Summer 1961

The Rockefeller Institute Quarterly 1961, vol. 5, no. 2

The Rockefeller University

THE ROCKEFELLER INSTITUTE *Quarterly*

SUMMER · 1961

The cover drawing shows the entry to the President's House as it is seen from the stone-paved driveway edged with ivy. Adapted from a photograph taken by Wayne Keith Lovett.

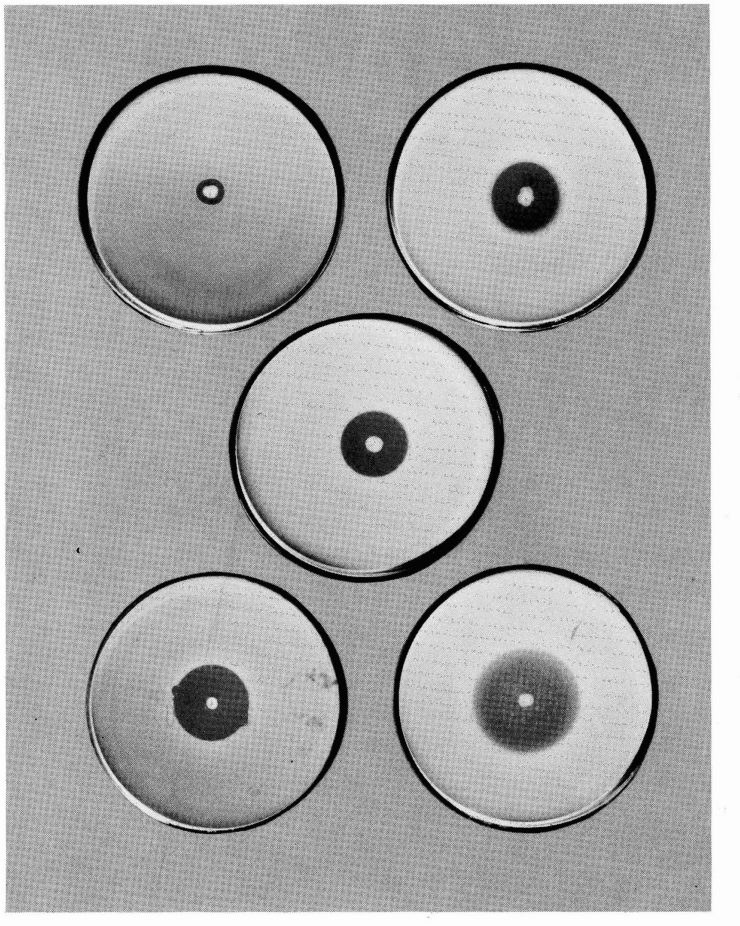
THE ROCKEFELLER INSTITUTE QUARTERLY

VOLUME 5 NUMBER 2 APRIL MAY AND JUNE 1961

THE ROCKEFELLER INSTITUTE PRESS 66th Street and York Avenue, New York 21

COLICINES: POTENT BACTERIOCIDES PRODUCED BY BACILLI

BY PROFESSOR WALTHER F. GOEBEL



Cultures of five strains of colicine-producing bacteria were killed and overlayered with colicine-sensitive bacteria. Dark circles show how differently growth was inhibited by the various colicines. At lower right is the original V strain and at lower left the K strain.

THE HUMAN INTESTINAL TRACT harbors myriads of bacteria which appear to live in harmony with the host they have invaded. Only on rare occasions do virulent microorganisms gain a foothold, and when this occurs they bring about distressing and dangerous disease processes such as typhoid fever or bacillary dysentery. Viruses, too, are found in the intestine, but most of these are benign in so far as the human host is concerned, yet virulent for certain of the microorganisms he carries. The study of these viruses, which are known as bacteriophages, has been an exciting field of investigation which has been extensively pursued during the past decade in many laboratories throughout the world.

Dominant among the intestinal flora are the colon bacilli, a great family of microorganisms which number well over a hundred different specific types. Some of these elaborate potent antibacterial agents of little-known nature which in some respects resemble the bacteriophages. These substances have been termed colicines, and their nature and our efforts to understand them are the subject of this article.

Colicines were discovered by Gratia in 1925. At that time he was working with a strain of *Escherichia coli* isolated from a rabbit which had died of infection. Because of its remarkable virulence he named the strain "V." He made the observation that cell-free filtrates of a culture of these microorganisms inhibited the growth of still another strain of *E. coli* which he named ϕ. He first thought this filterable agent to be a bacterial virus, or bacteriophage, but he soon found that this was not the case. Gratia was struck by the fact that his "V principle" exhibited a remarkable specificity, for when he tested it against a variety of different bacteria only occasional microorganisms proved to be susceptible.

Colicines are selective killers which attack only certain strains of intestinal or enteric bacteria. In this respect they resemble the bacteriophages, yet they are not phages, nor are they like the antibiotics elaborated by molds, for their spectra of activity are far more limited.

From the time of their discovery in 1925 until the mid-forties, colicines remained a curiosity. No one seemed particularly concerned about them until Dr. Pierre Frédéricq, a student of Gratia's and a distinguished microbiologist at the University of Liège, began an extensive study of the bacteria which produce these unique microbial agents. Frédéricq began his studies by investigating the flora of the human intestine, and it soon became apparent that colicine-producing bacilli were to be found there in far more abundance than was commonly supposed. Furthermore, he succeeded in showing that many varieties of colicines exist, each with distinct properties. In fact, to date some seventeen different colicine types are known; these have been designated with letters, such as colicine A and colicine B.

In attempting to understand the nature and distribution of these agents it is important to realize that many strains of colon bacilli, which differ remarkably in various ways, can nevertheless elaborate identical colicines. Not only this, but many strains elaborate more than one type of colicine.

In the accompanying illustrations are to be seen photographs of five Petri dishes containing nutrient agar; each has been stabbed in the center with a different strain of colicine-producing colon bacillus. After the colonies had grown for some 48 hours, they were killed with chloroform vapor and the dishes then overlayered with approximately 50 million cells of the colicine-sensitive strain *E. coli B*. The latter is a strain of colon bacillus which has been used for many years by bacteriophage workers. It has a very broad pattern of susceptibility both to the bacteriophages and to the various colicine types. The photographs reveal that around each central colony is a broad zone of inhibition where the sensitive strain of *E. coli B* has failed to grow, because of colicine which has diffused through the agar gel. In this respect, these zones bear a similarity to the much smaller zones of lysis, or plaques, produced by bacteriophage particles. This elegant technique was devised by Frédéricq, and it

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serves admirably for detecting colicinogenic bacteria. It will be noted that although the various zones of inhibition show certain similarities, they also exhibit characteristic differences in size and in shape.

The ability to elaborate these potent and highly specific substances is not confined to colon bacilli; other enterobacilli (intestinal bacteria) such as dysentery and typhoid bacilli, also produce colicines, and bacteria quite unrelated to intestinal organisms are known which also elaborate specific bacterial inhibitors. Since inhibitory agents may arise from unrelated bacteria the name "bacteriocines" has been used by some investigators to embrace all colicines and colicine-like substances.

RECEPTOR SITES

How does a colicine carry out its lethal mission when it encounters a susceptible bacterial cell? The first step is, of course, specific combination between the colicine and what appear to be certain specific receptor sites located on the bacterial cell surface. When this occurs, death of the microorganism follows promptly. The cells die, but just what enzymatic pathways are involved in this death struggle is not known. We know only that the microorganisms promptly stop synthesizing their complement of intracellular nucleic acids, though for a short time they continue to respire.

The ability of a microorganism to synthesize a given colicine is an exceedingly stable hereditary characteristic. Several investigators have shown that the genetic factors which govern colicine synthesis can be readily transferred to noncolicinogenic microorganisms either of the same family or to other related families of enteric bacilli, such as *Salmonella typhimurium, Salmonella paratyphoid B,* or *Shigella sonnei.* When this factor has been transferred, the new strain retains all of the characteristics of the parent and differs from it only in so far as its newly acquired colicinogenic property is concerned and in the fact that it has become resistant to the colicine it synthesizes.

Certain microorganisms, such as *E. coli B,* are susceptible to a number of different colicines. By growing such a strain in the presence of a particular colicine type (e.g., colicine E), it is possible to obtain resistant mutants which have apparently lost their specific receptor sites for the colicine in question, and which are therefore unaffected by the antibacterial agent. Such mutant strains are still susceptible to other colicines. However, by repeating the same procedure still other variants can be obtained which have resistant patterns coinciding with the colicines to which they have been subjected. Thus, a microorganism which was originally *susceptible* to a number of different colicines can be rendered *resistant* to them all.

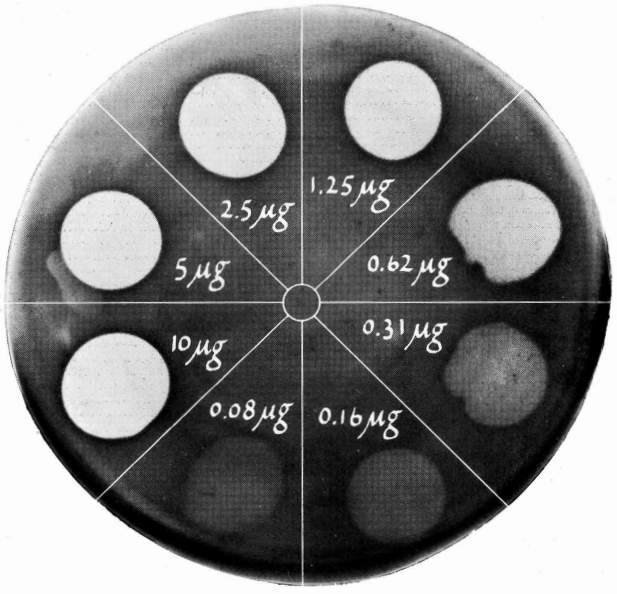
The concept of specific receptor sites on the cell surface of the susceptible microorganism is by no means a figment of the imagination. Indeed, "receptor sites" might better be termed "receptor substances," for it has been demonstrated that extracts of colicine-susceptible bacteria contain substances which inactivate *in vitro* the colicine to which the cell is susceptible.

One of the important and fascinating properties of the colicines is their resemblance to the bacteriophages. It is this enigmatic relationship perhaps more than anything else which has stimulated the curiosity of investigators to unravel the genetic, serologic and biochemical nature of colicine-producing microorganisms and the colicines themselves. In fact it was at a conference on bacteriophages that I first heard of colicines. This meeting, held during the early part of the summer of 1952 under the auspices of UNESCO, took place at the lovely and ancient Abbaye Royaumont situated a few miles outside of Paris. Here we lived in a wonderful twelfth-century abbey, though perhaps somewhat more austerely than did our predecessors the monks. For some eight hours each day we participated in lively discussions dealing with nearly every aspect of the bacteriophages. One of these days was devoted to a discussion of the colicines and their relationship to the bacterial viruses. Two papers were presented that day, one by Frédéricq, in which he reviewed his work dealing with the occurrence and characterization of colicinogenic microorganisms and their striking relationship to phage-carrying, or lysogenic bacteria. The other paper, also dealing with this relationship, was presented by François Jacob of the Pasteur Institute.

L'Abbaye Royaumont, cloistered scene of a conference on bacteriophage where, as often occurs, the research of a laboratory was decisively redirected by stimulating discussions.

COLICINES AND PHAGES

At the time there seemed to me to be certain voids in these two brilliant presentations. The analogies which were drawn between phages and colicines, striking and persuasive though they were, did not appear to justify the implication that these antibacterial substances were precursors of the bacterial viruses. Even the suggestion that colicines were proteins, as they



Toxicity of a colicine is tested by putting drops of varying concentration on culture medium and observing inhibition of bacterial growth. Clear circles show inhibition at 1.25 micrograms of colicine and some effect with only one-tenth that amount.

were alleged to be, appeared questionable. Moreover I was impressed with the fact that no one had yet isolated or characterized a colicine nor had anyone demonstrated any direct relationship by serological techniques between phages and colicines.

Just what are these relationships between colicine and phage, or between colicine-like and lysogenic bacteria? What evidence is there that colicines are proteins, and is there any direct experimental evidence to support the contention that colicines are related to the protein component of the sperm-like tail of the bacteriophage particle, as some investigators have suggested?

PROTEINS OR NOT PROTEINS

First, let it be said there can be no question but that the colicines are exceedingly susceptible to protein-splitting enzymes. At first sight this would seem evidence enough that the colicines are proteins. However, the fact that they lose their biological activity when brought into contact with these ferments does not necessarily warrant the deduction that colicines are actually proteins. Many complex biologically active substances occur in nature which are predominantly carbohydrate, but which contain amino acid residues as an integral part of their molecules. The molecular integrity of these substances is essential for a complete expression of their biological activities, yet this activity may be destroyed or radically impaired if the amino acid residue is split by appropriate enzymes. In view of this it is quite conceivable that the colicine might fall into a similar category of substances and that their biological activities might be lost if but a small segment of the molecule be split by the proteolytic enzyme in question.

One of the striking similarities between bacteria which bear temperate phages (so-called lysogenic bacteria) and those which elaborate the colicines is the fact that both can be induced to liberate their lethal agents by subjecting them to irradiation with ultraviolet light or to certain chemicals such as hydrogen peroxide or the nitrogen mustards. Finally, and perhaps most significant, is the fact that some phages and colicines attack certain susceptible bacteria through the same receptor site. For example, a phage and a colicine are known both of which attack one of the dysentery bacilli. If a mutant strain of this bacillus is produced which resists attack by one of these agents, it is invariably found to be resistant to the other. It is thus apparent that the virus and the colicine share the same specific receptor site on the cell surface of the susceptible microorganism, and because of this the deduction seems logical enough that the colicine and virus ought to be related. All of this, which I first heard in 1952, was very impressive but many questions made me hesitate to give credence to this fine fabric of circumstantial evidence. The colicines loomed as a fascinating problem indeed, and before our meeting at Royaumont had ended, Dr. Frédéricq had generously offered to send me his colicinogenic strains for chemical study. In the autumn of 1952 I returned to my laboratory and embarked upon the problem.

For our studies we chose colicine K chiefly because of its relationship to the colidysentery phage T6, a virus with which we had had some considerable experience. First, a variety of media, both natural and synthetic, were tested, but none favored the production of the colicine. Eventually it was found that aqueous extracts of beef heart muscle as well as autolyzed yeast contained a growth accessory factor which greatly stimulated the elaboration of the colicine. Next, a mutant of the colicine K producing microorganism originally sent us by Dr. Frédéricq was isolated which by good fortune was found to produce nearly ten times as much colicine K as did the original strain.

THE BACTERIOSTAT

Still further experimentation revealed that the amount of colicine K in the medium reached a maximum at that point where the bacterial population too had reached its peak, and when the acidity (pH) of the medium was carefully maintained at an optimum value. These very important observations led to the development of an electronic device for controlling the pH of the culture medium. This ingenious equipment, which was developed for us at this institution by Dr. Theodore Shedlovsky, enabled us to grow colicine-producing microorganisms at any preselected acidity and to study the influence which the pH of the medium had upon colicine production. In addition, it permitted us to obtain a very high bacterial population by growing the microorganisms in relatively high concentrations of glucose. Eventually we were able to obtain cell populations ten times as concentrated as those obtained when the bacteria were grown in the conventional manner. In addition, the amount of colicine liberated into the culture medium was two hundred times that obtained in our initial experiments. Because of the relatively high concentration of colicine in the medium it was no great problem to subject it to chemical fractionation.

Two distinct and different substances were obtained. One proved to be a most unusual polysaccharide, a polymer of n-acetyl

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neuraminic acid, which we named "colominic acid." The other had powerful antibacterial properties and was named "purified colicine K."

PURIFIED COLICINE K

Purified colicine K was soon identified as belonging to a class of substances which is present in the cell wall of all gram negative enteric bacteria — a high molecular weight complex molecule constituted from protein, carbohydrate, and phospholipid. These substances, which are known to microbiologists as O antigens, endow enteric bacilli with their specific immunological characteristics and with their toxic properties as well. These lipocarbohydrate-protein complexes are powerful toxins both in man and in many other mammalian species.

In the case of our material from the colicinogenic bacillus, we had in hand a complex which was not only a potent neurotoxin for man, but a powerful antibacterial agent as well—a double-headed bludgeon, a killer of man and a killer of bacteria. So lethal was this substance that 0.02 milliliters of a solution containing one part per million, sufficed to kill a million cells of *E. coli B*. This was exciting indeed, for we had unearthed a new fact, namely that bacterial endotoxins may be endowed with a biological property hitherto unsuspected —they could function as killers of other enteric bacteria.

The next problem with which we were concerned was that of the purity of our colicine. Was it a homogenous substance, or was its antibacterial activity due to an accompanying impurity, the true colicine? The solution to this difficult question was achieved by my brilliant associate Tsunehisa Amano, Professor of Bacteriology at the Medical School of Osaka University, who had joined our laboratory as a guest investigator. Prior to his coming we had found that purified colicine K stimulated antibody production in experimental animals when injected in minute subtoxic quantities, thus behaving like an O antigen. The sera of these animals contained two different antibodies, one which precipitated the colicine, the other which neutralized its antibacterial activity. Yet these facts did not obviate the possibility that the colicine K itself might be a second substance which accompanied the true O antigen rather than being an integral part of the antigen molecule. If the colicine were indeed a separated entity, Amano reasoned that he should be able to obtain a genetic variant of the colicinogenic bacillus which would elaborate an O antigen devoid of colicine K activity.

For many months he sought the bacterium he wished. Finally, he obtained it from irradiated cultures of *E. coli* K235. Before his return to Japan he was able to show clearly and convincingly that the noncolicinogenic bacillus elicited in rabbits only the antibodies which precipitated colicine K. These antisera were entirely devoid of colicine-neutralizing antibodies. Although colicine K was readily precipitated by the sera, its antibacterial activity remained unaffected. Suspensions of the immune precipitates so obtained still killed the test organism *E. coli B*.

Here indeed was proof that colicine K and the O antigen of the colicinogenic bacillus was not a mixture, but a single macromolecule endowed with antigenicity, specificity and toxicity, both for mammals and bacteria. During this past year still further proof of a direct chemical nature has been obtained which substantiated Dr. Amano's elegant immunological experiments.

In sum our experimental evidence all points to the conclusion that colicine K and the O antigen of *E. coli* K235 are one and the same and that the serological specificity and the bacterial activity are properties of different components of the same macromolecule.

THE COLICINE K MOLECULE

The colicine K molecule, or if you will, the O antigen of *E. coli* K235, is constituted of some 15% of protein, 30% of lipid and the remainder carbohydrate. These three components are held together in firm chemical union. Yet the molecule can be severed to yield a protein or protein-like constituent and a lipocarbohydrate which can be readily separated. The latter bears the serological specificity of the complete antigen and is highly toxic for mammals, but it is quite devoid of any activity against bacteria. The protein component, on the other hand, retains all of the antibacterial properties of the parent substance and, as one would expect, is some ten times as active as is the intact substance. This protein-like component is constituted from at least twenty different amino acids and has certain unique properties. Of this protein-like substance, a thousandth of a microgram suffices to kill a million cells of *E. coli B*. Though we do not yet have adequate proof, it is our belief that the specific antibacterial activity of colicine K is determined by a particular sequence of amino acids which form part of the protein component of the colicine molecule.

During the past two years John Hutton, a graduate fellow of The Rockefeller Institute working in our laboratory, has undertaken a study of a second colicine, colicine V. This, it will be recalled, is the original colicine described by Gratia and is identical with his "V principle." Hutton obtained colicine V in a high state of purity. It too has proved to be a protein-lipocarbohydrate complex, identical with the O antigen of the colicine V producing bacillus *E. coli* K357 from which it was derived. The gross chemical and toxic properties of colicine V are essentially indistinguishable from those of colicine K. It differs from the latter, however, in its spectrum of toxicity for other enteric microorganisms, and in the fact that it bears no serological relationship whatsoever to colicine K.

THE FUTURE

At present this is about all we can say concerning the nature of colicines. Our observations, for the most part, have confirmed those of others who have made sallies into the elucidation of the nature of the colicines. Whether other colicines will prove to be similar to colicines K and V is unpredictable.

It is our opinion that a detailed study of the protein components of the O antigens of *E. coli* K235 and of its noncolicinogenic variant should reveal differences in their amino acid make-up which can be directly correlated with the unique antibacterial activity of the colicine K molecule itself. At present our laboratory is very actively engaged in the elucidation of this interesting problem.

I presume the reader will not be happy unless a guess is ventured as to whether colicines could ever serve as therapeutic agents. This I cannot do. Let this be a surprise for some future reader.

Portrait Gallery

SAMUEL ~~JOSEPH~~ *ames* MELTZER

THE GALLERY OF portraits in the Dining Room of Welch Hall is devoted to that noble employment referred to by Pliny the Younger when he urged us "to rescue from oblivion those who deserve to be remembered." Among the distinguished men honored there is Samuel ~~Joseph~~ *ames* Meltzer, Member of the Institute from 1907 until his death in 1920.

A scholar by nature, Meltzer forsook his father's intention to limit him to rabbinical studies. Instead he studied philosophy at the University of Berlin under Steinthal and earned the degree of Doctor of Medicine under Kronecker. Before he left Germany, Meltzer's investigations of the act of swallowing led him, in 1883, to anticipate by ten years Sherrington's conclusions regarding the role of reciprocal inhibition in the central nervous system.

Meltzer came to New York almost penniless in 1884. Soon he had a flourishing practice, which, however, did not prevent his carrying on intensive investigations from which began to flow a stream of significant scientific publications. In 1899 he began to explore the inhibitory and anesthetic effects of magnesium salts, which not only led to important physiological conclusions, but had practical clinical applications as well. Studies of anesthetization led him to artificial respiration, and he and his son-in-law, John Auer, developed a method of tracheal insufflation which was of practical importance to thoracic surgery.

Throughout his life Dr. Meltzer maintained a devoted interest in numerous professional societies. He was the founder and first president of the Society for Experimental Biology to which he gave so much that it was known informally for years as the "Meltzer Verein." His deep and active interest in young workers led him to organize the American Society for Clinical Investigation, which came to be called "The Young Turks." One of Meltzer's attempts at organizing a society, aimed at elevating international morality, was too far removed from political reality to succeed and was soon forgotten. Launched in 1915 with the support of 150 leading medical scientists of the country, the "Fraternitas Medicorum" secured some 16,000 members in this country alone who wished to protect international cooperation in science against the unreasoning emotion of war. With the entry of this country into the war, however, Meltzer, fearing accusations of lack of patriotism, publicly suspended the organization. He was first president of the American Association for Thoracic Surgery, and also served as president of the Association of American Physicians, the American Gastroenterological Society, the Federation of American Biological Societies, and the American Physiological Society. He was an active member of the American Society of Biological Chemists, the Society of Pharmacology and Experimental Therapeutics, the Society for Experimental Pathology, the American Philosophical Society, the National Academy of Sciences, as well as many others.

Dr. Meltzer's wife, Clara, was one of the first Scholars of The Rockefeller Institute (1902) and in 1904 he became an Associate of the Institute. When the new laboratories were opened in 1907 he was invited to become head of the Department of Physiology and Pharmacology and Member of the Institute. The opportunity to devote himself wholly to research was the realization of a cherished dream, and even though it involved a considerable financial sacrifice, Dr. Meltzer accepted without hesitation. He remained actively at work thereafter until the hour of his death, in spite of great suffering from diabetes.

On the question of retirement he is quoted as saying: "There are only two things which would stop me from working. If anyone said to me, 'Meltzer, your work is no longer good,' then I would stop, or if anyone said to me, 'Meltzer, you can no longer understand a young man,' then I would stop also." No one ever said either. Illness necessitated his partial retirement in 1919, however, and shortly before that, in recognition of his distinctions and service, Mr. John D. Rockefeller, Jr., commissioned Mr. Adolphe Borie to paint the portrait of Dr. Meltzer that now hangs in Welch Hall.

INSTITUTE HOLDS CONVOCATION FOR CONFERRING DEGREES

AT ITS THIRD academic convocation, held on June 16, 1961, The Rockefeller Institute conferred the degree of doctor of philosophy on ten of its students, among whom were the first women to be graduated from the Institute.

Each one of ten members of the faculty described a candidate's intellectual progression and the way in which studies in many fields of science ultimately led him or her to seek new knowledge and understanding through research. Each told how the graduand's study enabled his or her research, the relevance of that research to other fields of learning, and the significance of the discoveries that the students had made during the course of their investigations.

The graduands, their wives, and their parents were guests of President and Mrs. Bronk at a buffet supper before the traditional Ball for the students on the night preceding the conferring of degrees. Following the ceremonies, the Trustees were hosts to those who attended the convocation at a luncheon in Abby Aldrich Rockefeller Hall.

President Bronk paid tribute during the ceremonies to the colleges and universities in which the graduates had pursued their undergraduate studies: Amherst, Barnard, Bowdoin, Columbia, Dartmouth, Harvard, Massachusetts Institute of Technology, the University of Michigan, Oberlin, Reed, and Smith.

In recognition of their scholarly achievements and the noble example they have set for youthful scholars, the degree of doctor of science, *honoris causa,* was conferred on Dr. Thomas M. Rivers, Director Emeritus of the Institute and Vice President for Medical Affairs of the National Foundation, as well as on Dr. Hugh S. Taylor, President of the Woodrow Wilson Fellowship Foundation and Dean of the Graduate School, Emeritus, of Princeton University.

As the graduates begin their postdoctoral careers in teaching and research they will go to many universities and research institutions. Miss Mary A. Bonneville will be a Teaching Assistant in the College of Physicians and Surgeons of Columbia University, Robert DeVoe will be Instructor in the Department of Physiology at The Johns Hopkins University School of Medicine, Allen B. Edmundson will hold a Public Health Service Fellowship in the Medical Research Council Unit in the Cavendish Laboratories in the University of Cambridge, Jack F. Kirsch will hold a Jane Coffin Childs Postdoctoral Fellowship in the Department of Biochemistry of Brandeis University, Miss Elena Ottolenghi will be a Research Fellow at the New York University College of Medicine, Peter Satir will be Instructor in biology and Research Associate in zoology at the University of Chicago, Aaron J. Shatkin will be associated with the Laboratory of Cellular Biology of the National Institute for Allergic and Infectious Diseases, Roger Thies will be Instructor in the Department of Physiology of Washington University, Bruce R. Voeller will remain at The Rockefeller Institute as Research Associate with Professor Armin Braun, and Frederick Wheelock will be Assistant Professor in the Department of Preventive Medicine of Western Reserve University School of Medicine.

THE CONFERRING OF DEGREES IN THE AUDITORIUM OF CASPARY HALL

MISCELLANY

Faculty Members Elected to National Academy of Sciences

Among those to be honored for original contributions to science by election to membership in the National Academy of Sciences this spring were two of the Institute's faculty and one of its Trustees: Rollin D. Hotchkiss, who has been a member of the faculty of the Institute since 1935 and Professor since 1955; George E. Palade, who has been associated with the Institute since 1946 and Professor since 1953; and William O. Baker, recently elected Trustee, who is Vice President–Research at the Bell Telephone Laboratories.

Sigma Xi Chapter Meets

The final dinner meeting and lecture of The Rockefeller Institute Chapter of the Society of the Sigma Xi was held on April 24, 1961, at which Professor Jesse L. Greenstein of the Mount Wilson and Mount Palomar Observatories and the California Institute of Technology gave the third public lecture of the academic year 1960-61. Professor Greenstein lectured on "Stellar Evolution and the Origin of the Chemical Elements."

Earlier in the year Sigma Xi lectures were given at the Institute by Professor Marston Bates, Professor of Zoology in the University of Michigan, on the subject of "The Human Ecology of an Atoll in Micronesia" and by Professor Loren Eiseley, Provost of the University of Pennsylvania, whose topic was "A Renewed Examination of Pre-Darwinian History."

New Books from the Faculty

Professor René Dubos's latest book, *The Dreams of Reason,* was published this Spring by Columbia University Press. The book is based on the George B. Pegram lectures which Professor Dubos gave at the Brookhaven National Laboratory last Fall. The lectureship was established by the Trustees of Associated Universities, Inc. "to provide a forum for discussing the broad implications of science in our times." Dubos, who subtitled his book "Science and Utopias," writes in his introduction: "I shall attempt to show that the illusions, aspirations, and whims of mankind, even more than its physical needs, influence profoundly the beliefs and activities of scientists."

The second and last volume of the late Henry E. Sigerist's *History of Medicine,* which was completed last year through the devoted labors of Professor Edelstein and others, was published this Spring by Oxford University Press. This volume, on early Greek, Hindu, and Persian medicine, was complete in manuscript when Dr. Sigerist died in 1957, and a note in his handwriting on the last page read: "Here my legacy ends." Dr. Edelstein says in his foreword as general editor: "These terse and moving words made it clear to me that he had hoped that the book would be published although he knew that he would be unable to finish it. I therefore undertook to carry out his wish as a token of my indebtedness to him as scholar and friend."

Less accessible to most readers than these, perhaps, is a Polish edition of a book by Professor Mark Kac: *Kilka Zagadnien Stochastycznych Fizyki i Matematyki.* It was originally published as "Some stochastic problems in physics and mathematics" by the Dallas Field Research Laboratory of the Magnolia Petroleum Company, based on a series of colloquium lectures he gave there in 1956.

New Facilities for Education and Research Completed

Creation of new facilities for education, research, and recreation is an almost continuous activity at the Institute, but in the Spring of 1961 an unusual number were completed.

Noteworthy among them are the new laboratories and studies completed in the South Laboratory Building. On the ninth floor are beautiful and spacious new suites of offices, studies, libraries and workrooms for philosophy, mathematics, and theoretical physics, which total nearly 7000 square feet of space. Professors Kac, Uhlenbeck and Berlin were able to occupy the mathematics and physics areas this Spring, and two additional rooms completed for Professor Edelstein, who had arrived last Fall, will enable him to provide studies for two associates in philosophy joining him on the faculty this Fall.

Professors Dubos and James Hirsch oc-

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Quotation LORD ADRIAN ON SIR FRANCIS BACON:

[Bacon]...insisted on the great practical value of scientific knowledge. The insight which the scientist obtains into nature can and should be employed in commanding nature for the service of man. Macaulay says that Bacon used means different from those of other philosophers because he wished to arrive at an end altogether different from theirs. The end was 'fruit' rather than 'light', utility and progress in improving the condition of the human race, the good of mankind in the sense in which the mass of mankind has always understood the word 'good'. 'To make men perfect was no part of Bacon's plan. His humble aim was to make imperfect man comfortable.' The utility of scientific progress was not, of course, an entirely new idea but it had never been insisted on so forcibly.

Bacon was well aware that the search for fruits and the search for light must go on together, 'ascending to axioms as well as descending to works'. 'What is most useful in practice is most correct in theory' and 'The improvement of man's mind and the improvement of his lot are one and the same thing'. 'To be ignorant of causes is to be frustrate in action'.

In fact he seems to want it both ways, but I think it must be agreed that Bacon did value 'fruit' at least as much as, and sometimes more than, 'light'.

From a lecture honoring the four hundredth anniversary of Bacon's birth given at The Rockefeller Institute and published as Occasional Paper Number Eleven.

New Facilities

(continued from page seven)

cupied their new laboratories, to which the entire fourth floor of the South Laboratory is devoted. In addition to the facilities which they moved from their former space in Theobald Smith Hall, they have added rooms in which to carry on special controlled environmental studies of animals with a view to investigating the effect of various environments in their totality on man and animals.

The student laboratories for physiology and organic chemistry, completed on the second floor of the South Laboratory last year, have been extended with nearly 3000 square feet of space on the third floor. The new laboratories for students, developed for biochemistry, cytology, embryology, and physiology, with appropriate dark rooms, cold rooms, and a chromatography room, were financed in part by a grant from the National Science Foundation.

Earlier in the year Professor Lipmann moved his laboratory to the sixth floor of the South Laboratory, Professors Porter and Palade moved into the fifth floor, and a major portion of the ground floor was occupied by the Institute's illustration service, which was completely re-equipped and modernized.

In Flexner Hall, laboratories for cytophysics were completed this Spring for Professor Weiss with financial support from the Health Research Council of New York City. These include a staff room and laboratory for a senior investigator, a room for operations and preparations, a biophysics laboratory with two staff rooms, a dark room and an electron microscope room.

A clinical laboratory, which is under the direction of Professor Vincent Dole, was completed on the seventh floor of the hospital. The entire fifth floor of the hospital has been converted into modern and consolidated laboratories for Professors Ahrens and Jules Hirsch, whose groups had heretofore been dispersed in three different locations.

The new planting boxes, extending for four blocks along York Avenue, were seen in dazzling splendor for the first time this Spring as the rhododendrons and pink and white azaleas planted among the shrubs and evergreens last Fall burst into blossom. Finally, a tennis court was completed this Spring on the west side of the Institute campus near York Avenue where it is shaded from the afternoon sun. The locker facilities of the Graduate Student Residence are available to players, who have made heavy use of the court since it was completed in June.

Visiting Scientists Enjoy Guest Facilities

The living quarters and social halls in Abby Aldrich Rockefeller Hall enable hundreds of visiting scientists each year to meet and associate informally with faculty and students in the course of their visits to New York City. During the three Spring months alone nearly two hundred were in residence including half a hundred from more than a dozen foreign countries.

Among the guests from abroad were Professor Charles de Hevesy of Stockholm, who received the Atoms for Peace Award here a few years ago; Professor Wilder Penfield, Director of the Montreal Neurological Institute, who was a guest for a month while he was preparing material for a biography of Alan Gregg, Vice President of the Rockefeller Foundation; and Lord Adrian, Master of Trinity College, Cambridge, who was in residence as a Visiting Professor at the Institute when he delivered the 400th Anniversary Lecture on Francis Bacon and two lectures on studies on sleep and on pain. Other visitors from abroad included Sir Harold Himsworth, Secretary of the Medical Research Council of Great Britain; Visiting Professor A. M. Monnier of the University of Paris at the Sorbonne; Msgr. L. Gillon, President of the University of the Congo Republic; Dr. Arthur Huggett, Professor of Physiology in the University of London; Dr. Hugo Steinhaus, Professor of Mathematics and Member of the Polish Academy of Sciences, who was Professor Kac's teacher; Sir Solly Zuckerman, Professor of Anatomy in the University of Birmingham and Chairman of the British Defense Research Policy Committee; Dr. Thorsten Teorell, Professor of Physiology in the Royal University of Uppsala, who was visiting Dr. Osterhout; Dr. Marcel Roche, Director of the Venezuelan Institute for Scientific Investigations; Dr. Karel Sebesta of the Institute of Organic Chemistry and Biochemistry of the Czechoslovak Academy of Sciences; and Dr. Hugh Huxley of University College, London, who was attending a meeting of the Board of Editors of the *Journal of Biophysical and Biochemical Cytology*.

Guests from other universities in this country included Dr. Saunders MacLane, Professor of Mathematics in the University of Chicago, who spent three months at the Institute during the preparation of a work on mathematics; Dr. Kasimir Fajans, Professor of Theoretical Chemistry, Emeritus, in the University of Michigan, who was Professor Berlin's close friend and teacher; Dr. O. H. Robertson, Emeritus Professor of Medicine in the University of Chicago, who was a guest of Dr. Rous; Professor Kenneth V. Thimann of Harvard University, a guest of Professor Bearn; and Professor Paul Doty of Harvard University; as well as the distinguished members of the Committee on Natural Resources Research, appointed by the National Academy of Sciences at the request of President Kennedy, which held the first of a series of meetings at the Institute this Spring.

Students and Faculty Explore the History of Science

A common interest in the origin and progress of science brought a score of faculty, students, and staff together once a month during the academic year for a series of evening seminars in the history of science. The sole condition of membership in the group is willingness to undertake to present some relevant topic to the group, using original sources as far as practicable. The seminars were organized three years ago by Dr. George Corner, Historian of the Institute. Dr. Howard Schneider served as co-chairman this year to assist in arranging the seminars after Dr. Corner's departure to become Executive Officer of the American Philosophical Society.

This year the series began with a discussion of Greek medicine led by Professor Edelstein and supplemented by photographs taken by Dr. Merrill Chase on the Island of Cos and by Dr. Corner at the shrine of Asklepios at Pergamum. Dr. Malcolm Peterson, a graduate of the Institute in 1960 who wrote his doctoral dissertation on chylomicrons, told of evidence that makes him believe that Leeuwenhoek had first seen these fatty particles which appear

in the blood following ingestion of fatty meals. Dr. Eugene Opie, whose interest in Chinese medicine was the subject of an article in the *Quarterly,* talked on the relation of the philosophy of scholars to the folklore of the people in traditional Chinese medicine. Dr. Alexander Bearn traced the historic development of the Royal Institution founded by Count Rumford, an American, and the role it played in the dissemination of science in England in the nineteenth century.

Other talks were given by Dr. Richard Krause on cultural and social contrasts between the Inca and Aztec civilizations, by Dr. Corner on curious legends about The Rockefeller Institute that he encountered while writing the history of the Institute, and by Dr. G.M.K. Wallach, a guest speaker, whose topic was "Early Litchfield County Physicians."

FACULTY ACTIVITIES

Academic Honors

DETLEV W. BRONK
Sc.D., Hamilton College.
The John and Samuel Bard Award in Medicine and Science, Bard College.

HENRY G. KUNKEL
M.D. *hon. causa,* University of Uppsala.

Academic Appointments

MAURICE S. FOX
Visiting Professor, Institute for Molecular Biology, University of Oregon.

EDWIN C. WOOD
Assistant to Professor of Obstetrics and Gynaecology, Royal Women's Hospital, Melbourne, Australia.

Lectures, Conferences and Symposia

EDWARD H. AHRENS, JR.
Invited Speaker, Annual Meeting, Association of American Physicians, Atlantic City.
Guest Speaker, Harvard Medical School Alumni Association, Boston.
Participant, Nutrition Conference, American Medical Association, New York.
Participant, Gordon Research Conference on Lipid Metabolism.

RUTH ARNON
Lecture, New York State Public Health Research Institute.

ARMIN C. BRAUN
The Harvey Lecture.
Annual Meeting, National Academy of Sciences.
McArdle Memorial Laboratory for Cancer Research, The University of Wisconsin.

DETLEV W. BRONK
Address, Temple University 75th Anniversary Convocation.
Address, 10th Anniversary, Cancer Research Institute of the New England Deaconess Hospital.
Address, Summer Lecture Series, University of Colorado.

VERNON B. BROOKS
Participant, Inter-Society Symposium on the Hemicholiniums, Annual Meeting, Federation of American Society for Experimental Biology.

LYMAN C. CRAIG
Participant, Gordon Research Conference on Proteins.

ARPÁD I. CSAPO
Lecture, University of Rochester School of Medicine and Dentistry.
Lecture, Department of Obstetrics, Downstate Medical Center, State University of New York, Brooklyn.

RENÉ J. DUBOS
Kober Lecture of the American College of Physicians, Georgetown University.
Silliman Lectures, Yale University.
Convocation Address, American College of Physicians, Miami, Florida.
Graduation Address, Albert Einstein College of Medicine.
Lecture, The Johns Hopkins University School of Advanced International Studies.
Speaker, Conference on Psychiatric Research, McLean Hospital, Boston.
Seelig Lecture, Washington University School of Medicine, St. Louis.
Lecturer, Congress on Environmental Health, University of Michigan School of Public Health.
Speaker, Public Health Conference, Rochester, New York.
Herman Beerman Memorial Lecture, Society for Investigative Dermatology, Philadelphia.

SAM GRANICK
Annual Lecture, Washington, D.C., Branch, American Society of Plant Physiologists.

JULES HIRSCH
Chairman, Gordon Research Conference on Lipid Metabolism.

TE PIAO KING
Invited Speaker, National Institute of Allergy and Infectious Diseases, Conference on Standardization of Ragweed Pollen Allergens, Santa Monica.

DANIEL E. KOSHLAND, JR.
Participant, Gordon Research Conference on Proteins.

GERTRUDE E. PERLMANN
Lecture, Dartmouth Medical School.
Participant, First International Symposium on Poly-α-amino Acids, Madison.
Participant, Gordon Research Conference on Proteins.

KEITH R. PORTER
Invited paper, 58th Annual Meeting, American Association of Pathologists and Bacteriologists, Chicago.

FLOYD RATLIFF
Louis Block Lecture in Neurophysiology, University of Chicago.

ROBERT R. SCHOENFELD
Lecture, Tri-State Meeting, American Academy of General Practice, North Conway, New Hampshire.

LOUIS E. SILTZBACH
Lecture, Royal Society of Medicine, London.
Lecture, Royal Free Hospital Medical School, London.
Participant, Royal Northern Hospital Symposium, London.
Lecture, St. Göran's Hospital, Stockholm.

GEORGE R. STARK
Participant, Gordon Research Conference on Proteins.

WILLIAM H. STEIN
Participant, Gordon Research Conference on Proteins.

IGOR TAMM
Participant, Conference on Urinary Macromolecules, Bowman Gray School of Medicine, Winston-Salem, North Carolina.
Lecture, Downstate Medical Center, State University of New York, Brooklyn.

EDWARD L. TATUM
Mike Hogg Lecture, University of Texas Postgraduate School of Medicine, Houston.

PAUL A. WEISS
Chairman, Symposium on Research and the Community, Advisory Council on Industrial Research and Development of the State of New York, Sterling Forest, New York.
Participant, Conference on Systems Research, Operations Research Society, Arden House, New York.
Opening Lecture, Annual Cancer Symposium, Henry Ford Hospital and Detroit Cancer Institute, Detroit.
Annual Initiation Lecture, Sigma Xi, Amherst College.
Anna Westhoff Memorial Lecture, American Rheumatism Association, New York.
Opening Lecture, Series on Cellular Pathology, Harvard Medical School, Boston.

D. WAYNE WOOLLEY
Louis Block Fund Lecture, University of Chicago.

Society Elections

ARMIN C. BRAUN
Honorary Member, The Harvey Society.
Secretary, Society for the Study of Development and Growth.

FRANK BRINK, JR.
Fellow, American Academy of Arts and Sciences.

LYMAN C. CRAIG
Fellow, American Academy of Arts and Sciences.

ROLLIN D. HOTCHKISS
Member, National Academy of Sciences.
Fellow, American Association for the Advancement of Science.

TE PIAO KING
Member, American Society of Biological Chemists.

HENRY G. KUNKEL
President, American Society for Clinical Investigation.

DAVID C. MAUZERALL
Member, American Society of Biological Chemists.

GEORGE E. PALADE
Member, National Academy of Sciences.

KEITH R. PORTER
Member, American Association of Pathologists and Bacteriologists.

ROBERT R. SCHOENFELD
Administrative Committee, Professional Group on Medical Electronics, Institute of Radio Engineers.

LEONARD B. SPECTOR
Member, American Society of Biological Chemists.

IGOR TAMM
Associate Editor, *Journal of Immunology*.

Other Appointments and Distinctions

EDWARD H. AHRENS, JR.
Member, Visiting Committee, Chronic Disease Research Institute, Buffalo.

RENÉ J. DUBOS
Member, Committee on the History of Medicine, National Institutes of Health.

ROLLIN D. HOTCHKISS
Member, Panel on Genetic Biology, National Science Foundation.
Member, Board of Scientific Counselors, National Institute of Allergy and Infectious Diseases.

DANIEL E. KOSHLAND, JR.
Advisory Editorial Board, Interscience Publishers, Inc.

MURRAY D. ROSENBERG
Member, Morison Panel on Life Sciences, President's Science Advisory Committee.
Consultant, Division of Biological and Medical Sciences, Advisory Panel for Specialized Biological Facilities, National Science Foundation.

HOWARD A. SCHNEIDER
Consultant, Biochemistry Training Committee, Division of General Medical Sciences, U.S. Public Health Service.
Consultant, Animal Disease and Parasite Research Division, Agricultural Research Service, U.S. Department of Agriculture.

RICHARD E. SHOPE
Member, Zoonoses Technical Advisory Group, Pan American Health Organization.
Member, Board of Scientific Counselors, National Cancer Institute.

WILLIAM H. STEIN
Member, Board of Scientific Counselors, National Institute of Neurological Diseases and Blindness.

IGOR TAMM
Associate Member, Commission on Acute Respiratory Diseases, Armed Forces Epidemiological Board.

PAUL A. WEISS
Member, Organizing Council, Institut de la Vie, Paris.
Member, Survey Committee on the Naples Zoological Station, International Union of Biological Sciences, Naples.

Newly Appointed Graduate Fellows

DAVID BALTIMORE, Swarthmore College.

ROBERT BROWN BARLOW, JR., Bowdoin College.

WILLIAM EDWARD BOWERS, Princeton University.

RICHARD DANA CAMPBELL, Harvard College.

CHARLES CHAPMAN CARTER, Pomona College.

BRIAN ROGER CLARK, Pomona College.

ROSEMARY FAULKNER, Radcliffe College.

CALEB ELLICOTT FINCH, Yale University.

JAMES DENNIS FOCH, JR., Dartmouth College.

ANN GALE, Radcliffe College.

ALEXANDER KESSLER, New York University and College of Physicians and Surgeons, Columbia University.

ROBERT MYRON KRUG, Harvard College.

ALAN ROGER LATHAM, Harvey Mudd College.

STEVEN WILLIAM MATTHYSSE, Yale University.

JAMES HENRY REILL, Haverford College.

NORMAN ROBBINS, Columbia University and Harvard Medical School.

LEONARD AUSTIN SAUER, Cornell University and The University of Rochester School of Medicine and Dentistry.

PHILIP MONTOY SEEMAN, McGill University.

GUDRUN DOROTHEA STAUB, Vassar College.

LAWRENCE STUART STURMAN, Northwestern University Medical School.

Faculty Promotions

To Associate Professor:

MAURICE S. FOX

RICHARD M. KRAUSE

S. WILLIAM PELLETIER

To Assistant Professor:

SAMUEL DALES

HANS J. EGGERS

EARL H. FREIMER

GEORGE R. STARK

New Appointments to the Faculty

NANCY W. ALCOCK, Research Associate with Professor Archibald. Formerly Research Assistant at Postgraduate Medical School, London.

SAMUEL E. ALLERTON, Research Associate with Associate Professor Perlmann. Formerly Teaching Fellow in Biological Chemistry at Harvard University.

RAJINDRA ANEJA, Research Associate with Associate Professor Pelletier. Formerly Associate at Stevens Institute of Technology.

STUART D. ELLIOTT, Guest Investigator with Professors Lancefield and McCarty. On leave from the University of Cambridge where he is Assistant Director of Research in the Department of Animal Pathology.

JOSEPH FENDRICH, Guest Investigator with Associate Professor Trager. On leave from the Israeli Institute for Biological Research from which he holds a fellowship.

ANNE GEISMAR, Research Associate with Associate Professor Csapo. From the Faculté de Médecine de Paris where she received the degree of Doctor of Medicine this year.

UWE GÖBELSMANN, Guest Investigator with Associate Professor Csapo. A NATO Fellow, formerly with Kreiskrankenhaus at Plochingen, West Germany.

MORTEN HARBOE, Guest Investigator and Fellow and Assistant Physician with Professor Kunkel. Formerly with the Institute for Thrombosis Research, University of Oslo.

JAMES HENDRIX, Guest Investigator and Fellow and Assistant Physician with Professor Archibald. Formerly Resident in Internal Medicine at State University of New York Medical Center at Kings County Hospital.

CHARLES H. HILL, Guest Investigator with Associate Professor Schneider. On leave from North Carolina State College where he is Professor of Poultry Nutrition. He is a Special Research Fellow of the National Institutes of Health.

JEROME KNITTLE, Research Associate and Assistant Physician to the Hospital with Professor Ahrens. Formerly with Massachusetts Memorial Hospitals.

BEATRICE S. MAGDOFF, Research Associate with Associate Professor Moore. Formerly Physicist with the Boyce Thompson Institute.

MART MANNIK, Guest Investigator and Assistant Physician with Professor Kunkel. Formerly Assistant Resident in Medicine at Massachusetts General Hospital.

JACOB NEEDLEMAN, Research Associate with Professor Edelstein. From Yale University where he received the degree of Doctor of Philosophy this year.

MICHIHIKO OGATA, Research Associate with Associate Professor Csapo. Currently a Postdoctoral Fellow in the Department of Physiology, College of Medicine, University of Florida.

P. AIYAPPAN PILLAI, Research Associate with Professor Weiss. Formerly Raptakos Medical Fellow at the Indian Cancer Research Centre, Bombay, and Lady Tata Scholar at the University of Lausanne.

JOEL ROTHSCHILD, Research Associate with Professor Palade. Formerly Helen Hay Whitney Foundation Fellow and Guest Investigator with Professor Palade.

NORTON SPRITZ, Guest Investigator and Assistant Physician with Professor Ahrens. Currently also Assistant Professor of Medicine, Cornell University Medical College.

BRUCE R. VOELLER, Research Associate with Professor Braun. A graduate of the Institute in June 1961.

EWALD R. WEIBEL, Research Associate with Assistant Professor Stoeckenius. Formerly Research Associate, Department of Medicine, Columbia University.

NEW APPOINTMENTS *continued from page eleven*

C. R. PAYLING WRIGHT, Guest Investigator with Associate Professor Bearn during the summer. A student at University College Hospital Medical School, London.

JOHN A. YANKEELOV, JR., Assistant Professor with Dr. Koshland, Affiliate of the Institute. Formerly with Brookhaven National Laboratory.

Departures from the Faculty

THOMAS P. ASHFORD, Guest Investigator with Professor Porter, left the Institute May 1 to return to Salt Lake City, where he will be in the Department of Surgery at Salt Lake General Hospital.

HAROLD M. BATES, Guest Investigator with Professor Lipmann, resigned May 1 to accept a position in industry.

J. MARION BRYANT, Guest Investigator and Associate Physician with Associate Professor Bearn, left at the end of June to return to the New York University Medical Center where he is Associate Professor of Medicine.

A. TYBJAERG HANSEN, Sophie Fricke Fellow of The Royal Danish Academy of Sciences and Letters in The Rockefeller Institute, left in July to return to Copenhagen where he is Associate Professor of Clinical Medicine at the University of Copenhagen and Chief of the Cardiovascular Laboratory in the University Hospital.

MELVIN LEVITT, Research Associate with Associate Professor Brooks, resigned May 31 to become an Associate in the Department of Anatomy, University of Pennsylvania School of Medicine.

ROBERT L. MCAULEY, Guest Investigator with Professor Ahrens, left at the end of June. He will continue to be associated with the Massachusetts Memorial Hospitals where he has been a Research Fellow in Pathology and Biochemistry.

MIROSLAV D. POULIK, Guest Investigator with Associate Professor Bearn, resigned May 30 to become Assistant Director of Research of the Blood Program of the American National Red Cross in Washington.

WILLIAM J. RAY, JR., Assistant Professor with Dr. Koshland, Affiliate of the Institute, resigned at the end of June to accept a position at Purdue University in the Biology Department.

ROBERT P. SCHEFFER, Research Associate with Professor Braun, left in June to return to Michigan State University where he is Associate Professor in the Department of Botany and Plant Pathology.

OLGA STEIN, Guest Investigator and Fellow with Associate Professor Moore, resigned in July to return to Hadassah Medical School of Hebrew University in Jerusalem where she is a Research Associate in the Department of Experimental Medicine and Cancer Research.

YECHEZKIEL STEIN, Guest Investigator and Fellow with Professor Ahrens, left in July to return to Hadassah Medical School of Hebrew University where he is Lecturer in Medicine and Physician to the University Hospital.

Guest Speakers

SAMUEL H. BOYER, The Johns Hopkins Hospital, April 6, 1961.

MINORU TSUTSUI, New York University, April 6.

R. JUNG, Department of Clinical Neurophysiology, University of Freiburg, April 13, 1961.

JOSEPH RUDINGER, Czechoslovak Academy of Sciences, April 20, 1961.

JESSE L. GREENSTEIN, Mount Wilson and Palomar Observatories and California Institute of Technology, April 24, 1961.

PETER MIESCHES, Professor of Hematology, New York University, April 26, 1961.

J. BENOIT, Laboratory of Histophysiology, Collège de France, April 27, 1961.

O. H. ROBERTSON, Emeritus Professor of Medicine, University of Chicago and Lecturer in Biology, Stanford University, May 4, 1961.

B. D. BURNS, Professor of Physiology, McGill University, May 9, 1961.

FAUSTO RAMIREZ, Department of Chemistry, State University of New York, May 10, 1961.

W. T. J. MORGAN, Lister Institute of Preventive Medicine, London, May 15, 1961.

KASIMIR FAJANS, Professor Emeritus of Chemistry, University of Michigan, May 16, 1961.

HUGO STEINHAUS, Professor of Mathematics and Member of the Polish Academy of Sciences, May 18, 1961.

AUDREY GLAUERT, University of Cambridge, May 18, 1961.

JACK H. SCHULMAN, Stanley-Thompson Professor of Chemical Metallurgy, School of Mines, Columbia University, May 23, 1961.

KAREL SEBESTA, Institute of Organic Chemistry and Biochemistry, Czechoslovak Academy of Sciences, May 24, 1961.

STEN SKOGLUND, University of Uppsala, May 24, 1961.

PER-AKE ALBERTSSON, Biochemical Institute, University of Uppsala, May 25, 1961.

VITTORIO LUZZATI, Center for Research on Macromolecules, Strasbourg, France, June 6, 1961.

BERNARD ERLANGER, College of Physicians and Surgeons, Columbia University, June 15, 1961.

Visiting Professors in Residence

LORD ADRIAN, Master of Trinity College, University of Cambridge, April 17-19, 1961.

A. M. MONNIER, Professor of Psychophysiology, University of Paris at the Sorbonne, May 1-12, 1961.

New Grants and Contracts

From the U.S. Public Health Service:

To Dr. Alexander Bearn for biochemical and genetical studies on human serum proteins $21,813

To Dr. Vernon Brooks for investigation of the excitability of pyramidal tract cells $14,715

To Dr. Zanvil Cohn for a study of virulence factors of staphylococci $14,962

To Dr. Vincent Dole for investigation of the turnover of plasma lipids in diabetic ketosis $26,150

To Dr. Fritz Lipmann for studies of biosynthetic mechanisms $69,447

To Dr. R. Lorente de Nó for investigating the relation of nitrogen compounds to nerve action potentials $28,013

To Dr. Clara Lynch for a genetic study of the susceptibility of mice to experimental tuberculosis $4,685

To Dr. George Miroff for the isolation and identification of the mammary tumor agent $26,450

To Dr. Dan Moore for etiological studies of mammary carcinoma and for a study of literature and information sources on viruses and cancer $54,515

To Dr. William H. Stein for investigation of the chemical structure and enzymic activity of proteins $60,497

To Dr. Igor Tamm for investigation of virus-induced alterations in animal cells $41,939

To Dr. William Trager for development of a training plan in experimental parasitology $29,567

To Dr. Paul Weiss for cinemicrography of cell interactions in culture $13,208

To Dr. Victor Wilson for investigation of recurrent conditioning in the spinal cord $6,959

From the National Science Foundation:

To Dr. Fritz Lipmann for a five-year study of biosynthetic mechanisms $750,000

To Dr. Beatrice Magdoff for determination of the structure of southern bean mosaic virus by X-ray diffraction $10,000

From the National Foundation:

To Dr. Alexander Bearn for study of certain congenital and inherited metabolic disorders in man by the combined use of biochemical and tissue culture techniques $53,210

To Dr. Igor Tamm for investigation of multiplication and inhibition of human viruses $70,769

To Dr. Norton Zinder for the study of a bacteriophage containing RNA $85,586

From the American Cancer Society to Dr. Paul Weiss for the experimental analysis of cellular interactions $14,250