. Osterhout died in New York in his ninety-third year. In accordance with his wishes, his ashes are buried in the cemetery of the Church of St. James the Less in Philadelphia among four descendants of Benjamin Franklin, an ancestor of Dr. Osterhout's widow, Marian Irwin. Many of us who knew him personally and The Rockefeller Institute where he spent four decades of his long life, mourn his death. His death seems to mark the passing of an important period in the history of biological science, a period which bridged the nineteenth and twentieth centuries. Here, as elsewhere, quantitative experimentation and important new ideas were supplementing or displacing the traditional descriptive methods of research in biology. Let us examine briefly his history as a man of science.



W. J. V. OSTERHOUT

At the Marine Biological Laboratory in Woods Hole, Massachusetts, a number of dedicated biologists, who were already eminent or were soon to become so, carried on their researches during the summer and influenced students – an enterprise which is happily continuing. Among these dedicated biologists were Jacques Loeb, T. H. Morgan, Frank and Ralph Lillie, E. B. Wilson, E. G. Conklin, Walter Garey, A. P. Mathews, Ivy Lee and of course, W. J. V. Osterhout.

While still an undergraduate student at Brown University, in 1892, young Osterhout came to the Marine Biological Laboratory where W. A. Setchell introduced him to research in botany. He started work and soon found that the four spores in a red alga, *Agardhiella,* each of which could produce a new plant, were able to combine and form a single plant. A year later – Osterhout had received the A.B. degree from Brown and he was the class poet by the way – he was again at Woods Hole, but now as Setchell's assistant in the botany course. Together

while collecting in Nobska Pond they found *Nitella flexilis*, but physiological experiments on this interesting material came only considerably later.

After a year (1895-6) at Bonn in Germany with the eminent plant cytologist, Eduard Strasburger, Setchell brought Osterhout to the University of California where he earned the Ph.D. degree in 1899 and met Jacques Loeb in 1902. Learning of Loeb's work on animal cells, he began to make similar studies on plant cells and did so with considerable success. Among other things, he was much interested in Loeb's observations on ionic antagonism such as exists between monovalent and divalent or trivalent cations, and he used effectively the measurement of electrical conductance in experiments with plant cells. Acquaintance with Loeb soon ripened into a great life-long friendship. While still in California, in those early years of the century, Osterhout got to know Svante Arrhenius and Hugo de Vries, with whom he doubtless participated in many discussions of matters scientific, philosophic, as well as honestly convivial. It was de Vries by the way who, through his own and Pfeffer's observations on the behavior of plants and artificial membranes, was instrumental in arousing his countryman, Van't Hoff, to take an interest in osmotic phenomena.

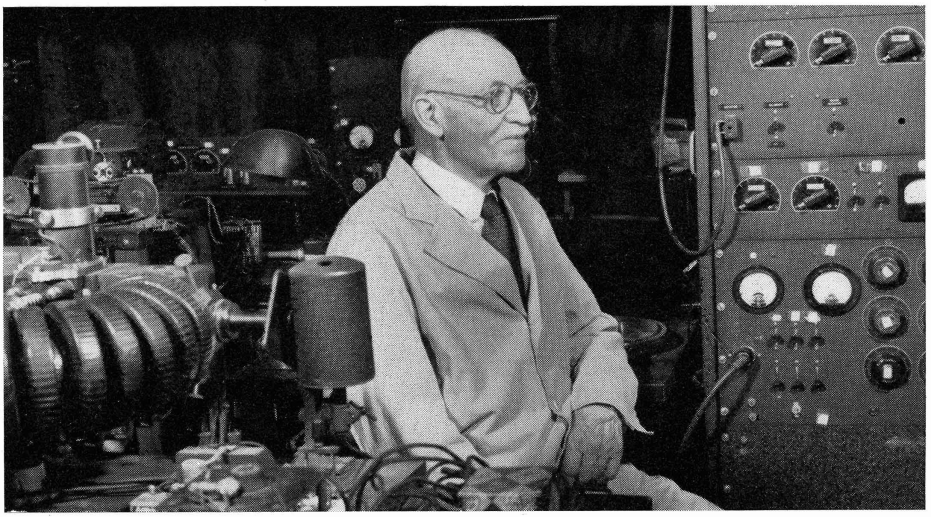
In 1909 Osterhout left the University of California as Associate Professor and moved to Harvard as Assistant Professor to become chairman of the division of biology, and Professor in 1913. When Loeb, who was a Member of The Rockefeller Institute for Medical Research, died in 1924, Dr. Osterhout was invited by the director, Dr. Flexner, to accept membership in the Institute. This invitation he accepted. At the Institute he was given a substantial laboratory in general physiology and a small laboratory at Bermuda for work on *Valonia macrophysa* and *Halicystis osterhoutii*. In New York he was joined by Marian Irwin, Laurence Blinks and later by S. E. Hill, W. Stanley, and several others. Interested as Osterhout always was in a physical-chemical approach to biological problems, he arranged for D. A. MacInnes to form a physical-chemistry group affiliated with his department. L. G. Longsworth and I soon joined this group.

After his return to the East from California, and while he was still at Harvard, Osterhout again became intimately associated with the Marine Biological Laboratory and remained so until just a few years ago. He became a trustee in 1910. Those of us who had the privilege of knowing him in New York, at Woods Hole, or in Cambridge, will fondly recall scientific discussions with him in the form of Socratic dialogues, as well as more general conversations which were seldom trivial and were usually well seasoned with wit and wisdom. We remember him as a gentleman, in the best and most accurate sense of the word, always with dignity but never with pomp or without a subtle warmth. We shall miss him: not only the scientist, the botanist, the physiologist, but also the mentor, the counselor, the friend.

Osterhout was a superb teacher. Although I did not have the good fortune of being one of his students, I know that his influence in attracting young people to research in biology was great. He had a gift for devising beautiful experimental demonstrations, that were presented with a persuasive but dignified enthusiasm for the subject, and he inspired many of his graduate students to undertake productive careers in research.

What were his main contributions to science? In the library of the Marine Biological Laboratory, there are about 270 cards in the W. J. V. Osterhout file. These include references to his early work in cytology, salt antagonism, osmotic studies and other physio-chemical aspects of plant cells and plant cell models. Perhaps his principal work was on permeability aspects and electrical properties of single plant cells. He was very early in accounting for the active transport of ions by a molecular carrier mechanism. To show this he constructed cell models which exhibited active transport with carrier molecules passing through non-aqueous membranes. For example, aqueous trichloracetic acid and pure water, separated by a layer of guaicol in the bottom of a U tube, showed the water apparently moving against its chemical potential gradient. Water movement and water absorption interested him greatly and was one of the subjects of his work with Mrs. Osterhout into the evening of his scientific life.

Bio-electric phenomena in living cells always held his active interest from the time of his early experiments in California on the relation of electrical conductivity of plant cells and ionic antagonisms. This field, traditionally controversial from the time of Volta and Galvani, has remained so through the



Dr. Osterhout
in his laboratory
Founder's Hall, 1952

period of phase-boundary potentials versus diffusion potentials, and even remains so today in the present era of biochemical and biophysical euphoria. Such a field is not an easy one to explore, but as Osterhout said of Loeb, "He did not select problems because they were easy, but because of their importance. His courage sprang largely from his faith in the materialistic conception of science."

While at Harvard, Osterhout's extensive electrical studies on *Laminaria* led in 1922 to the book *Injury, Recovery, and Death in Relation to Conductivity and Permeability*. This book stimulated other investigators by its novelty of concept and method of interpretation involving consecutive reactions. Throughout his life Osterhout stimulated biologists to engage in meaningful quantitative experiments, and physical chemists and physicists to consider the problems presented by the living cell.

Photosynthesis, respiration, oxidation and related topics had received attention in his publications. In particular, he demonstrated photoinduction through a striking observation with A. R. Hass (1918) in which he noted that when the marine plant, *Ulva*, was transferred from darkness to light the rate of photosynthesis was increased.

I have already mentioned his important concept of carrier molecules, so much invoked today. It should also be noted that he pioneered in the concept of the steady state as against equilibrium in accounting for the kinetics of penetration of substances into living cells, and, of course, no self-respecting student of molecular biology today will deny at least some knowledge of Irreversible Thermodynamics. But Osterhout's influence in general physiology was even greater than the sum of his papers and of personal contacts with other investigators and students: I refer to the *Journal of General Physiology*. He was, with Jacques Loeb, co-editor of this journal from its beginning. Let me quote from his own words in the "Outline of the History of the Journal of General Physiology," written in 1955:

> Dr. Jacques Loeb and I realized the need for a journal to promote the study of general physiology. Dr. Flexner agreed to publish the Journal from The Rockefeller Institute for Medical Research beginning in 1918. Dr. Loeb and I were the sole editors until he died in 1924. The statement, "Founded by Jacques Loeb" was placed on the cover of the Journal and a memorial volume was published in his honor. Dr. John H. Northrop and Dr. William J. Crozier joined the editorial board in 1924 after Loeb's death. For about twenty-two years Dr. Northrop, Dr. Crozier and I were the only editors. In 1946 Dr. Wallace O. Fenn joined us. For about thirty-seven years each editor read *every* paper submitted.

We shall miss Dr. Osterhout. But for many of us his memory will often be refreshed when we pass the fourth floor of Founder's Hall, when we read the *Journal of General Physiology*, when we visit Woods Hole, when we think of *Nitella, Valonia, Halicystis*, and *Laminaria*, or when we recall the wit and wisdom which so often emanated from him to inspire us in so many ways.

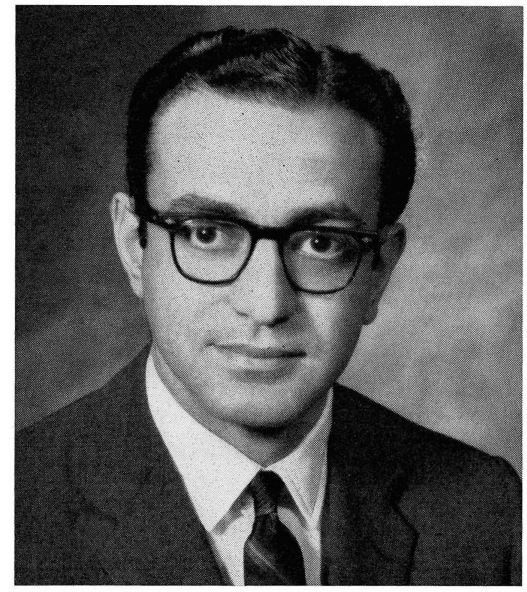
NEW FACULTY

Eight new appointments to the faculty were announced by Dr. Bronk in August. The new professorial appointments include a physicist, a mathematician, and a sociologist as well as a visitor from the Department of State.

Nicola N. Khuri has been appointed Associate Professor of the Institute. Dr. Khuri, a physicist, was born in Beirut, Lebanon, and was graduated from the American University of Beirut in 1952. He received the M.A. and Ph.D. degrees from Princeton University, the latter in 1957. Dr. Khuri has been a member of the Physics Department of the American University of Beirut and a Member of the Institute for Advanced Study of Princeton. During the past year he was a Visiting Associate Professor in the Physics Department of Columbia University. Dr. Khuri, a theoretical physicist whose special fields of interest are high energy particle physics and mathematical physics, will join the group of Professor Abraham Pais. At present he is engaged in studying certain mathematical properties of elementary particle scattering-amplitudes at high energies.

Doctors Hans Rademacher and Donald R. Young have accepted appointments as Visiting Professors. Professor Rademacher, a mathematician, was born in Hamburg, Germany, and received the Ph.D. degree from the University of Göttingen where he was a student of Constantin Carathéodory. He has been a faculty member of the University of Berlin, the University of Hamburg, the University of Breslau, and from 1934 to 1962, of the University of Pennsylvania. Dr. Rademacher has been interested in functions of real variables, orthogonal functions, and more recently, analytical number theory and numerical analysis. His only excursion into applied mathematics was during World War II when he worked with the first computer, ENIAC, on computations of ballistic trajectories. Professor Rademacher is coeditor of *Acta Arithmetica* and coauthor, with the late Otto Toeplitz, of *Von Zahlen und Figuren* which was translated into Russian and Polish and also appeared in an English edition, *The Enjoyment of Mathematics.* His *Lectures on Elementary Number Theory* were published last spring.

Professor Young is a sociologist who was born in Macungie, Pennsylvania, in the farmhouse where he still spends his leisure hours. He received the M.A. and Ph.D. degrees from the University of Pennsylvania, the latter in 1922. He progressed from Instructor to Professor in the Department of Sociology at the University of Pennsylvania, becoming Chairman of the Department in 1943. For part of this period and the five years following, Dr. Young was on leave with the Social Science Research Council, first as



NICOLA N. KHURI

Secretary for Fellowships and Grants in Aid, and for the last three years as President. From 1948 to 1963 he served as Director and then President of the Russell Sage Foundation, relinquishing the latter post because, as he put it, "plants bloom better if they are repotted from time to time." Professor Young is author of *American Minority Peoples* and *Minority Peoples in the Depression,* and the motion picture, *A Study in Social Legislation.*

New appointments to Assistant Professor include Doctors M. A. B. Bég, Betty S. Danes, Howard M. Grey, and David T. Rowlands, Jr. Irving M. Tobin of the Department of State will be at the Institute during the coming year as a Visiting Lecturer in International Affairs.

FACULTY PROMOTIONS

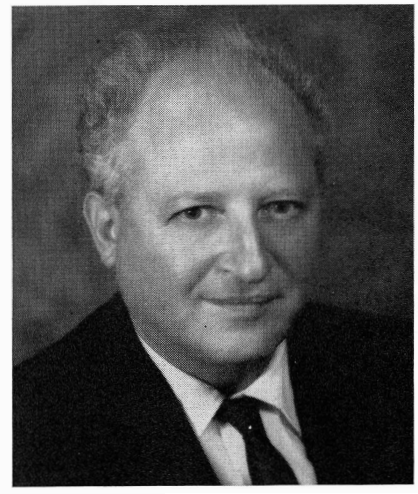
Five members of the faculty of The Rockefeller Institute, Alexander G. Bearn, Sam Granick, Igor Tamm, William Trager, and Norton D. Zinder, have been promoted to the rank of Professor. Doctors Bearn and Tamm have also become Senior Physicians to the Hospital. These promotions were approved by the Board of Trustees and were made public by President Bronk on August 7. Promotions to Associate Professor and Assistant Professor were also made at this time.

Professor Alexander Gordon Bearn was born and educated in England and received the M.B.B.S. and Doctor of Medicine degrees from the University of London. In 1951 after studying in the Postgraduate Medical School at London, he came to The Rockefeller Institute to work in the laboratory of Dr. Henry Kunkel. Dr. Bearn was appointed Associate Professor and Physician in 1957. In his research activities at the Institute, Professor Bearn has been interested in the broad problem of the role of genetic factors in human variation and disease. Since 1951 he and Dr. Kunkel have been studying a rare metabolic disorder, Wilson's disease, which they have shown may be due to a lack of ceruloplasmin, the end result of an "inborn error of metabolism," caused by the absence of a particular enzyme in the biosynthetic chain. The genetic nature of the disease has also been confirmed by Professor Bearn. He is currently investigating the inherited variations in serum proteins based on analyses of blood samples obtained from several isolated populations. In addition he and his colleagues have in recent years been exploring the value of tissue culture studies in the elucidation of genetic defects in man. In 1961, Dr. Bearn was named honorary member of the Sociedad Medica and the Sociedad de Biología, both of Santiago, Chile. He is also Advisory Editor of *The Journal of Experimental Medicine* and Associate Editor of the *Cecil-Loeb Textbook of Medicine, 11th ed.*

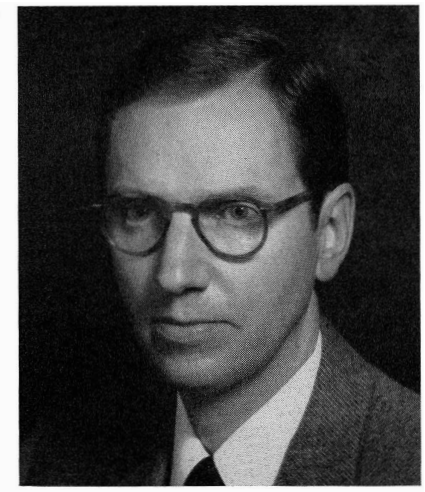
Professor Sam Granick has been at The Rockefeller Institute since 1939. A New Yorker by birth, Dr. Granick received the B.S., M.S., and Ph.D. (in plant physiology) degrees at the University of Michigan where he was a Newcombe Fellow from 1934 to 1938. He became a Rockefeller Fellow at The Rockefeller Institute upon leaving the University of Michigan and worked in the laboratory of Dr. Leonor Michaelis. He was made an Assistant two years later and became an Associate Professor in 1951. Professor Granick's research interests have been in the areas of chloroplast structure and inheritance, heme and chlorophyll biosynthesis, and iron metabolism. His isolation of chloroplasts made possible for the first time quantitative determinations of their composition. In 1947 he and Dr. Keith R. Porter took the first electron microscope pictures of the chloroplasts, which revealed their dense grana and disc-like components. More recently, with Dr. Aharon Gibor, he has found evidence for the self-replication of DNA in chloroplasts. By means of chlorella mutants the two principal "powerhouse" pigments of protoplasm, heme and chlorophyll, were found to be members of the same biosynthetic chain. He is continuing his studies of this chain in order to understand the structural and functional evolution of these pigments. Dr. Granick's first research interest at the Institute was the iron-protein, ferritin, which he studied with Dr. Michaelis in connection with its magnetic properties. The feeding of iron was found to induce the synthesis of this specific iron protein.

Professor Igor Tamm joined The Rockefeller Institute faculty in 1949 and was promoted to Associate Professor and Physician in 1956. He was born in Estonia and studied at the State English College in Tallinn and later at the Tartu University Medical Faculty. He attended the Karolinska Institute in Sweden from 1944 to 1945, passing his medical candidate examination, and then completed his medical studies at Yale University where he received the James Goodrich Memorial Scholarship. He was awarded the degree of Doctor of Medicine in 1947. From 1947 to 1949, he served as Assistant in Medicine at the Yale University School of Medicine. Professor Tamm's special area of research interest has been the mechanism of the multiplication of animal viruses, and the investigation of the alterations in cells brought about by viruses. He has carried out basic studies of the selective inhibition of virus

ALEXANDER GORDON BEARN



SAM GRANICK

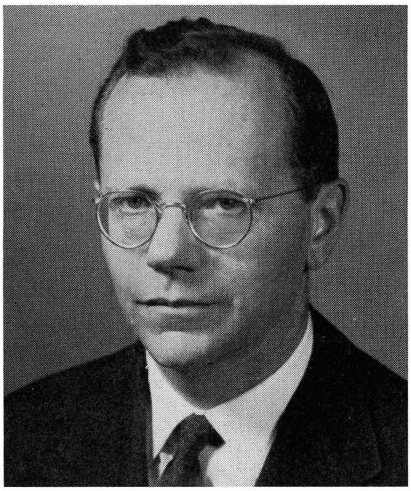


IGOR TAMM

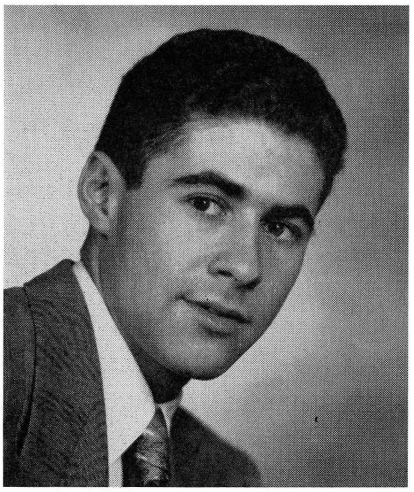
growth by benzimidazole derivatives which are of particular interest because they seem to interfere with the virus-specific function of RNA replication. In 1958 and 1959, Professor Tamm served as Associate Editor of *Virology* and since 1961 he has been an Associate Editor of the *Journal of Immunology*. In 1963 he became an Editor of the *Proceedings of the Society for Experimental Biology and Medicine*. Professor Tamm is an Associate Member of the Commission on Acute Respiratory Diseases of the Armed Forces Epidemiological Board.

Professor William Trager has been with The Rockefeller Institute since 1933 when he first joined the Institute laboratories in Princeton. Born in Newark, New Jersey, Professor Trager received the Bachelor of Science degree from Rutgers in 1930 and the Master of Science and doctorate from Harvard University, the latter in 1933. Professor Trager, who became an Associate Professor in 1955, has spent most of his professional career at the Institute. His chief research interests have been entomology and protozoology and he has conducted a variety of studies in these fields, including the cultivation of cellulose-digesting protozoa from termites; the first successful tissue culture of ovarian tissue from the silkworm; the culture of viruses in silkworm and mosquito tissues *in vitro;* studies of the nutritional requirements of mosquito larvae; investigations of acquired immunity to ticks; studies of factors involved in the susceptibility and resistance to avian malaria; and most recently, research on the physiology, biochemistry, and fine structure of the parasitic protozoa, particularly the malarial parasites. His work on parasitism has taken him to the tropics on three occasions: in 1939 for a summer at the Gorgas Memorial Laboratory in Panama; in 1944-45 to New Guinea as an officer of the U. S. Army working on malaria; and in 1958-59 as a Visiting Investigator at the West African Institute for Trypanosomiasis Research in Northern Nigeria. Professor Trager has been Editor of the *Journal of Protozoology* since its founding in 1954.

Professor Norton David Zinder, also a native New Yorker, received the A.B. degree from Columbia University in 1947 and the doctorate from the University of Wisconsin in 1952. He has also spent most of his professional career at The Rockefeller Institute, having come here in 1952. Professor Zinder, who was an American Cancer Society scholar from 1956 to 1959, was promoted to Associate Professor in 1958. While working with Joshua Lederberg at the University of Wisconsin, Dr. Zinder discovered the phenomenon of transduction in *Salmonella typhinurium* in the course of unsuccessful attempts to observe bacterial mating in these microorganisms. More recently Professor Zinder and his colleagues have developed techniques for mating *Salmonella* and are using transduction and recombination together to study the organization of the genetic material of the bacterial cell. Dr. Zinder's most recent finding has been two extremely small *E. coli* bacteriophages, one of which is remarkable because it is the first of the bacterial viruses discovered to contain RNA. Because of



WILLIAM TRACER



NORTON DAVID ZINDER

their small size they are believed to contain only three or four separate genes and current studies are underway to define the function of each of these. Dr. Zinder received the Eli Lilly Award in Microbiology in 1962.

Faculty promotions to Associate Professor include Purnell Choppin who was also made Physician to the Hospital, Henry G. Frankfurt, David Mauzerall, John M. Stewart, and David A. Yphantis. Newly-promoted Assistant Professors are Richard L. Costello, Lee R. Ehrman, Jack Goldstein, Gopi N. Gupta, Alan F. Hofmann (also appointed Associate Physician to the Hospital), Richard D. Levere, David J. L. Luck, Beatrice S. Magdoff, George Miroff, and Tokumasa Nakamoto.

New Students

TWENTY-NINE NEW students were awarded fellowships and admitted as candidates for the degree of Doctor of Philosophy at the opening of the academic year.

ROBERT S. ANTHONY, B.S. Cornell University

BARRY S. BEAN, B.S. Tufts University

DAVID D. BRAYSHAW, B.S. Lafayette College

DAVID T. CHENG, B.A. Dartmouth College

WILLIAM L. R. CRUCE, B.S. The University of Chicago

THOMAS G. EASTON, B.S. Michigan State University

JOHN H. EHRENREICH, A.B. Harvard College

WILLIAM D. ENSMINGER, B.S. The University of Michigan

STANLEY D. FOWLER, B.A. Pomona College

STEVEN M. GREEN, B.S. California Institute of Technology

STEPHEN GROSSBERG, B.A. Dartmouth College

DAVID K. HERRON, B.A. Carleton College

JOHN G. HILDEBRAND, A.B. Harvard College

LEWIS J. KLEINSMITH, B.S. The University of Michigan

GRETCHEN K. KNECHT, B.A. DePauw University

FRED R. KRAMER, B.S. The University of Michigan

ANDREA LESKES, A.B. Vassar College

HERBERT E. LONGENECKER, JR., B.S. Tulane University

ARNOLD MARGLIN, A.B. Harvard College; M.D. Columbia University

FREDERICK MEINS, JR., B.S. The University of Chicago

JERRY L. MOSSER, A.B. Indiana University

RICHARD D. NAGIN, A.B. Harvard College

BARRY W. PETERSON, B.S. California Institute of Technology

PAUL PRICE, B.A. Pomona College

HUGH D. ROBERTSON, A.B. Harvard College

PHYLLIS S. ROMANOFF, B.A. Brown University (Pembroke College)

EDWARD F. ROSSOMANDO, D.D.S. University of Pennsylvania

BARBARA SHORTLE, A.B. Vassar College

GAIL WALKER, B.A. Bryn Mawr College

ACS Award Winners

TWO MEMBERS of The Rockefeller Institute faculty, Doctors Gertrude E. Perlmann and Gerald M. Edelman, were among the winners of the American Chemical Society awards announced on August 31 at a general assembly of the Society's 148th National Meeting. Dr. Perlmann was recipient of the $1,000 Garvan Medal given to the woman chemist of the year and Dr. Edelman was given the $1,000 Award and bronze medal in Biological Chemistry sponsored by Eli Lilly and Company. Both prizes will be presented at the Society's 149th National Meeting in Detroit in April.

The Garvan Medal was awarded to Dr. Perlmann in recognition of her work on the structure of pepsin. Her special research interest has been in the field of protein chemistry with particular emphasis on the macromolecular conformation of proteins and its relationship to their biological function. In the course of her investigations she has helped to establish a correlation between the structure of pepsin and its enzymic activity and also to detail the changes that occur when pepsinogen is activated to form pepsin.

Dr. Perlmann was born in Reichenberg, Czechoslovakia, and received the Sc.D. degree in 1936 from the German University of Prague. After holding research posts in Prague and in Copenhagen, where she worked in close collaboration with Dr. Fritz Lipmann and the late Professor Linderstrøm-Lang, she came to the United States in 1939 as a research assistant at the Harvard Medical School. Dr. Perlmann came to The Rockefeller Institute in 1946 as a Commonwealth Fund Fellow, working in the laboratory of Professor Lewis G. Longsworth, and was appointed to the Staff of the Institute in 1947. She is now an Associate Professor and the first member of the Institute to receive the Garvan Medal.

The Award in Biological Chemistry, received by Dr. Edelman, is given "to stimulate fundamental research in biological chemistry . . . by young chemists working in the colleges and universities and other nonprofit institutions of the United States." For the past five years Dr. Edelman's work has been concerned with the structure of antibody molecules. He and his colleagues have shown that gamma globulin molecules consist of several types of polypeptide chains. This finding has clarified the relationship between the structure and biological activity of antibodies.

Dr. Edelman joined the Institute as a Graduate Fellow and Assistant Physician to the Hospital. He received the Ph.D. degree in 1960 and is now Associate Professor and Associate Dean of Graduate Studies. He is the fourth Institute member to be honored by the Lilly award. Others have been Doctors Joseph S. Fruton, Max A. Lauffer, Jr., and D. Wayne Woolley.

Stichting Award

DR. ARPAD CSAPO, who until last year was an Affiliate of the Institute and is now Professor of Obstetrics in the Washington University School of Medicine, has received the De Snoovan't Hoogerhuys Stichting Award and prize of 5,000 florins for "the best work in the field of reproduction in its broadest sense" for work done while at The Rockefeller Institute. This is the first time that the honor, conferred on Dr. Csapo at a meeting of the Dutch Gynecological Society, has been given to a scientist from outside of Holland.

ILLUSTRATIONS

THE COVER PHOTOGRAPH shows the north end of Abby Aldrich Rockefeller Hall: the open pavilion above adjoins the dining room; the terrace and fountains below lead into the Faculty and Students Club; photograph by Richard Carter.

PAGES 2, 3, and 4 by Heka; PAGES 5, 6, 7, and 8 courtesy of the State University of New York, Upstate Medical Center, Department of Pharmacology; PAGE 9 pencil drawing by Louise Prentiss Bracken; PAGE 11 photograph by Louis Schmidt; PAGES 14, 16, and 17 The Rockefeller Institute Illustration Service.