7-1973

NEWS AND NOTES 1973, VOL.4, NO.10

The Rockefeller University

THE ROCKEFELLER UNIVERSITY

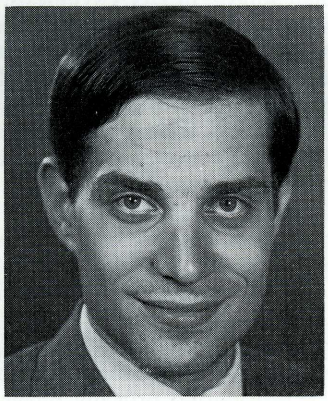
JULY 1973

VOLUME 4 NUMBER 10

news and notes

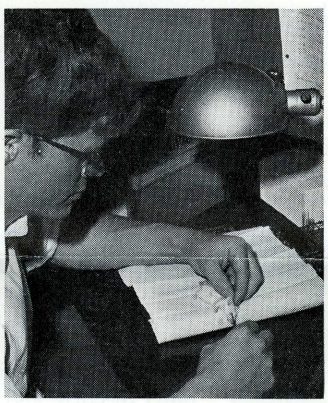
Twenty-Seven Awarded Degrees at Fifteenth Convocation

AZMITIA

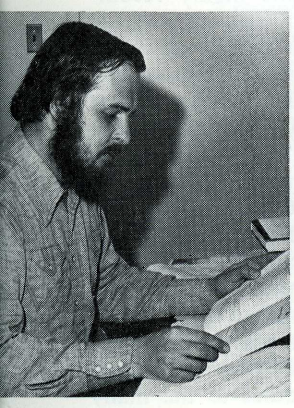


BALK

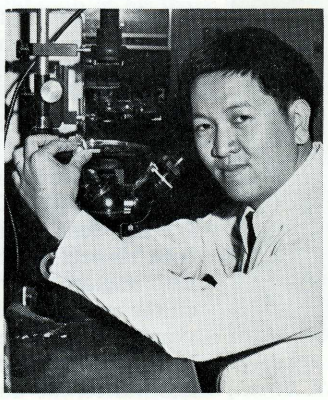
BOUVIER



BRILES



BUSCH



CHEN

Twenty-seven doctor of philosophy degrees were awarded at the University's 15th convocation ceremonies, held on June 13, and honorary doctor of science degrees were presented to two members of the University's faculty, Moses Kunitz and Rebecca C. Lancefield, who first came to this institution 60 and 55 years ago, respectively. Twenty-four of the Ph.D. recipients were present to accept their degrees and congratulations from President Seitz before an audience of family and friends, University colleagues, and trustees, including Chairman of the Board David Rockefeller. Among the graduates was the first degree recipient from the mathematical psychology laboratory, Alice Fenvessy Healy, whose husband, James Bruce Healy, also received his degree that day. Dr. Kunitz, now retired and living out of town, was unable to attend the ceremonies because of ill health. The citation in his honor, prepared by Professor Stanford Moore, was read by Professor Lyman C. Craig in Dr. Moore's absence. Vice President Maclyn McCarty presented Professor Lancefield.

Moses Kunitz began his career at The Rockefeller Institute for Medical Research in 1913 as a technician with Jacques Loeb. He brought to his studies of the physical and chemical properties of proteins and enzymes a rare combination of theoretical insight and practical skills. In the '20s and '30s, he and John H. Northrop, Jr. performed what the citation called "a series of classic experiments on the purification and crystallization of enzymes that proved beyond doubt that enzymes were proteins." By isolating a trypsin-inhibiting enzyme, they helped to solve the mystery of why the powerful digestive enzymes do not destroy living tissue. Further work led to the crystallization and isolation of ribonuclease, an enzyme critical in the study of genetics, virology, and all life processes dependent on nucleic acid.

Like Dr. Kunitz, Rebecca Craighill Lancefield began her work at Rockefeller as a technician in 1918. She left shortly after to pursue advanced studies, but returned in 1922 to the campus where she has remained actively engaged in the bacterial research that has brought her international recognition. Dr. Lancefield and her group were responsible for experiments which led to an understanding of the composition of hemolytic streptococci. Epidemiological studies of streptococcal disease have depended upon the use of the Lancefield system of classification of Group A streptococci. (Sera prepared in her lab are sent, on request, all over the world.) Other work on the chemical composition and biological properties of components of Group A streptococci has resulted in reports on the properties of the M protein and of other antigenic substances which she has discovered.

Other festivities during convocation week included a reception for graduates, their families, and their faculty advisors at the President's residence, a preconvocation dinner, a trustees' luncheon, and a reception on the Esplanade immediately after the ceremonies. The Convocation Ball was held that evening.

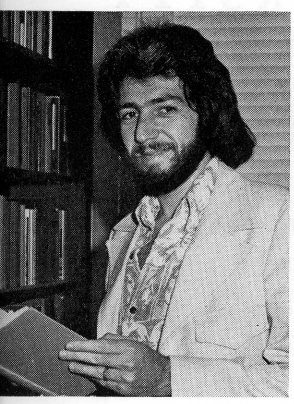
Following are condensations of the presenters' remarks. The degree recipients' names appear first.

PH.D. DEGREES

EFRAIN CHARLES AZMITIA, JR.

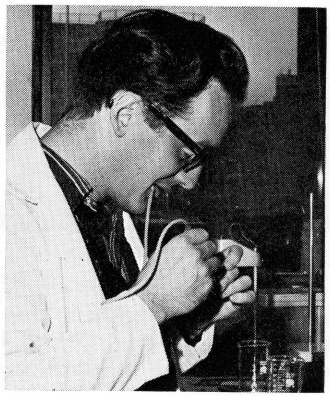
Bruce S. McEwen

During his first summer at Rockefeller, Efrain Azmitia began what was to become his thesis research, studying the conversion of the amino acid tryptophan into serotonin. This turned out to be a fortunate choice because it was soon evident from his work on albino rats that the adrenal hormone corticosterone (the hormone secreted during stress) plays an influential role in the formation of serotonin in the brain. For example, he was able to demonstrate that stressors such as winter-like cold increase serotonin formation via activation of the adrenal gland. When an adrenalectomized animal is similarly stressed, serotonin forma-

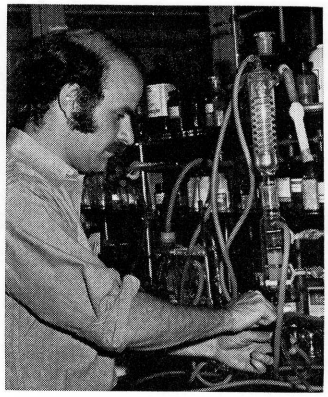


COLEMAN

DWORKIN



FULPIUS



GALARDY

GAUNT

tion does not increase. Taken together with the fact that serotonin plays an important role in cerebral control of adrenal secretion, Efrain's work indicates that adrenal steroids can control their own secretion by acting upon the serotonin system in the brain. More generally, his work opens new possibilities for understanding the biochemical basis of endocrine abnormalities in man, particularly ones in which mental disorders are present.

SAMUEL D. BALK

Armin C. Braun

Dr. Samuel Balk studied one of the most fundamental but, as yet, least understood aspects of the cancer problem. He set out to learn why tumor cells grow in an essentially unrestrained or autonomous manner in their hosts while the growth of all normal cells is precisely regulated. He approached this problem experimentally by attempting to reproduce in cell culture the situation as it is found to occur in a host. This he succeeded in doing by rather ingeniously manipulating ingredients in his culture medium. Having developed the desired method, he then proceeded to characterize the area of metabolism that is specifically concerned in the regulation of growth of the normal cells. This he found to involve a Ca-mediated function that operates just prior to chromosomal DNA replication and that sets into motion the metabolic machinery that is concerned with cell growth and division. The tumor cells were found to have become largely independent of this Ca-mediated function. The system that Dr. Balk has developed is unique and, if now explored further, will doubtless provide meaningful insight into those changes in proliferative behavior that constitute the ultimate basis of the tumor problem.

FRANÇOIS BOUVIER

Norton D. Zinder

Fundamental as it is, our knowledge of the mechanism of DNA synthesis has had its ups and downs over the years. Recently with the isolation of the appropriate bacterial mutants and particularly by dissection of the stages of synthesis such as the initiation, propagation, and termination of DNA chains, the necessary enzymes and control signals involved are becoming clearer.

François Bouvier decided to study the synthesis of the DNA of a small bacterial virus. This virus contains only a few genes, none of which is directly involved in DNA synthesis, and it therefore relies on the hosts' systems. The virus particle contains a covalently closed ring of single-stranded DNA. Certain bacterial mutants have been found which stop host DNA synthesis. The question asked was, do these mutants affect virus DNA synthesis and at what stage? Particular emphasis was placed on a bacterial mutant that allowed bacterial DNA synthesis to proceed for one generation and then caused it to stop. For the phage, all the normal intermediates seen during phage DNA replication, both double- and single-stranded forms, were found. Still no progeny phage was produced. More precise analysis of the single strands showed them to be open linear molecules instead of closed rings. A handle has been obtained for the study of the proper initiation and termination of DNA synthesis.

Postconvocation smiles, left to right: Board Chairman David Rockefeller, Vice President Maclyn McCarty, Professor Rebecca C. Lancefield, President Seitz, Dean James G. Hirsch, Professor Lyman C. Craig, and Vice President Carl Pfaffmann.

DAVID E. BRILES

Richard M. Krause

In high school and at the University of Texas in Austin, David had an abiding interest in genetics, nurtured perhaps by his parents, both of whom are students of this science. The immunogenetics of poultry, the genetics of disease susceptibility of corn, and the genetics of *Drosophila* occupied his attention. No surprise then, that David came highly recommended, and fortunate we were, because it had been the habit of his university advisor, Dr. Stone, to send his promising students off to Harvard. After arrival at Rockefeller University, David was drawn to Dr. Edward L. Tatum's laboratory, and his work in immunogenetics, which began there with Dr. Curtis A. Williams, Jr., has been continued with us. It has been suspected for many years that genetic factors have a profound influence on the antibody response to bacteria and viruses, and on resistance to infections. Man and animals produce an almost endless variety of antibodies to the many different bacteria and viruses. David has

probed for an understanding of the facile genetic mechanism which generates this richness in antibody diversity. Breeding experiments were performed with inbred mice, and sensitive and subtle methods were employed to measure the antibodies in crosses and backcrosses following immunization with streptococci. In this long series of imaginative and thoughtful experiments, David has identified genes which control the occurrence of antibodies to the antigens of streptococci. This achievement has advanced our knowledge on the genetic control of the immune response. It should, perhaps, be mentioned on this occasion that the streptococci employed in these experiments are the same pathogenic organisms which were employed in 1919 by Avery, Dochez, and Lancefield for studies on the pathogenesis of streptococcal infections.

DOUGLAS R. BUSCH

Donald A. Martin

Douglas Busch came to us from New Zealand with a background in philosophy and already with a quite extensive knowledge of mathematics and logic. He began attacking problems mostly in descriptive set theory and was successful in several cases. Perhaps his most interesting research, however, concerned a rather different question, that of capacitability. The physical notion of the capacity of a conductor leads to the notion of the capacity of certain subsets of space. This in turn leads to an extension of the concept of capacity to more general spatial sets. A set to which this general concept applies is called a capacitable set. Using the axiom of choice, one can show that not every set is capacitable. Doug proved, among other things, that the use of the axiom of choice is necessary: it is consistent with the other axioms of set theory that every spatial set is capacitable. To carry out this enterprise, Doug needed not only the tools of logic and set theory but also a sound understanding of the theory of capacities, not generally possessed by logicians, which he set out to get on his own. Along the way he was forced into the more difficult task of teaching me at least part of this subject in order to explain his proof. Happily he managed to make the learning process quite painless.

CHANG CHEN

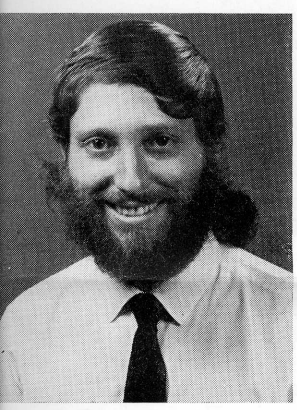
Zanvil A. Cohn

Chang Chen, better known to us as Patrick, received his medical degree in Taiwan and came to The Rockefeller University with interests in the cellular aspects of immunology. Although attempts were made to interest Patrick in the intricacies of bilirubin metabolism, he firmly and effectively advised us that this was not his cup of tea. Shortly thereafter he began working on the production of specific antibody under tissue culture conditions. This model was thought to involve three cell types—the bone marrow- and thymus-derived lymphocyte and the macrophage. Within a short time, Patrick unraveled the role played by the macrophage. Rather than processing antigen or transmitting informational molecules to competent lymphoid cells, macrophages released a nutritional factor into their environment which maintained the viability of antibody-producing lymphocytes. In a detailed series of studies he demonstrated that critical numbers of macrophages were required and that their interaction with antigen was not necessary. Although the extracellular factor has not been identified, Patrick discovered that it could be replaced by a simple molecule—mercaptoethanol. This agent is promptly oxidized to its disulfide form which is then quite stable and mimics all the properties of the macrophage product.

JULES L. COLEMAN

Joel Feinberg

Jules L. Coleman is the second student to qualify for a Ph.D. in philosophy at The Rockefeller University, and the first in moral philosophy. Since his aim is to appraise the role of the fault principle in moral judgment and in systems of civil liability, he devotes a major part of his work to an analysis of the concept of fault itself and its relation to such concepts as blame and causation. This analytic part of his thesis is valuable in its own right as a contribution to the theory of moral responsibility, but Coleman pro-



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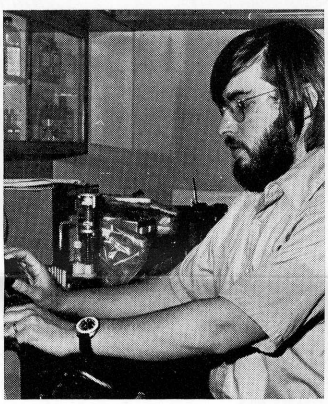

HARTMAN

HEALY

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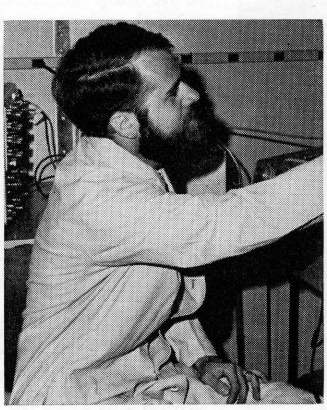
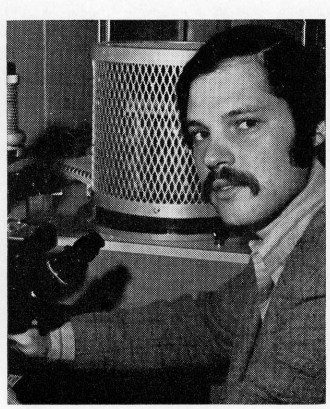
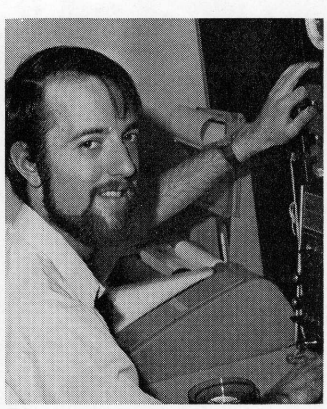
HUBBARD



LARKIN



RUTISHAUSER



SCHOR

SIMON

ceeds to apply its results to a critique of the view that elimination of the fault principle from accident law would be unjust. He examines the relevant notions of distributive, retributive, and compensatory justice, and concludes that these notions, properly understood, actually lend support to systems of no-fault accident law.

BARRY R. DWORKIN

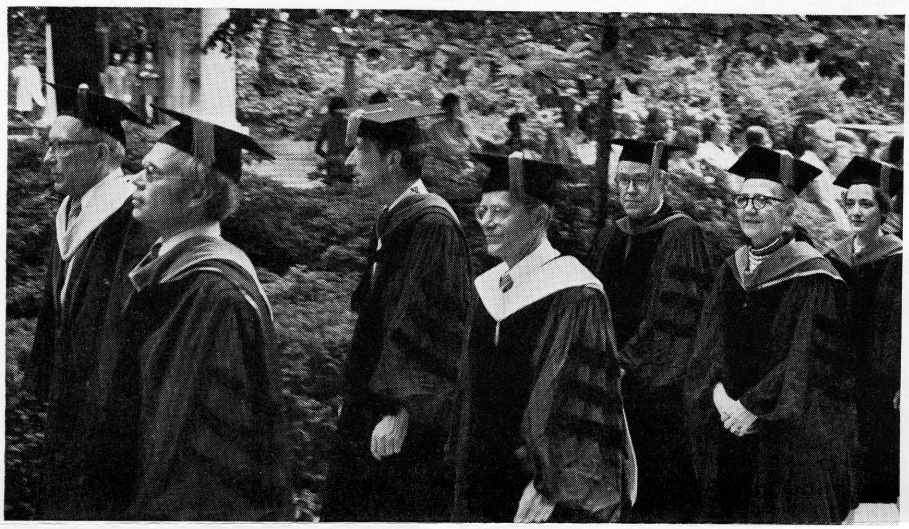
Neal E. Miller

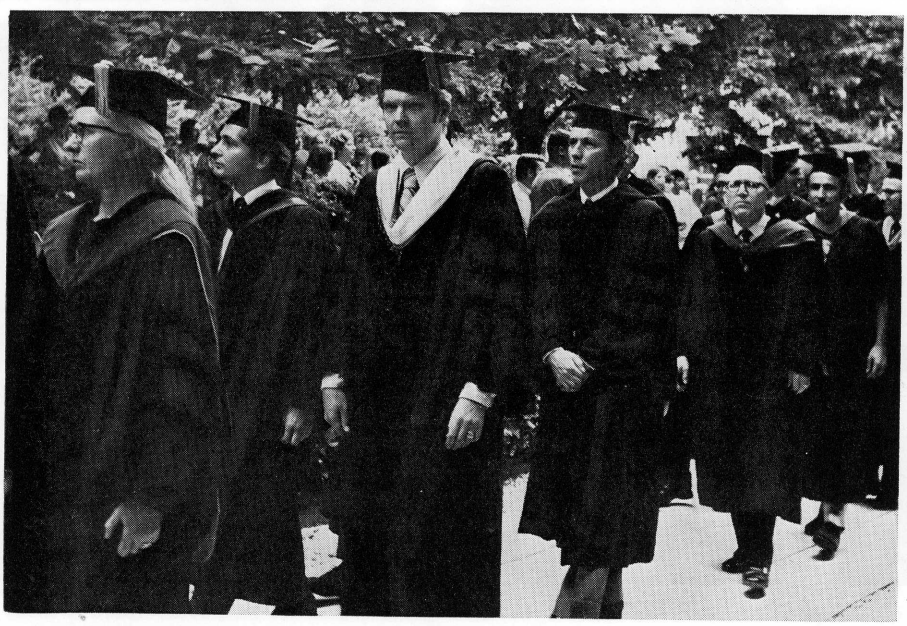
Barry Dworkin has shown unusual resourcefulness, intelligence, creativity, and persistent scientific devotion in working with me on the most frustrating problem of my scientific career: why apparently robust results, previously secured by a half-dozen different collaborators, on the visceral learning of rats paralyzed by curare have declined progressively during six years to virtually zero. It is to The Rockefeller University's credit that it has used the scientific excellence of the attempt, rather than the largely negative results, as the basis for evaluating his dissertation. Mr. Dworkin has shown the ability independently to master a wide range of knowledge and techniques essential to his research. He has invented a superior device for continuously measuring human blood pressure indirectly without the invasive procedure of catheterizing an artery. It has been a great pleasure to have Mr. Dworkin as a student and colleague.

BERNARD FULPIUS

Edward Reich
(read by Anthony Cerami in Dr. Reich's absence)

Bernard Fulpius has always been curious to know how the brain works. When he joined our graduate program, he thought at first to examine the brain's electrical properties in greater depth. However, the electrical activity of nerves is triggered by chemical reactions, and one of the most interesting reactions is the transmission of signals between cells. When this happens a nerve ending releases a chemical that combines with receptors on the surface of a second cell, and the reaction between receptor and transmitter then generates an electrical impulse. These receptors are the targets for the action of many drugs, and because they also initiate all electrical activity in nerve and muscle, physiologists and pharmacologists have been trying to isolate them for nearly a century. All previous attempts had failed because the receptors are present in small amounts and are hard to measure. Fulpius elected to try his hand at this problem and teamed up with Dr. Robert P. Klett. Their approach was to overcome the experimental difficulties by exploiting two exotic freaks of nature. The first was to use the electric eel as starting material; this fish, which lives in the Amazon, produces high voltage discharges, and its electric organ contains large amounts of receptor. The second requirement was to develop a sensitive assay, and this was accomplished by using a toxin that binds specifically and tightly to the receptor and can be isolated from the venom of the cobra. Fulpius and Klett succeeded in isolating a pure cholinergic receptor and thereby established a landmark in pharmacology. This made it possible for the first time to study the interaction of drugs with the same receptor molecules that mediate drug action in the body, and Fulpius was able to reproduce several of the patterns of drug effects with solutions of receptor in the test tube. He therefore took the first step in defining the molecular basis of drug action with neural receptors, and his work will now become the starting point for the efforts of many laboratories in this and in related fields.





RICHARD E. GALARDY

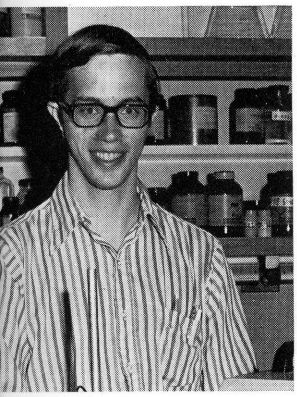
Lyman C. Craig

It is known that certain molecular structures in living things have the ability to recognize and bind specific solutes with amazingly high discrimination. These molecular structures, such as enzymes, antibodies, hormones, and genes, are usually large but the molecules they bind are often small, which indicates that the contact region can be relatively small. It is obviously very important to know the location and detailed structure of this region called "the active site." Dick Galardy, who came to us from Dartmouth, has designed a possible chemical way to locate the active site. He chose an active fragment of the hormone, gastrin, to develop his method and attached certain chemical structures to it which become very reactive when exposed to light. The modified hormone finds its way to the active site in the normal process then, when activated by light, attaches itself permanently to the site as a stable marker.

GEORGE L. GAUNT, JR.

Christian de Duve

George Gaunt is a glutton for work with an insatiable thirst for knowledge. I apologize for these gastronomic metaphors, but I see no other way of describing a young man who, when at the Uni-



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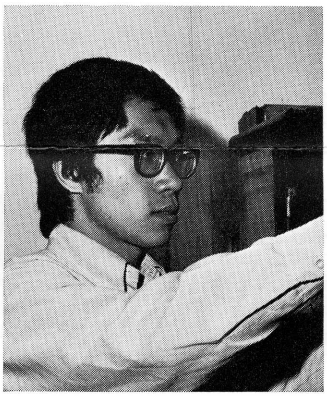
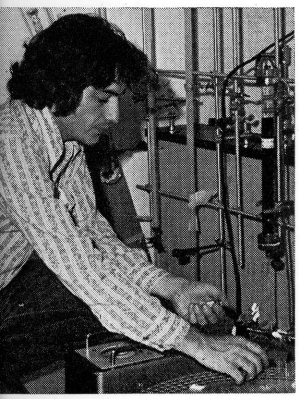
TARTAKOFF

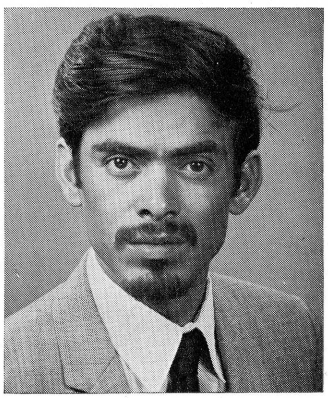
VAN MOERBEKE



WANG



WANGH



ZEPEDA

versity of Michigan where he was a straight-A student, majored both in chemistry and in zoology and then took a master's degree in zoology, is today receiving a Ph.D. degree from The Rockefeller University, and will next fall enter Yale Medical School with the objective of specializing in neuropathology after receiving his M.D. degree. The nervous system has been for many years George's main focus of interest, and he will undoubtedly bring to the study of nervous pathology a unique kind of multidisciplinary training. His thesis work has yielded the surprising finding that rat cerebellum contains a special type of particle, very rich in D-amino acid oxidase, but, unlike the peroxisomes of liver and kidney, containing little or no catalase.

STEVEN GREEN

(Degree granted *in absentia*)

The topic of Steven Green's thesis was Communication by a Graded Vocal System in Japanese Monkeys: A Field Study. His research adviser was Peter R. Marler.

NEIL HARTMAN

Norton D. Zinder

In most biological forms the genes are organized on the large linear chromosomes in a sequential linear array. While this reduces the number of components the cell must keep track of, such that each cellular generation should have a full complement of genetic material, it could have reduced the evolutionary potential of the reassortment of genes to be tried out in different combination. Some 50 years ago it was found that homologous chromosomes interchange parts and therefore their genes during the formation of gametes, thereby restoring the potential for gene reassortment. So important a process is genetic recombination that even the most primitive forms containing naked genetic material, DNA, undergo genetic recombination. It is to the study of the molecular mechanism of genetic recombination that Neil addressed himself. Using a small bacteriophage, Neil was able to find a potential means for looking at the physical structure of the recombination intermediates. Taking advantage of the fact that certain bacteria contain DNA structure-specific endonucleases, recombination studies were performed in bacteria with and without these enzymes. Thus if certain kinds of structures were to be found during recombination they would be destroyed by these endonucleases. Indeed it was found that for some crosses whole classes of recombinants disappeared when compared to these same crosses performed in hosts lacking these enzymes. From these results a picture of the recombination intermediates is beginning to emerge.

ALICE FENVESSY HEALY

William K. Estes

This commencement is a notable one for the mathematical psychology laboratory which is just ending its first five years on the campus and is now presenting its first degree candidate. Alice Fenvessy Healy received her A.B. from Vassar College in 1968, where her academic promise was recognized by a *summa cum laude* degree, membership in Phi Beta Kappa, and a New York State Regents Scholarship. In her doctoral research she has been attempting to understand the kind of memory that enables you to hold in mind the sequence of sounds someone has just spoken for the time needed for you to appreciate its meaning. She has shown that some aspects of this kind of memory can be accurately predicted by relatively simple mathematical models and has brought out important differences between the properties of memory for a temporal sequence of events such as sounds and the memory for a spatial arrangement of events such as letters on a printed page. On the side she has published five articles in scientific journals, two having to do with mathematical and statistical methods and three with various aspects of psycholinguistics, the latter reflecting the influence of Professor George A. Miller.

JAMES BRUCE HEALY

Nicola N. Khuri

A central problem of theoretical physics for the past generation has been the problem of performing a marriage between relativity and quantum mechanics, the two major advances in 20th century physics. One thing we have learned over the past 20 years is that these two sets of principles taken together are very restrictive. Indeed at times there have even been some doubts whether physical theories that are both relativistic and quantum mechanical can exist at all. Of the many manifestations of the power of the limitations that these two sets of principles force on a physical theory is the fact that one can prove that in a general relativistic and quantum-mechanical system the strength of the forces is not arbitrary. There is a limit on how strong the interaction can be. No interaction can exist whose strength exceeds that limit without violating either some of the principles of relativity or of quantum mechanics. James Bruce Healy has used considerable analytical skill and ingenuity to show that the earlier limits on the strength of the interaction can be significantly improved and made even more restrictive by making better use of a symmetry property of particle dynamics known as "crossing symmetry." This symmetry is a direct and general consequence of relativity and quantum mechanics.

FELIX T. HONG

David C. Mauzerall

Some people are not only born to do research, they are highly gifted for this endeavor. After obtaining an M.D. degree in Taiwan, Felix came here to study mathematics, physics, and chemistry. He then expended the same care and attention on experimental work that he had lavished on theoretical studies. Having such an ordered mind it is appropriate that Felix studied the nature of order in biological systems. In the theoretical work he has shown how a magnetic field can orient biological structures. The small diamagnetic anisotropy of molecules is summed by the long-range order in structures. The results of Felix's experimental studies of photoeffects in lipid bilayers are unique: the stability, the reproducibility, the submicrosecond time range, and the theoretical analysis are all new to this field. His measurements give direct information about reactions across the lipid-water interface, a sub-

microscopic layer which composes all biological surfaces. Felix's analysis also contains good news for experimentalists —more information about these important interfacial reactions can be obtained with a nonideal measuring device than with a perfect, theoretical one. The harvest from Felix's work is bountiful and far from exhausted.

ANN L. HUBBARD

Zanvil A. Cohn

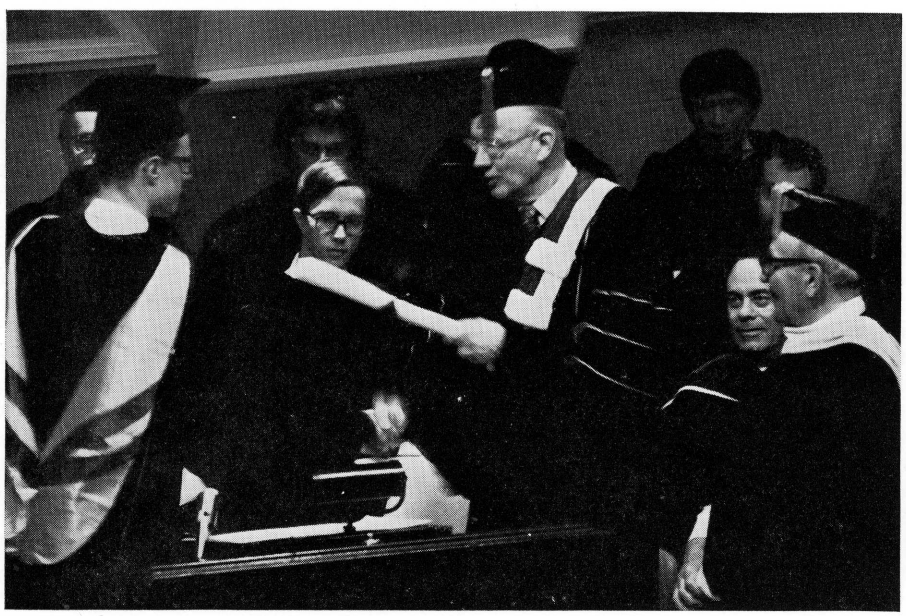
The cell envelope or plasma membrane is an organelle which governs metabolite transport, contains recognition sites for cell-cell interactions, and transmits signals for cytoplasmic and nuclear events. It is this critical but poorly defined structure which Ann Hubbard wished to investigate. Her first task was to develop a method which would specifically label the membrane and not intracellular structures. Utilizing an enzymatic method, she was able to tag covalently the externally disposed proteins of living cells without compromising cell viability. The method was first employed on the human red cell and, through skillful biochemical and electron microscopic studies, Ann demonstrated that only two major proteins were present on the cell surface. The application of the method to dividing mammalian cells yielded a much more complex pattern. In this case at least 15 proteins on the cell surface were labeled. When cells were cultivated in vitro all membrane proteins appeared to turn over at the same rate. The site for this rapid and coordinated turnover was found to be not on the cell surface but followed the interiorization of membrane by endocytosis—then, the majority of membrane polypeptides were degraded to small molecules. It is clear that many of the techniques developed by Ann's imaginative and dedicated efforts have broad applicability, not only to our understanding of the life history and assembly of membrane constituents but to the architecture of normal and malignant cell surfaces.

RONALD P. LARKIN

Carl Pfaffmann

It is now well established that the control of hunger and of eating behavior is vested in two reciprocal areas in the hypothalamus at the base of the brain. Destruction of the lateral so-called "hunger area" renders the animal aphagic, that is, it will not eat in the midst of food. Lesions of the medial area lead to exaggerated overeating to such a degree that the animal becomes obese and may in fact double or triple its body weight. Current interpretation is that the medial area is a satiety region that stops eating. The paradox is that, though ventromedial-lesioned animals eat more, they will not expend effort to get food.

Ron Larkin's thesis research has concerned the resolution of this paradox. His interest stemmed from one observation he made during a laboratory course project under Dr. Harry R. Kissileff that VM-lesioned animals would indeed bar press more vigorously for food from a vending device. Ron continued the project on his own under Dr. Ralph E. Norgren's and my sponsorship after Dr. Kissileff left our faculty. Two factors emerged as important in the paradox. One was the amount of pretraining in the test situation and the other was the nature of the electrode by which the neural tissue had been damaged. Pretraining before the operation and lesioning with platinum electrodes, as contrasted with the more commonly employed stainless steel, produce an animal which eats more and works harder than controls. Thus it is no longer correct to say that the hyperphagics, though obese, are less hungry and less motivated than normal animals. Ron Larkin's thesis calls for a reevaluation of currently accepted theories of the neural control of hunger.



URS RUTISHAUSER

Gerald M. Edelman

The cells of immunity known as lymphocytes patrol practically all of the precincts of the body. On the surface of each lymphocyte is a particular kind of antibody molecule able to bind to one or another of the foreign molecules that invade the body. In general, different lymphocytes carry different antibodies on their surface, and the population is therefore very heterogeneous and difficult to study. Urs Rutishauser began his work in our laboratory by first studying the purification and structure of antibody molecules, but, being a violinist, he had romantic or at least symphonic aspirations, and I believe that he always wanted to tackle the lymphocytes themselves. He knew that the key problem in dealing with these cells was to sort them out. One day I came to him with the proposal that the horsehair of a violin bow suitably treated and shaken with the lymphocytes might pick up cells of mainly one specificity. Soon we had graduated to harpsichord-like arrangements in tissue culture dishes of treated nylon fibers to which the cells were attached. Prompted by this extended and occasionally mixed metaphor of music, Urs found a way of removing the cells by plucking the fibers. In his subsequent graduate studies, Urs exhaustively applied this instrument to a quantitative analysis of the population dynamics of lymphocytes. He has been able specifically to purify various lymphoid cells, analyze their surfaces, and even to transfer the cells to animals to reconstitute an immune response of the proper specificity. This is highly original work and like new music, it will, I suspect, take some time to be fully appreciated. To achieve it has taken mastery in protein chemistry, cell biology, and immunology.

ROBERT H. SCHOR

Victor J. Wilson

Robert Schor arrived here from the California Institute of Technology exceedingly well trained and soon became a most valuable member of our laboratory. He was better than anyone at fixing our equipment when it broke down, and not only wrote fine computer programs for our experiments but occasionally fixed the University computer when it malfunctioned. In the midst of these activities he found time for other things. He acquired a good grasp of the fundamentals of neurophysiology and of the rapidly increasing literature in the field. He planned and executed a difficult series of experiments on the vestibular system. The latter, consisting of the labyrinth and its central connections, is responsible for our sense of orientation in space and plays a role in the regulation of posture. Having motorized an existing tilt table (which some of you may have heard performing when you walked along the A corridor of Smith Hall), Bob conducted experiments that have added significantly

to our knowledge of the dynamic properties of the vestibular system of the cat and that have raised interesting questions to be answered by further work.

SANDRA R. W. SIMON

Philip Siekevitz

Sandra Simon joins two other graduate students I have had whose role has been to introduce me either to a field somewhat new to me or to an experimental organism entirely new to me. In her case it has been the latter, *Rhodospirillum rubrum,* a beautiful purple-red photosynthetic bacteria which gains a new set of internal membranes, photosynthetic in nature, when grown anaerobically in the light. For that introduction, I am extremely grateful to her, and I am also congratulatory for her work in separating and characterizing, for the first time from the same cell, the two membrane systems of the cell—the photosynthetic one and the already-existing plasma membrane. Her work will form the basis, I am sure, of much future work in the fields of bacterial photosynthesis and of membrane formation and differentiation.

JOHN ALLEN SOGN

William A. Gibbons

John Sogn came to Rockefeller University from Brown University in 1968 strongly qualified in mathematics, physics, and chemistry with the expressed intention of studying biochemistry. John chose to pioneer a new method for investigating the 3-D structure and interactions of biological molecules in solution. The novelty in his use of nuclear magnetic resonance (NMR) spectroscopy is that he focused not, as is traditional, on the hydrogen atoms attached to the molecular framework of the molecule but rather on the framework itself viz. the carbon and nitrogen atoms. John's contributions to this area are notable and pioneering. He was the first to publish and draw attention to the use of carbon-13 magnetic resonance in peptide and protein chemistry. More recently he has completed the first total assignment of the carbon-13 spectrum of a gramicidin S, a peptide long popular as a model for proteins. This achievement required extensive research in biosynthesis, organic synthesis, and separation techniques as well as an excellent knowledge of molecular spectroscopy and instrumentation. John is therefore an excellent example of a modern interdisciplinary chemist.

This is the final issue of *news and notes* for the academic year. Publication will resume with the October issue. During the summer months, we look forward to receiving news items—by mail or phone.

ALAN M. TARTAKOFF

(Degree granted *in absentia*)

Alan M. Tartakoff's thesis was on Parallelism in the Processing of Pancreatic Proteins. His research advisor was George E. Palade.

PIERRE VAN MOERBEKE

Mark Kac

How to arrive at a decision in the presence of unpredictable chance fluctuations is a question which arises in such diverse situations as that of a man deciding whether to sell a stock or that of a physician having to choose a treatment from a number of alternatives. In spite of the seemingly hopeless all-embracingness of the problem it can, in many instances, be formulated in precise mathematical terms and, in some cases, can even be solved explicitly. In his doctoral dissertation Pierre van Moerbeke generalized, extended, and greatly deepened the results of many investigators, arriving at a unified approach to finding optimal strategies in a large and important class of decision-making situations. To achieve this he not only had to master the old tools but also had to sharpen them and to invent a number of new ones. His work has already achieved wide recognition, and he has been invited to lecture on it in what seems like an infinite number of places both in this country and abroad. Last but not least, having been named a year ago Professeur Associé at the University of Louvain, he is already an established member of the academe.

JOHN L. WANG

Bruce A. Cunningham

The interaction of foreign substances, or antigens, with lymphoid cells leads to a series of events constituting the immune response. Binding of antigens can stimulate the lymphocytes to divide and to produce antibodies that can protect against antigens. Curiously, a group of plant proteins termed "lectins" can bind to carbohydrates on lymphocytes and induce effects resembling those produced by specific antigens. John Wang became interested in lectins and their effects on lymphocytes in terms of the question: How does the binding of a molecule at the cell surface initiate the complex events that subsequently take place inside the cell? The answer is important not only to immunology, but has significant implications for our understanding of such processes as cellular differentiation and the development of tumors. John focused on the molecular aspects by analyzing the structure of a single lectin from the jack bean, concanavalin A, and examining its effects on lymphoid cells. He was the first to show that concanavalin A as usually isolated contains fragmented molecules and that the fragments can be separated from the intact protein. This was a critical step in the analysis of the detailed structure of the molecule—a huge task in which he was a major participant. He played a central role in determining the amino acid sequence of concanavalin A and helped interpret X-ray crystallographic data in terms of the sequence. These studies resulted in the elucidation of both the chemical and the three-dimensional structure of the molecule, and thus provided the first complete description of the structure of a lectin. John then prepared chemical derivatives of concanavalin A and compared their biological properties with those of the native protein. He showed that some of these derivatives were composed of only two subunits and had only two binding sites instead of the four found in the native protein. These studies have provided valuable information about the factors that influence the mobility of cell surface receptors and the stimulation of cell division.

LAWRENCE J. WANGH

Vincent G. Allfrey

Lawrence Wangh came to The Rockefeller University from Brandeis University in 1968. He was keenly interested in genetic problems and spent his first year with Dr. Theodosius Dobzhansky working on the selection of behavioral mutants in *Drosophila.* He then decided to learn more about the chemistry of chromosomes and the control of genetic expression. He started with techniques for the separation of histones, and he developed procedures which separated certain classes of purified histones into new subgroups, depending upon the degree to which they are acetylated. This advance permitted a demonstration that cells, such as sperm cells, that are genetically inactive as far as RNA synthesis is concerned, have all their histones in the nonacetylated form. However, when RNA synthesis resumes in the early embryo, the acetylated forms of the histones reappear. Larry then decided to investigate what happens to histones during the maturation of red blood cells. Using techniques which could separate the cells according to their age, he established that phosphorylation of the histones was restricted to times when chromosomes were being duplicated, while acetylation continued into the nondividing but RNA-synthesizing stages of differentiation. These important basic observations offer new insights into the control of chromosome structure during embryonic development and cell aging. Larry's contributions reflect his intensity, his clarity of purpose, a keen critical sense, and his enormous range of interests and abilities.

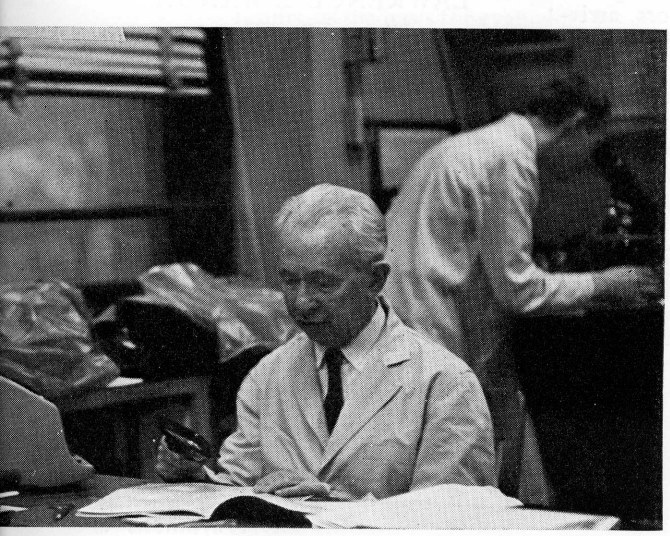
ARNULFO ZEPEDA

(degree granted *in absentia*)

Arnulfo Zepeda's thesis was titled A Class of Chiral Theorems. His research advisor was M. A. B. Bég.

MOSES KUNITZ
(*in absentia*)
Lyman C. Craig

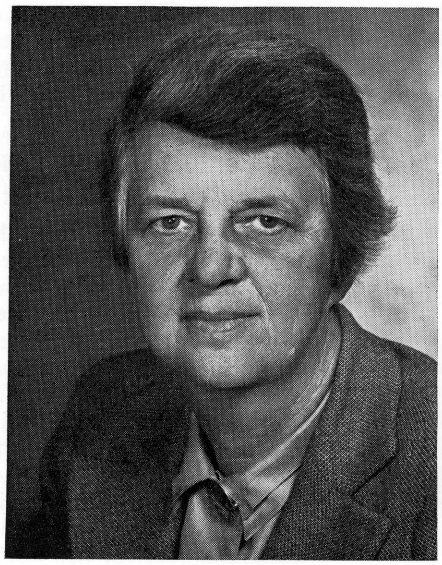
The career of Moses Kunitz provides an inspiring record of dedication, skill, and accomplishment. As an immigrant in this country, at the age of 25 he obtained his first job at The Rockefeller Institute in 1913 as a technician in the laboratory of Jacques Loeb. Through determination to further his education and with the encouragement of his employers, he went to night school and earned his B.S. degree from Cooper Union in 1916. Over the next eight years, cooperation between Moses Kunitz and Jacques Loeb was characterized by exceptional rapport and led to research through which the promising scholar fulfilled the requirements for the Ph.D. from Columbia University in 1924. His thesis was a physicochemical study of the properties of gelatin in salt solutions. To this subject Moses Kunitz brought a strong mathematical skill, which helped to focus the Donnan law of membrane equilibria on the problem, and a special aptitude for the design of apparatus, which led to simple but very effective equipment for the measurement of osmotic pressure and cataphoresis. This combination of practical and theoretical skills was extended in cooperative experiments with John H. Northrop and, following Jacques Loeb's death, the two young colleagues moved in 1926 to the new branch of The Rockefeller Institute in Princeton, New Jersey. They began a series of classic experiments on the purification and crystallization of enzymes that proved beyond doubt that enzymes were proteins. Through the art and science of Moses Kunitz, there became available a remarkable series of crystalline proteins which included chymotrypsinogen, chymotrypsin, trypsinogen, trypsin, ribonuclease, deoxyribonuclease, hexokinase, and pyrophosphatase. The subsequent structural studies on many of these proteins have had, as their starting point, the preparation according to Kunitz. Throughout the highly productive decades of his scientific career, Moses Kunitz has been a quiet, modest scholar, with a sense of humor, a deep enjoyment of his work, and a generosity that endeared him to all who had the privilege of consulting him.



MOSES KUNITZ

REBECCA C. LANCEFIELD
Maclyn McCarty

In the first third of this century, the class of microorganisms called streptococci were identified as the culprits in a variety of common ailments, including sore throat and scarlet fever, which could also lead to even more serious aftereffects in the form of rheumatic fever and acute nephritis. These are the organisms that are familiarly known today as "strep." The family of streptococci is extremely large and diverse and is made up of a bewildering number of species. Some are closely related to one another; others are related in little more than appearance under the microscope. Some are the primary agents of disease in man and animals; many others are harmless and without medical significance. Despite this diversity, our detailed knowledge of the pathogenic streptococci and their disease-producing capacity is extraordinarily complete. That our knowledge has reached this well-organized state is due in large part to the work of Rebecca C. Lancefield. A major portion of the concepts and methodology, as well as the detailed experimental analysis, which form the basis for our understanding of streptococci and streptococcal infections, has come from her laboratory. Dr. Lancefield made her initial acquaintance with streptococci while working at The Rockefeller Institute with O. T. Avery and A. R. Dochez during World War I. She was then a graduate student at Columbia University, having received her A.B. from Wellesley College in 1916. These studies on streptococci from serious epidemics in military camps set the pattern for her future work, which she resumed on her return to The Rockefeller Institute in 1922 following completion of her graduate studies. Relying principally on serological analysis, she sought to identify the major components of the common streptococci and to relate their occurrence to the biological properties of the organism. She demonstrated that streptococci isolated from various sources in nature can be divided into several distinct serological groups that correlate well with their natural habitat. From this it emerged that the important streptococcal infections of man are referable to a single group—now designated Group A. Dr. Lancefield showed also that the individual groups can be subdivided into many specific types on the basis of serological analysis of other components. The importance of this serological differentiation of streptococci is widely recognized, and the name Lancefield is associated throughout the world with the grouping and typing of these organisms. However, in her overall studies this formulation represents only the means to an end. The biological significance of the antigens that she defined by serological analysis was her primary interest. Thus, the antigens responsible for type-specificity of Group A streptococci were shown to be proteins that are essential for the virulence of the organism. Her findings on the properties of those protein antigens changed our concepts of streptococcal infections and led to an understanding of the epidemiology of streptococcal disease and rheumatic fever. It is clear that in a career devoted to the study of a single category of pathogenic microorganisms—and carried out at a single institution—Dr. Lancefield has systematized our knowledge of the organisms at the same time that she has illuminated their biology and the mechanisms by which they produce disease. The scope of these achievements is difficult for the nonbacteriologist to grasp, but it is worthy of note that in this field of science she is looked upon as an almost legendary authority.



REBECCA C. LANCEFIELD

STUDENT REPRESENTATIVES

The Student Representative Committee election was held on May 23. Those elected to serve for the coming year are: Lily Anne Conrad, Elizabeth Dickson, Jeffrey Geronimo, Ivan Lieberburg, Abraham Zvi Snyder, Rocky Sung-chi Tuan, and Robert Ziff.

news and notes is published monthly from October to July. This is Volume 4, Number 10. Contributions are welcome and may be sent to *news and notes*, Box 194 or phone ext. 1166. All photographs in this issue by Graphic Services except page 6 by Ingbet.

The Class of 1973: A Look into The Future

Where to now for the members of the class of 1973, among whose ranks are representatives from California, Florida, Illinois, Massachusetts, Missouri, New Jersey, New York, North Carolina, and Pennsylvania, and from Belgium, France, Mexico, New Zealand, Switzerland, and Taiwan?

Efrain C. Azmitia, Jr. has been awarded a postdoctoral fellowship by the Foundations' Fund for Research in Psychiatry. He will study in the Neuropharmacology Department of the National Institute of Mental Health in Washington, D.C.

Samuel D. Balk, an M.D. from New York University before coming to Rockefeller, is serving as visiting scientist at the National Research Council of Canada in Ottawa.

François Bouvier has been appointed assistant professor in the Centre de Biochimie et Génétique Cellulaires at the Université Paul Sabatier in Toulouse, France. Dr. Bouvier took back with him to his native land the artistic talent that helped make his laboratory walls among the most decorative at the University.

David E. Briles has a postdoctoral research post in the Department of Pathology at the Washington University School of Medicine in St. Louis, Missouri.

Douglas R. Busch will continue his research at Rockefeller while formulating plans which, he expects, will ultimately take him back to New Zealand, his home country.

Chang Chen will do postdoctoral work at the Sloan-Kettering Institute for Cancer Research. He is also distinguished, among friends and colleagues, as a master of Szechuan cuisine.

Jules L. Coleman becomes a visiting assistant professor at the University of California in Santa Barbara and will also be serving as consultant to the Public Studies Corporation.

Barry R. Dworkin is one of the seven graduates who are remaining at the University. He has been appointed assistant professor in the physiological psychology laboratory of Professor Neal E. Miller. Dr. Dworkin is the unofficial campus photographer, as evidenced by a recent exhibition of his work in Caspary Gallery.

Bernard Fulpius, an M.D. from the University of Geneva Medical School, returns to his alma mater as an assistant professor in the Department of Pathology. Dr. Fulpius broke a long family tradition of medical practice by turning to research. He came to the University at the urging of a Swiss colleague who was a Rockefeller alumnus.

Richard E. Galardy will be doing postdoctoral research at the Yale University School of Medicine. He is one of four of this year's degree recipients bound for Yale.

George L. Gaunt, Jr. is also among those going to Yale. He will be working toward an M.D.

Steven Green has been appointed an assistant professor at the University. He is now in India studying vocal communication in monkeys.

Neil Hartman will be preparing for an M.D. at the Cornell University Medical College.

Alice F. Healy has been appointed assistant professor in the Department of Psychology at Yale.

James B. Healy will be a visiting member at the Institute for Advanced Study at Princeton.

Felix T. Hong will continue at Rockefeller as an assistant professor with Professor David C. Mauzerall. After earning his degree from the National Taiwan University College of Medicine, he found research his true métier and came to Rockefeller on the advice of his sponsor at medical school.

Ann L. Hubbard has been awarded a postdoctoral fellowship by the Leukemia Society and will work with Dr. George E. Palade at Yale.

Ronald P. Larkin has been appointed a research associate at the University where he is pursuing bird migration studies with Professor Donald R. Griffin.

Urs Rutishauser has a postdoctoral fellowship at the Weizmann Institute in Rehovot, Israel.

Robert H. Schor will do postdoctoral work in the Department of Physiology and the Department of Theoretical Biology of the University of Chicago.

Sandra Simon has an appointment as a research associate in the Biology Department of Brookhaven National Laboratory in Upton, New York.

John A. Sogn will continue at Rockefeller as a postdoctoral fellow in organic chemistry.

Alan M. Tartakoff has an appointment as a research associate in pathology at the University of Geneva Medical School.

Pierre L. J. van Moerbeke is associate professor of mathematics at the University of Louvain in Belgium. Early next year he will be at the Institute for Advanced Study in Princeton for several months.

John L. Wang has a Damon Runyon postdoctoral fellowship and will remain at Rockefeller in the laboratory of Professor Gerald M. Edelman.

Lawrence J. Wangh is headed for postdoctoral research at the M.R.C. Laboratory of Molecular Biology in Cambridge, England.

Arnulfo Zepeda has returned to his native Mexico City with an appointment as full professor at the Centro de Investigacion del IPN, where he is continuing his research in high energy physics.

PERSONAL MENTION

Graduate Fellow **Darcy B. Kelley** was married on June 16 to Richard S. Bockman. Dr. Bockman, a 1971 Rockefeller graduate, has been serving as an associate at the Sloan-Kettering Institute for Cancer Research, a fellow in endocrinology at Memorial Hospital, and an assistant professor of biochemistry in the Graduate School of Medical Sciences, Cornell University. This month he begins a residency in medicine at New York University.

Edward Pelle, an assistant for research in the laboratory of Dr. Rollin D. Hotchkiss, was married June 23 to Evangeline Solero, an education student at Fordham University.

Where Are They Now?

Twenty years ago, the plans were announced which resulted, in 1955, in the arrival of the first small band of graduate fellows on the Rockefeller campus. Each year since then, others have come—from across the country and the world—to join their ranks, earn their degrees, and go on to pursue their chosen careers. Where are they now and what are they doing? The immediate destinations of this year's 27 degree recipients are described on this page. What of the 213 young men and women who preceded them?

The directory of graduates and later reports reveal that Rockefeller alumni can be found in 28 states and the District of Columbia, in Australia, Canada, Denmark, England, France, Italy, Mexico, Sweden, and Switzerland. The largest single group, 59 in number, are in New York, 25 of them full-time on this campus. Twenty-three alumni are full professors, including 5 department chairmen, 42 are associate professors, and 73 are assistant professors. Another 39 of the more recent graduates are research associates and fellows. One alumnus is in private medical practice and a number have gone on to medical school. Six are associated with major industrial research organizations and 1 directs a family research laboratory. Several hold research positions with governmental laboratories and others with public health agencies or foundations. One is a legislative advisor in Washington and another heads a unit of the World Health Organization in Geneva. Twenty-six alumni are married to each other. Another just married a graduate fellow still on campus.

Kappas Awarded $25,000 to Fund New Program

Professor Attallah Kappas, senior physician and director of the University's Clinical Research Center, has received a $25,000 special award in clinical pharmacology from The Burroughs Wellcome Fund, a private, nonprofit foundation. The award money will be applied toward the development of a new clinical pharmacology program being established jointly by Rockefeller University and the Cornell University Medical College where Dr. Kappas holds appointments as professor of medicine and of pharmacology. The new program will coordinate teaching, clinical, and research activities in this field on all levels of medical and postgraduate medical training at the two institutions.

Dr. Kappas, who first came to the University in 1966 as a guest investigator, heads a laboratory group whose principal studies are concerned with drug and hormonal control of heme (blood pigment) and heme-protein synthesis. Clinical work has focused on heme-related diseases such as porphyria, lead poisoning, and certain anemias of man. Recent work at Rockefeller with Professors Sam Granick and Shigeru Sassa contributed to the development of new, extremely sensitive and precise blood tests for the diagnosis of genetic and acquired defects of the heme pathway in man such as those associated with lead intoxication, iron-deficiency anemia, and the hereditary porphyrias.

IN PRINT

The May 25 issue of *Science* contains an article, "Antibody Structure and Molecular Immunology," which is the text of the lecture delivered by Professor **Gerald M. Edelman** in Stockholm, Sweden last December when he received the 1972 Nobel Prize in physiology or medicine (which he shared with Rodney R. Porter). In the piece, Dr. Edelman discusses some of the implications of the structural analysis of antibodies. He also considers the related but less well-explored subject of antibodies on the surfaces of lymphoid cells and describes some recent experiments in his laboratory.

In an article, "The Nurse in a Methadone Maintenance Program," in the May issue of the *American Journal of Nursing,* Karin Nelson, clinic administrator of the Adolescent Development Program, a joint methadone maintenance project of Rockefeller University and The New York Hospital–Cornell Medical Center, describes the special kind of therapy a nurse can offer a drug addict.

Psychological Bulletin for May carries a paper, "Criterion Shifts in Recall," by **Alice F. Healy,** a degree recipient this June, and Graduate Fellow **Cindy Jones.** Another paper by Dr. Healy, "Can Chimpanzees Learn a Phonemic Language?," appeared in the April issue of the *Journal of Psycholinguistic Research.*

Visceral Learning: Toward the Science of Self-Control by Gerald Jonas, published by The Viking Press on July 2, describes the work of Professor **Neal E. Miller,** Physiological Psychology. The book appeared originally as a two-part series in *The New Yorker* (August 19 and 26, 1972). It is a selection of the Psychology Today Book Club.

CORRECTION

The "In Print" column for June carried notice of a volume recently edited by David P. C. Lloyd, a Rockefeller emeritus, whom we described as now living in his "native" England. Although Dr. Lloyd is indeed an Oxford graduate and is an honorary research fellow of University College, London, he was born in Alabama, as a sharp-eyed reader was quick to inform us.

Co-workers bid farewell to Reolena Edwards (right) at a party in her honor on June 26. Mrs. Edwards retired from the Hospital housekeeping staff after 25 years with the University. To her left, Ann Winn.

BRIEFS

Professor **René J. Dubos,** Environmental Biomedicine, was awarded an honorary doctor of science degree from Fairfield University in Connecticut on June 3. Dr. Dubos was commencement speaker at the Cornell University Medical College on May 30. On June 18, the American Institute of Biological Sciences presented its Distinguished Service Award to Dr. Dubos at a meeting held at the University of Massachusetts at Amherst.

Seven years ago, at the age of 48, **Carl Alper,** supervisor of shipping and receiving in the University's Purchase and Supply Service, went back to school at night. In June 1972, he earned his B.A. in Romance Languages from Lehman College. Last month, Mr. Alper was informed that his excellent scholarship has earned him election to Phi Beta Kappa, the national honorary society.

Professor **Donald Davidson,** Philosophy, will be a visiting fellow at All Souls College, Oxford University, England, from September 1973 to June 1974.

Lawrence A. Caliguiri, who has been serving as associate professor of virology, was named professor and chairman of the Department of Microbiology at Albany Medical College on July 1.

Professor **Gerald M. Edelman,** Biochemistry, received an honorary doctor of science degree from the University of Pennsylvania on May 21. (Dr. Edelman earned his M.D. degree from the University of Pennsylvania in 1954.)

Professor **Alexander Tomasz,** Biochemistry and Genetics, was cochairman of an international conference on the Mode of Action of Antibiotics on Microbial Walls and Membranes, sponsored by the New York Academy of Sciences Section of Microbiology, June 6–8 in New York City. Those attending the conference were guests of the University at a reception on June 6.

Professor **Philip Siekevitz,** Cell Biology, received the 1973 Alumni Award from the Philadelphia College of Pharmacy and Science.