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THE ROCKEFELLER INSTITUTE Quarterly

VOLUME 2 NUMBER 2 SUMMER 1958

# BIOCHEMICAL GENETICS AND INHERITED METABOLIC DISEASE

THE IDEA THAT not only gross traits of species and individuals are genetically determined but that even detailed biochemical processes are gene-controlled owes much to the work of Dr. Edward L. Tatum, now at The Rockefeller Institute. In this article we will tell something about studies of metabolic disorders in bacteria and fungi, and we will also describe similar work at the Institute with other organisms. Dr. Sam Granick, for example, has found the genetic techniques pioneered by Dr. Tatum to provide a key to unravelling a part of the biosynthesis of porphyrin, an essential component in the synthesis of those key molecules of plant and animal life, chlorophyll and hemoglobin. And Dr. A. G. Bearn, also at The Rockefeller Institute, has been interested in a hereditary metabolic disorder in man known as Wilson's disease.

It may surprise many readers to be told that our present understanding of the way genes control biochemical processes in organisms as dissimilar as yeast and men rests heavily on studies of the inheritance of nutritional deficiencies in the red bread mold, *Neurospora crassa*. But the studies of this simple organism, undertaken by Dr. Tatum at Stanford University nearly 20 years ago with Dr. George Beadle—now Professor and Chairman of the Division of Biology at the California Institute of Technology—have vastly increased our knowledge of both biochemistry and genetics.

A number of inherited metabolic disorders in man have been known for a long time, and the specific biochemical defects which cause them are in some cases rather well understood. Wilson's disease, which we shall describe later, is one of them. But on the whole, man is not a very suitable organism for any kind of genetic studies. His life cycle is long, his offspring are relatively few, and experimental cross-breeding, so important in genetics, is out of the question. It is no wonder that geneticists have concentrated on other organisms, among them being mice, the fruit fly, and corn. While these are useful organisms for genetic studies, the fungus *Neurospora* is preferable for biochemical studies for several reasons.

The life cycle of *Neurospora* was well understood many years ago, thanks to the studies of Dr. B. O. Dodge at the New York Botanical Garden. It is a microorganism that exists in two sexes so that cross-breeding experiments are possible, and the cycle from infancy to maturity is only 10 days. The fungus also multiplies asexually, that is by simple division, so that billions of individuals with identical hereditary traits can quickly be grown in the laboratory. Some other virtues of *Neurospora*, however, are especially important for biochemical and genetic studies. First, it can be grown on a very simple medium (even simpler than bread, where we often find it), which means that many links in elaborate biochemical chains can be studied, starting from scratch, so to speak, and end-

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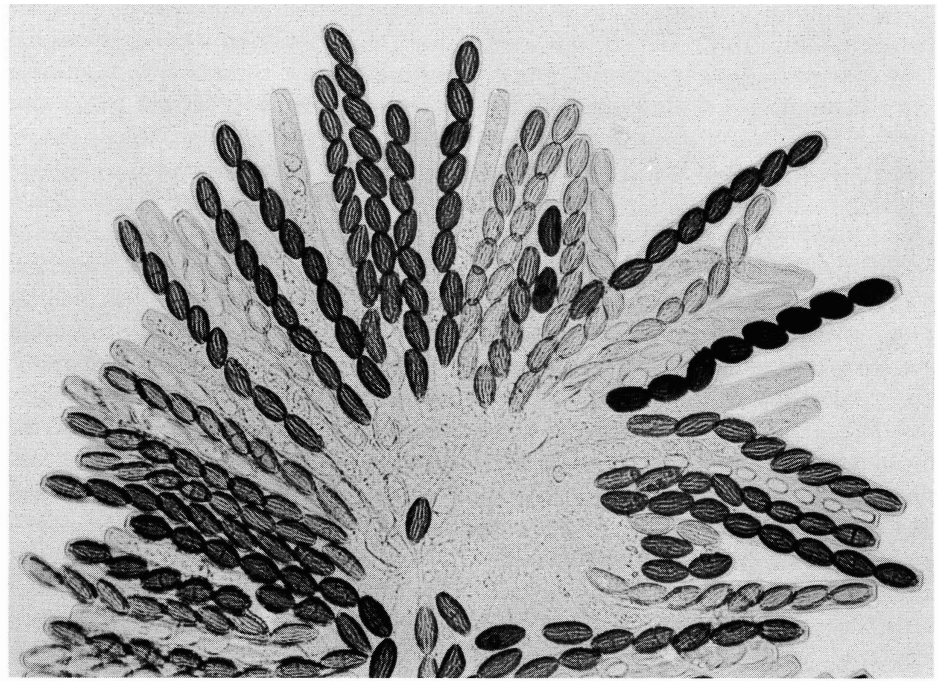

*Spores of Neurospora sitophila, enlarged about 500 times. Photo courtesy Dr. B. O. Dodge.*

ing with such complex materials as the vitamins.

To explain more of the other virtues of *Neurospora* we must recall some of the mechanics of genetics and sexual reproduction. In man and most higher organisms there are two sets of genes present in all cells, one set of which was obtained from each parent. Each set appears to have something to do with nearly all of our inherited characteristics, but in some cases the gene from one set overshadows the effect of the corresponding gene in the other set. For example, suppose a gene for dark eyes is contributed to a child by the father and one for blue eyes by the mother. The color of the child's eyes will not be arrived at by compromise; they will be dark. The blue-eyed gene is present, but it does not express itself, i.e., it is said to be recessive. This causes surprises in the families of dark-eyed parents. For if two such dark-eyed individuals bearing recessive blue-eyed genes marry, the recessive genes from each parent may both appear in the same child. In this case there is no "dark" gene to cover them up, so to speak, and a blue-eyed child is born to dark-eyed parents. The double gene-set arrangement, therefore, complicates analysis. *Neurospora* obligingly dispenses with it. Its nuclei contain only one set of genes, and whatever is contained in the gene collection of an individual cell is expressed at once in that individual.

### PACKAGED SPORES

In addition to this convenience, *Neurospora* is also easy to study genetically because of the simple, methodical way in which the offspring of sexual matings are segregated. If spores of two sexes are placed together on a suitable medium, the nuclei from each (containing the genes) may fuse in sexual union. This results in a nucleus which contains two sets of genes, one from each parent. But when the nucleus divides the genes segregate again so that half go to one nucleus and half to the other, each nucleus now having only the normal single set of genes. This pair divide twice more to produce eight cells or spores which up to this point are neatly arranged in a definite order and packaged in a single microscopic spore capsule. Thus, with skill, each of the products of a single mating can be separated from the spore capsule and grown into a colony large enough for biochemical study. The photograph on page one shows a much-magnified view of several spore capsules, each with its eight spores. The organism shown is *Neurospora sitophila,* a close relative of *crassa.*

If we now introduce the idea of mutation into the story we shall have all the genetic ideas necessary to complete our account. Return to the blue-eyed child of the dark-eyed parents. It is clear that both of its eye-color genes were "blue." Now suppose that two such individuals marry. If all goes according to our simplified presentation there should not be a dark-eyed gene anywhere to be found, and *all* the children of such a marriage should have blue eyes. In fact, something can go wrong with the genes of one of the parents, and a heritable dark-eye pigment may appear in one or more of their children. Something like this often happens. It is called a mutation, meaning a change in a gene. Unfortunately, most of these gene *changes* could be better called *damages,* for mutations are usually deleterious. This is because they are the result of apparently random changes in the genes. Mutations are caused by such things as nuclear and cosmic radiation, X-rays, and certain chemicals in our environment.

Indeed Beadle and Tatum's experiments with *Neurospora* depended on the possibility of producing mutations artificially with X-rays. When they irradiated some millions of normal spores of *Neurospora,* capable of synthesizing all their biological needs from very simple foods, some were occasionally damaged in such a way that they and their descendants needed dietary supplements. Moreover, using techniques that were simple in principle but arduous in practice, they could show that the defective strains of *Neurospora* were true mutants, i.e., that a gene had been altered which caused a heritable defect. In this way mutant strains were produced, each of which required an external supply of one of the B vitamins: thiamine, for example, or riboflavin, pyridoxine, inositol, etc. Others have been produced which needed certain amino acids, and so on.

### ONE GENE—ONE ENZYME

By cross-breeding normal, unirradiated spores with mutant strains it was possible to show conclusively that in almost every mutation only one gene was involved, and that only one nutritional item was not synthesized. This is interpreted to mean that if a gene is damaged it is not able to provide the cell with a certain enzyme necessary to permit a given step in a chain of biochemical reactions to proceed. Now since an elaborate molecule such as a vitamin is not fabricated in a single step, but in several successive steps, it is reasonable to suppose that defects in any of several genes (each responsible for a given enzyme and hence for a given step in a biosynthesis) may give rise to the same nutritional deficiency. It is as if in an assembly line in a factory several stages of production could be interfered with, any one of which could stop the output of the final product.

### AN AMINO ACID SEQUENCE

Srb and Horowitz at Stanford University, for example, found three different mutant strains of *Neurospora,* each of which required a supplement of the amino acid, arginine. However, different stages in the assembly line for producing arginine were disrupted in each strain. One, for example, could not live without arginine, but another could apparently make its own arginine provided citrulline were available instead. The third strain could get along with either arginine or citrulline or even with ornithine. Srb and Horowitz concluded that normal *Neurospora* must contain gene-controlled enzymes that transform some simpler materials into ornithine, ornithine into citrulline, citrulline into arginine, and so on. If the citrulline-arginine enzyme were missing because of a damaged gene, arginine would have to be supplied. But if only the enzyme were missing that produces ornithine out of its raw materials, then a supply of ornithine would be all that was required because the other steps in the assembly line were intact. Citrulline or arginine would also enable the mutant to grow, but they would leave the undamaged part of the assembly line idle. This metabolic sequence occurs in the mamalian liver as well as in *Neurospora,* but how much more readily it is studied in the mold than in man!

For several years Dr. Sam Granick at The Rockefeller Institute has been using X-ray induced mutations in a rather similar way to study metabolic disorders. Granick was interested in certain intermediate steps in the synthesis of chloro-

phyll, the green pigment in plants that makes it possible for them to store the energy of the sun in the form of carbohydrates. This is a process in which we animals have an acute interest, for we cannot carry it out ourselves. We must therefore ultimately depend on food from the plants to provide us with energy.

Granick worked with the single-celled green plant *Chlorella vulgaris,* which is easily grown in solutions of inorganic salts. A colony of *Chlorella* was irradiated to produce a variety of mutant forms and these were then sorted out and grown in separate colonies. Instead of showing the green color characteristic of chlorophyll, some of the mutants were pale green, some lacked yellow pigments, others were yellow or brown or orange, indicating that something had stopped or altered chlorophyll synthesis. Granick's analysis showed that in some cases the cause of the color change was that a colored material that normally would be converted by an enzyme to another form was being accumulated. Presumably a defective gene failed to produce the enzyme necessary to continue the process. One mutant collected so much pigment that it actually was deposited as granules in the plant tissues and was easily analyzed. It was found to be a molecule known as protoporphyrin 9—presumably a step in the synthesis of chlorophyll. Another mutant was able to get past protoporphyrin but not all the way to chlorophyll. It accumulated a slightly modified protoporphyrin containing magnesium which could be isolated from the mutant colony.

Porphyrin is also involved in the formation of heme, the pigmented part of hemoglobin in red blood cells that enables us to transport oxygen to our tissues. Dr. Granick, working with Dr. Helen Gilder at the Institute ten years ago, shed considerable light on the biochemistry of this part of the picture. They based their work on the porphyrin requirements of the bacillus, *Haemophilus influenzae,* some strains of which require the pigment, heme, for growth. There are other iron porphyrin proteins, the cytochromes, which are found in all cells of both plants and animals, including bacteria. These proteins make possible the burning of oxygen by the cell.

Granick's work strengthened the basis for believing that the steps leading to the synthesis of the red blood cell pigment, heme, and those leading to the green plant pigment, chlorophyll, must be parallel up to a point. That point is now shown by Granick to be protoporphyrin 9. Green plants then manage to slip an atom of magnesium into the center of the porphyrin ring and with a few other changes produce chlorophyll; the growing red blood cells of animals contrive to put iron in the same place to produce heme.

The similarities between the resulting pigments and the molecule they are both built from can be seen from our figure. (See page 5.) There is a certain satisfaction in seeing the close structural relation between these two pigments which have such significant and closely related functions. Their role in chlorophyll and the heme pigment appears on a very large scale to be that of maintaining a balance in the chemical constitution of the earth's atmosphere. Green plants, during the day, remove carbon dioxide from the air and, with the help of chlorophyll and sunlight, produce carbohydrates. At night they consume the carbohydrates and return oxygen to the air. Fortunately for the animal kingdom, plants produce far more carbohydrates than they need to maintain themselves, and it is from this surplus that we derive our energy. Animals eat the plants and burn their carbohydrates to produce carbon dioxide again. To do this, however, animals must first remove oxygen from the air and, with the help of hemoglobin, transport it to their tissues. The carbon dioxide from the tissues is exhaled to the atmosphere where it is ready to continue the cycle through the plant world again. Incidentally, when we burn wood or coal, or even oil, we are also using the solar energy plants store up with the help of chlorophyll.

To return to the theme of our article, however, it must be pointed out that hereditary metabolic disorders of porphyrin synthesis are found in man, as well as in *Chlorella.* In acute porphyria severe abdominal pains are accompanied by mental symptoms which have often been confused

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REBECCA CRAIGHILL LANCEFIELD has been promoted to the rank of Member and Professor at The Rockefeller Institute. Dr. Lancefield, who was born in Fort Wadsworth, New York, received her Ph.D. in immunology and bacteriology from Columbia University in 1925. She has been associated with The Rockefeller Institute since that time. Dr. Lancefield served as a civilian scientist with the Office of Scientific Research and Development during World War II. She is a past president of the Society of American Bacteriologists, a member of the American Association of Immunologists, a member of the Harvey Society, and a Fellow of the New York Academy of Medicine. Her husband, Dr. Donald E. Lancefield, is Professor of Biology at Queens College, and they have one daughter who is married.

That our knowledge of hemolytic streptococci has reached its present well-organized state is due in large part to the work of Dr. Lancefield. The major portion of the conceptual schemes, methodology, and detailed experimental analyses which form the basis for understanding the composition of this important group of microorganisms has come from her laboratory. She has demonstrated that the type-specific M protein, which she discovered, is of primary importance in the virulence of Group A streptococci, and that immunity is a type-specific phenomenon dependent on the development of antibody to this antigen. Recently she has shown that type-specific antibodies persist in man for as long as 30 years after streptococcal infections of known type.

with those of more common mental disturbances. This is an example of a mental disturbance which is really connected with a biochemical disorder. Another heritable disease, congenital porphyrinuria, which often produces hypersensitivity to light, eruptions of the skin and disfigurements of various sorts, also involves some reduction in the use of porphyrin. As a result this pigmented molecule appears abnormally in the urine, which in some cases is dark red from birth, or as a brown color in the bones, and even occasionally as a pink color in the teeth.

### CYTOPLASMIC INHERITANCE

Dr. Granick's work, which he is now carrying on in association with Dr. David Mauzerall, bears on a side of genetics which has received relatively little attention. The science of genetics has been primarily concerned with the role of the nuclear genes in inheritance. There is evidence, however, that bodies outside the cell nucleus contain inheritable factors of their own, but this is still a largely unexplored territory. Because porphyrins appear to be synthesized in connection with these extra-nuclear bodies in the cell, a knowledge of the steps in porphyrin synthesis may provide us with a biochemical handle for studying cytoplasmic inheritance, that is, inheritance factors other than the genes in the nucleus.

The techniques which Beadle and Tatum used to study the biochemical genetics of *Neurospora* have been applied not only to Granick's *Chlorella* but to many simpler organisms as well. Tatum found mutants with nutritional deficiencies in *Escherichia coli,* a harmless or perhaps even useful inhabitant of the intestines of men and animals. Subsequently, similar heritable changes have been found in almost every species of bacteria investigated.

Tatum wondered whether any evidence could be found in the inheritance mechanisms of bacteria to suggest that they multiply not only by simple division, asexually, but as a result of sexual fusion, as well. He began work on *E. coli* at Yale University with Joshua Lederberg who took a leave of absence from medical school to work with him. Tatum, when he was at Stanford, had developed two mutant strains of *E. coli,* each of which bore not one but several nutritional defects, different in each strain. Now if these two strains were grown together in the same culture one would expect to find nothing particularly interesting if they minded their business and multiplied only asexually. When Tatum and Lederberg tried this, however, they found individuals in the combined cultures that combined traits from both strains. In fact some were free from the defects of either strain. This work was completed only shortly after Avery, MacLeod, and McCarty had published their epochal paper showing that mere chemical extracts of one strain of cells could transfer heritable traits from that strain to another. (See The Rockefeller Institute *Quarterly,* Spring 1958.) Tatum and Lederberg had to consider this possible explanation of what happened to combine the traits of their *E. coli.* However, when they grew the two strains together but prevented physical contact between them by a porous barrier, no transfer of characters took place. The combination of heritable characteristics of two strains, depending upon the possibility of physical contact among the individual bacteria of the strains, strongly suggested a form of sexual reproduction, and further genetic studies confirmed this conclusion.

### SEX IN BACTERIA

Thus Tatum and Lederberg established that sexual reproduction occurs in at least one form of bacteria as well as in higher organisms, and subsequently sexuality has been demonstrated in almost every bacterium studied. Bacteria had long been regarded as anomalies in the world of living organisms by the complete absence of any mode of sexual reproduction. They were now brought back into the biological fold. Moreover, there was a considerable practical advantage to biochemical genetics in being able to cross-breed bacteria, for biochemical processes carried on by certain bacteria could now be studied genetically with more flexibility of experimental manipulation than would be possible if only asexual breeding occurred in them. Lederberg, by the way, never returned to medical school. Instead he took his Ph.D. at Yale and is now Professor of Genetics at the University of Wisconsin.

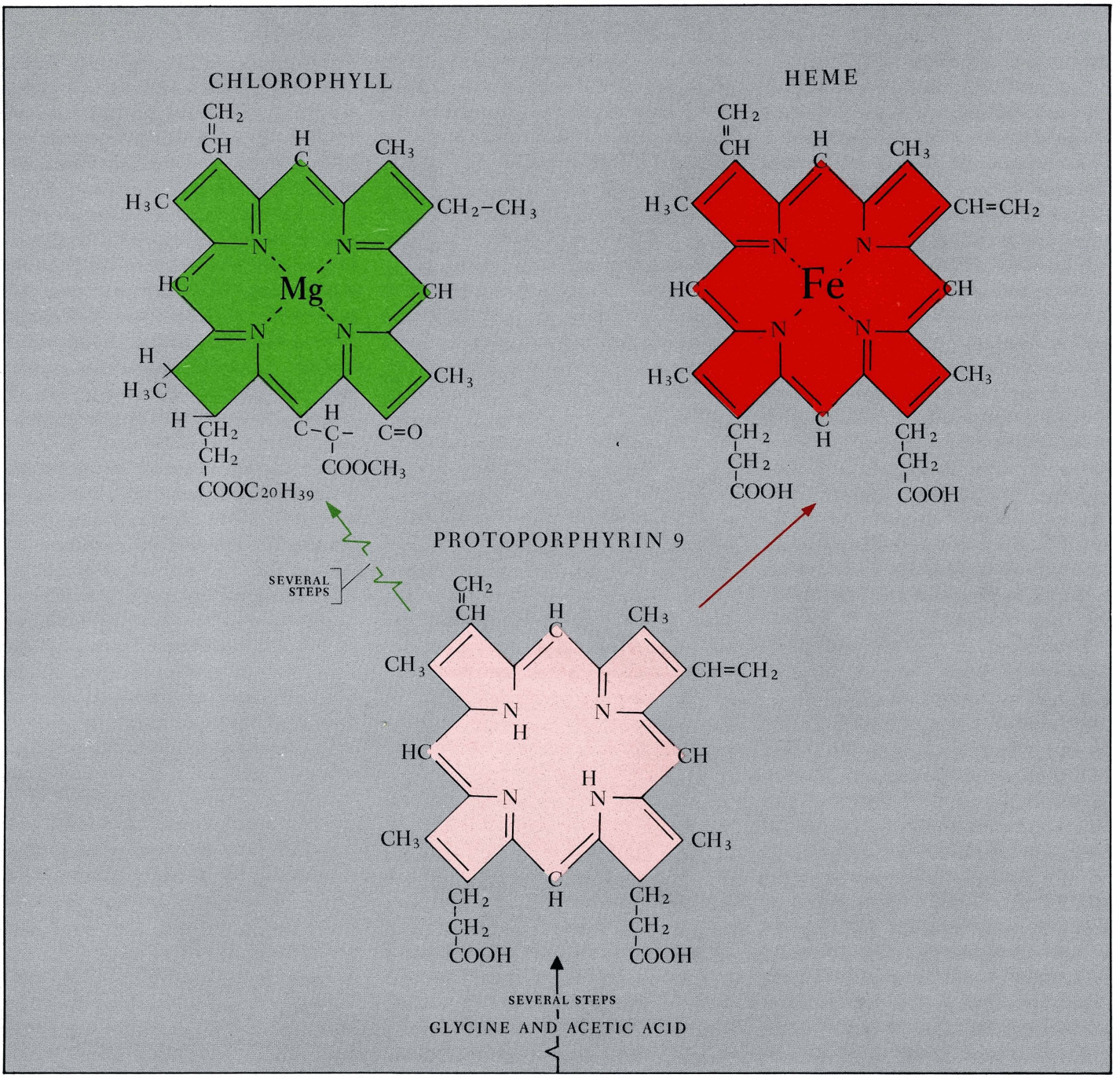
Since he came to The Rockefeller Institute a year and a half ago, Dr. Tatum, together with Dr. Laura Garnjobst, and Dr. S. R. Gross, has undertaken to extend his studies of *Neurospora* and other microorganisms to include a search for biochemical factors affecting not only growth, metabolism, virus resistance, etc., but gross physical structure as well. Some mutant strains of *Neurospora,* for example, have visible morphological abnormalities. If the gene-controlled enzymes and related biochemical reactions that produce these differences could be found, a step would be taken in the direction of answering the question of how the genes in the nucleus of the microscopic germ cells can contrive to determine that monkeys have tails, for example, and men have almost none.

### WILSON'S DISEASE

Tatum and Granick have confined their studies of metabolic disorders to bacteria and fungi, but Wilson's disease, which Dr. Alexander Bearn has been studying at the Hospital of the Institute almost since he came to Dr. Henry Kunkel's laboratory in 1951 from England, has much in common with their work. Wilson's disease was first described by Dr. S. A. K. Wilson of the National Hospital in London in 1912. Wilson characterized the disease as "a familial nervous disease associated with cirrhosis of the liver." By "familial" he meant that it seemed that frequently more than one member of a family is affected with it, but he said flatly it is not hereditary. Evidently Wilson was put off by the fact that the disease is so rare that little data on its occurrence were at hand. As is now known, Wilson's disease is heritable, caused by a defect in a recessive gene which is usually compensated for by a corresponding normal gene. Thus, the disorder actually appears only occasionally, even in families known to carry the defective gene.

Marriages between cousins, in families where a recessive defective gene exists, are especially likely to result in children in which the recessive defect appears. The defective gene may be passed (along with a protecting normal gene) from a grandparent to parents, and in turn to their children, without any of them showing that they bear the defective gene. But if two of these children, cousins or more closely related, marry, there is a good chance that some of *their* children will receive the defective gene from each parent, giving rise to expression of the disorder.

In spite of Wilson's clear description of the disease in 1912, understanding of its




cause remained obscure until a happy accident in 1940. A group of investigators at Oxford University who were studying another nervous disorder, multiple sclerosis, undertook to study its effect on the metabolism of copper. They found no effect. But one of the controls in the experiment studied for comparison, a patient with Wilson's disease, excreted relatively large amounts of copper in his urine. It would have been natural to suppose that this was the reflection of a high copper content in the blood which "spilled over" into the urine through the kidneys, as in certain other metabolic defects. Dr. Bearn therefore examined the serum copper levels in the blood of several patients with Wilson's disease and found to his surprise that it was *lower* than normal, not higher. Indeed the combination of high copper excretion in the urine and low serum copper in the blood is more characteristic of the disease than the appearance of either abnormality alone.

Dr. Bearn and Dr. Kunkel have since shed considerable light on the biochemistry of the disease. It had been shown else-

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THE STRUCTURAL chemical formulas of the pigments, chlorophyll and heme, show at once their close similarity. Protoporphyrin, a pink molecule, is the common precursor of them both. Chlorophyll, in the cells of green plants, and heme, in the red blood cells of animals, assist in the reciprocal movement of carbon dioxide and oxygen from the atmosphere into organic life and to the atmosphere again.

Some forms of life employ other pigments for the same purpose, always a complex protein containing a metal atom. Certain worms have a green blood containing iron (chlorocruorin) and the blood of most insects contains a blue copper pigment (hemocyanin).

where that the nervous disorders and cirrhosis of the liver are the result of deposits of copper in brain and liver tissues, and other organs may also be affected. This seemed hard to explain if the blood of patients with Wilson's disease, which one would suppose carried the copper to the affected tissues, is actually deficient in copper. Bearn and Kunkel found that the blood of affected individuals contains little or no ceruloplasmin, a protein that contains copper, so named because it is blue when purified. This protein binds the copper in our blood tightly to itself. If it is absent the copper in the blood is carried instead by albumin, which does not hold it firmly. The loosely bound copper is quickly and easily deposited in certain tissues, where it causes damage. Normal blood contains more copper than that of diseased patients, but most of it is safely held in ceruloplasmin. Diseased patients have less total copper in their blood, but it is only precariously held by the albumin.

The absence of ceruloplasmin in patients with Wilson's disease is presumed to be a metabolic disorder caused by the absence of a certain enzyme at some point in the biochemical chain leading to the synthesis of ceruloplasmin, and the missing enzyme is presumably the result of a defective gene. Evidently a single normal gene is sufficient to assure an adequate supply of ceruloplasmin, for the parents of patients with Wilson's disease (each of whom must bear one normal and one defective gene) have never been found to show any of its symptoms. Incidentally, though for a long time there was strong suspicion that Wilson's disease was caused by a recessive genetic defect, the families of earlier cases had never been studied systematically with this question in mind, and the presumption was not clearly demonstrated. Dr. Bearn's search for cases of Wilson's disease and his studies of the entire families of patients have provided convincing evidence, however, that it behaves genetically as would be expected. It was found, for example, that nearly two-thirds of the marriages that resulted in the cases of Wilson's disease studied by Bearn were between second cousins or closer relatives.

Dr. Bearn has considered possible means of treating Wilson's disease with some success. Some patients have lived for several months on a diet as free as possible from copper with some improvement, but hardly worth the astringency of the treatment. One of the diets consisted largely of egg yolks. He has also attempted to remove the copper deposited in the affected tissues, and some of the means tried have uniformly increased the excretion of copper. But though this is biochemically satisfying, clinical improvements have been unpredictable. Perhaps one day it will be possible to discover the specific enzyme or missing component in the biochemical scheme leading to the formation of ceruloplasmin and provide this, just as Tatum provided the necessary growth factors to his defective bacteria. This is the basis for the well-known treatment of diabetes, where a metabolic fault, which is in some cases, at least, of genetic origin, is compensated for by injections of insulin, a hormone normally produced by the pancreas. A more fundamental way of dealing with the disease would be to avert the combination of two defective genes in the same individual. To do this some way is needed to determine whether an apparently normal individual carries one defective gene. A plausible hypothesis is that the ceruloplasmin levels in such individuals may be lower than normal. It appears that statistically there may be such a difference, and in cases of really low levels in normal appearing individuals the diagnosis can be made with confidence. But individual differences are great; moreover, compensating factors may produce a normal amount of ceruloplasmin even with one damaged gene. Thus, detection of the recessive gene on the basis of differences in ceruloplasmin level alone would be unreliable.

Dr. Bearn hopes, however, that it may be possible to devise some biochemical stress involving copper metabolism which produces a clearly abnormal and easily detectable response in those with one defective gene of Wilson's disease. Conceivably, when more of the biochemistry of copper metabolism is understood, a microorganism may be found in which copper is used in the same way as in man. With biochemical studies of induced mutations such as those Tatum and Granick have studied, the missing metabolism link in Wilson's disease may some day be discovered. Perhaps no better example of the unity within diversity of organic life could have been found than the inter-relation of these studies of bread mold, pond scum, and a rare nervous disease of man.

## HIGH SCHOOL STUDENTS VISIT THE INSTITUTE

DURING THE YEAR since the last annual visit of high school and college students interested in science the entire nation's attention has been focused on this critically important period in training the future's scientists. But the Institute's attention to this problem is long-standing, and the visits of young people have already become a tradition. The visit this year, on May 22, coincided with a visit by a group of 85 science teachers from elementary and high schools in New York and its environs, arranged in cooperation with Mr. Earl Ubell, Science Editor of The New York Herald Tribune.

About thirty students together with their science teachers visited the Institute from the Abraham Lincoln High School in Brooklyn, the Walton High School in the Bronx, the New York High School of Commerce, the Biology Club of Nyack High School, the Science Club of Scarsdale High School, and the Centenary College for Women in Hackettstown, New Jersey.

Dr. Douglas Whitaker and Dr. Ernest Smillie arranged a program of special interest to the students and their teachers. This began with a luncheon in Abby Aldrich Rockefeller Hall, attended by Drs. Braun, Moses and Weiss, whose laboratories were later visited. George Collins, Director of the Animal House, showed some of the problems in dealing with experimental animals, and Audrey Evans showed the Media Room and some of the biological techniques involving the use of special media.

Dr. Stonier of Dr. Braun's laboratory presented a lecture and demonstration on plant pathology, Dr. Moses of Dr. Porter's laboratory demonstrated the electron microscope, discussing examples of its use, and Dr. Weiss presented his work on cell architecture, showing his time-lapse moving pictures of cell locomotion and tissue growth.

# ROCKEFELLER INSTITUTE CHAPTER OF THE SIGMA XI INAUGURATED

THE ROCKEFELLER INSTITUTE Chapter of the Society of the Sigma Xi received its Charter at an Installation Ceremony in Caspary Auditorium on May 13, 1958. Installing Officer was Dr. Frank M. Carpenter, President-elect of the Society of the Sigma Xi and Chairman of the Department of Biological Sciences at Harvard University. Dr. Carpenter presented the Charter of the new Chapter to Dr. Norman R. Stoll, who had been elected President of the Institute Chapter earlier in the day. Dr. Walther F. Goebel was elected Vice-President; Dr. James S. Murphy, Secretary; and Dr. Herbert Jaffe, Treasurer.

In his charge to the new Chapter, Dr. Carpenter observed that in many ways the Institute Chapter is unique as the Institute's graduate education program is unique. He urged the officers and ninety-six charter members to look to no other Chapter as their guide but to bring their highest imagination and devotion to the challenging task of giving life to the new organism for which they would have responsibility.

In accepting the Charter on behalf of The Rockefeller Institute from Dr. Stoll, President Bronk, a member of the Council of the Society, made the following remarks:

I would add few words to those of Professor Carpenter regarding the significant role of the Society of the Sigma Xi in our Institution of higher learning.

Seventy-two years ago, when our Society was created, it was needed to encourage research because there was so little in this country. Today there is need for Sigma Xi because there is so much research.

In the earlier times research was done by scholars at great personal sacrifice, with little encouragement and with less assistance, if they were driven by their curiosity. Usually research was the avocation of those who earned their living by teaching, preaching, or other service. Now many do research as a livelihood; research is often a profession and, all too often, a trade rather than a calling. Many of those who now prepare for careers of research find it necessary to continue investigation without the stimulus of curiosity; they have no other training for the earning of a living. As I think of these considerations during budget days in Washington, I often wonder how we shall use the added millions we request for the furtherance of our national welfare and the employment of still more investigators without eroding the spirit of science.

I realize full well the necessity for scientific research as a means of gaining new knowledge necessary for the solution of new problems. It is essential to the survival of our culture and our nation. Scientific research is necessary to the continuance of human life itself in our ever more complex civilization.

In this University, devoted mostly to the sciences of life, we are acutely aware of the need to solve urgent problems posed by man's creation of a new environment for man and by the extension of his power. Such achievements of physical scientists and engineers make it more desirable than ever that we bring them and biologists and physicians closer together.

Certainly the work of countless scientists who are technicians, as well as the work of scientists who are scholars, is needed for the solution of countless problems that are practical and urgent.

But having said all this, I would go on to plead for the continuance of research as a great intellectual adventure on the frontiers of knowledge. I would plead for some institutions which give modest emphasis on scientific careers which are scholarly careers. I would hope that freedom for the achievement of excellence will be recognized as a necessary foundation for the great development of scientific enterprise in this nation.

And so Sigma Xi, which seventy-two years ago was created to stimulate research, now has a great opportunity to keep alive the spirit and the ancient high ideals of science.

In accepting the Charter of this new chapter I pledge devotion of The Rockefeller Institute to the furtherance of science as a great odyssey of the human spirit.

Among the distinguished guests who attended the ceremonies were: Dr. Wallace R. Brode, Science Advisor to the Department of State, Dr. Elmer Hutchisson, Director of the American Institute of Physics, and Dr. George H. Boyd, Dean of the Graduate School and Director of Research at the University of Georgia, who is President of the Society of the Sigma Xi. Dr. Boyd presented formal notice to the Institute Chapter that its petition for establishment had been accepted, and he informed us that the Institute's Chapter is the 132nd to be established in the seventy-two year history of the Society. In another respect, also, history was made on this occasion, for it was the first time that members of the faculty appeared in Caspary Auditorium in academic costume.

After a reception and banquet in Welch Hall the ninety-six charter members of the Institute Chapter and their guests received greetings and congratulations from representatives of Sigma Xi Chapters at other Institutions. Among those so represented were the Alpha Chapter of Cornell University, the first Sigma Xi Chapter to be established, and, in order of seniority, Yale University, the University of Pennsylvania, Columbia University, Rutgers University, Brooklyn Polytechnic Institute, Amherst College, Stevens Institute of Technology, and Brooklyn College. Sigma Xi Clubs at the University of Delaware and the Georgetown University School of Medicine as well as the Triple Cities Club at Endicott, New York, also presented their greetings.

The Officers of the new Chapter are now at work planning a program of activities for the next academic year, news of which will appear in future issues.

## FIFTY YEARS AGO AT THE ROCKEFELLER INSTITUTE

### *Surgical Operations in a Vacuum*

BEFORE about 1906 surgical operations on the human lungs were practically out of the question because once the chest was opened the lungs collapsed, no longer being kept distended by the negative pressure that normally exists in the thoracic cavity. In June 1908 the celebrated German surgeon Ernst F. Sauerbruch demonstrated at The Rockefeller Institute, on a dog, an elaborate apparatus which he had brought from Marburg, consisting of a cabinet large enough to permit two surgeons to work inside it on a patient whose head was outside, his neck being surrounded by a gasket, while his body was inside under partial vacuum, sufficient to distend the lungs.

According to The New York Times, June 22, a spokesman for the Institute stated that it would install a similar but much larger cabinet. The next year, however, Samuel J. Meltzer, head of the physiological laboratory of the Institute, and his colleague and son-in-law, John Auer, announced the invention of an incomparably simpler method, that of intratracheal insufflation, by which the lungs are distended by positive pressure of air introduced through a tracheal tube.

This permanently ended experiments with negative pressure chambers in thoracic surgery.

## PRESIDENT BRONK AND ACADEMIES OF SCIENCE

THREE ELECTIONS announced during the past few months focus attention upon the remarkable record of President Bronk in Academies of Science throughout the world.

At the 95th annual meeting of the National Academy of Sciences of the United States Dr. Bronk was elected President for his third consecutive four-year term. This is the first time in the history of the Academy that a member has been thus honored. His first presidency followed five years as Foreign Secretary. Among Dr. Bronk's distinguished predecessors in the presidential chair were: Alexander Dallas Bache, Joseph Henry, Alexander Agassiz, Ira Remsen, William Henry Welch, A. A. Michelson, Thomas Hunt Morgan, Frank Jewett and A. N. Richards.

From abroad have come reports that President Bronk has been elected a Foreign Member of the Royal Swedish Academy of Science and of the Academy of Sciences of the USSR. Both elections were stated to be in recognition of his outstanding discoveries in neurophysiology, to which the Soviet Academy added "and in the fields of biophysics and aviation medicine." During the past ten years three other Academies have conferred such honors on Dr. Bronk: The Royal Society of London, the French Academy of Sciences and the Royal Danish Academy of Sciences and Letters. Benjamin Franklin was the first American to be a foreign member of a European Academy and he, too, was a member of five; few since then have attained that distinction.

## SEMINARS IN PHYSICAL CHEMISTRY

TO HELP THE GRADUATE FELLOWS at The Rockefeller Institute acquire a sound background in physical chemistry Dr. Shedlovsky, Member and Professor, organized a seminar program of unusual interest during the academic year just past. Approximately three months at the beginning of the year were devoted to providing a solid core of chemical thermodynamics under Dr. Norman Sutin, Associate Chemist at the Brookhaven National Laboratory and an Affiliate at the Institute. Dr. Sutin presented problems during weekly lectures which were later discussed in detail at work sessions of several hours' duration.

Following Dr. Sutin's introductory work, seminars were presented on specific topics in physical chemistry of particular interest to research in biology. The determination of molecular weights with the aid of the ultracentrifuge was discussed by Dr. Longsworth, and Dr. Rothen discussed the physical chemistry of surface films and its bearing on the structure and permeability of biological membranes. Dr. Walter Kauzmann of Princeton University considered the denaturation of proteins in the light of recent ideas on this subject, and Dr. Arthur Tobolsky, also of Princeton, discussed the mechanical behavior and structure of polymers. X-ray analysis of crystal structure and the use of X-ray spectroscopy in determining the elementary composition of mixtures were covered by Dr. I. Fankuchen of the Brooklyn Polytechnic Institute. Peter Debye, now Emeritus Professor at Cornell, discussed the structure and theory of the electrical double layer, a subject of fundamental importance in electrochemistry with promising implications for bioelectrics. Three of the Graduate Fellows themselves, Allen Edmundson, Lewis Greene, and David Eaker presented seminars on crystal structure, ion exchange resins, and protein titration curves.

On a more relaxed note the seminar adjourned for the year with an informal dinner and social evening in Abby Aldrich Rockefeller Hall. In the Fall the series will be resumed with seminars on transport phenomena, electrochemistry, reaction kinetics and radioactivity.

## INSTITUTE ACADEMICIANS

THE ELECTION of Professor Walther Goebel to membership in the National Academy of Sciences brings to thirty the number of Institute faculty who hold this distinguished honor. Of these, eight have been elected or have come to the Institute within the past five years. In addition to the thirty, there are ten of our visiting professors and eight trustees who are Academicians. This is a remarkable record for a faculty numbering only 147.

## ASSOCIATION FOR THE HISTORY OF MEDICINE

THE ROCKEFELLER INSTITUTE and the New York Academy of Medicine were co-hosts to the American Association for the History of Medicine at its thirty-first annual meeting May 22, 23 and 24, 1958. Opening and closing sessions of the meeting were held at the New York Academy of Medicine, and the morning and afternoon scientific sessions on the second day were held at The Rockefeller Institute. After presentation of contributed papers during the morning session, a buffet luncheon was given in Abby Aldrich Rockefeller Hall. The afternoon session in Caspary Auditorium was devoted to a symposium on the History of the Drug House.

Dr. George W. Corner, Historian of The Rockefeller Institute, presided at the morning session in Caspary Auditorium. Five papers making up the program ranged from an account of the 16th-17th Century poet-physician, Thomas Campion, to a report on the National Institutes of Health Research Grants program. President Bronk, in welcoming the 100 members and guests of the Association to the Institute, briefly outlined his concept of the relation between science and æsthetics that has been manifested in the development of the beautiful new facilities at the Institute. Dr. Bronk's remarks so inspired one of the members of the Association, Dr. Chauncey D. Leake, well-known pharmacologist and medical historian of the Ohio State University, that he composed a sonnet in blank verse for the occasion which we print here, with his kind permission, for the first time:

To Doctor Detlev Bronk and his associates in response to his moving welcome to the American Association for the History of Medicine at The Rockefeller Institute.

Within the dignity of gardened grounds,
Where brilliant probing of the mysteries
Of living comes to understanding wise,
And practical, you've made a haven for
The intellect, a refuge in our rough
Tumultuous world, for wisdom and for peace.
Here unite a faith in goodness with
The beauty of the lithe asymmetry
Of nature and the rocky search for truth.
Here there is a miracle that you
Have wrought in making steel and
concrete serve
The fragile mind; here you give the clue
To link our science to humanity,
Our sense of goodness, beauty, to the true.

# FACULTY ACTIVITIES

## Academic Honors

DETLEV W. BRONK
SC.D., Kenyon College
LL.D., Lafayette College
LL.D., Miami University

GEORGE W. CORNER
DR. MED. SC. (Hon.), Woman's Medical College of Philadelphia
SC.D., University of Chicago

ARPAD I. CSAPO
Honorary Professor, Faculty of Medicine, University of Bahia, Brazil

RICHARD E. SHOPE
SC.D., University of Chicago

D. WAYNE WOOLLEY
LL.D., University of Alberta

## Academic Appointments

GABRIEL C. GODMAN
Associate Professor, Department of Microbiology, College of Physicians and Surgeons, Columbia University

## Lectures, Conferences and Symposia

GEORGE ACS
Participant, Gordon Research Conference on Proteins and Nucleic Acids.

A. G. BEARN
Participant, Symposium on Liver Diseases, Annual Meeting, American College of Physicians.

CARL BERKLEY
Lecture, "Electronic Capsules in Gastrointestinal Investigations", Professional Group on Medical Electronics—Institute of Radio Engineers, Milwaukee Chapter.
Lecture, "Applications of Ultraviolet Color-translating Television Microscopy", Royal Microscopical Society, London.
Lecture, "Medical Data Processing", International Conference on Medical Electronics, Paris.

ARMIN C. BRAUN
Lecture, "The Nature of Autonomous Growth in Neoplastic Plant Cells", Department of Botany, Yale University.
Lecture, "A Physiological Basis for the Autonomous Growth of Crown-Gall Tumor Cells", Division of Biological Sciences, Northwestern University.

DETLEV W. BRONK
Commencement Address, California Institute of Technology.
Address, Seventh Annual Meeting, Building Research Institute.
Opening Address, Conference on Bio-Astronautics, Washington.
Symposium on the Education of the Gastroenterologic Internist, World Congress of Gastroenterology, Washington.

MERRILL W. CHASE
Lectures, "Immunology" and "Recent Studies in Antibody Formation and Transfer", Fourteenth Annual Postgraduate Course in Allergy, the American College of Allergists.

GEORGE W. CORNER
Commencement Address, Woman's Medical College, Philadelphia.
Address, "American Contributions to Knowledge of the Reproductive Cycle, 1900-1958", Dedication of the Research Pavilion, Lying-in Hospital, Chicago.
Address, "The Physiology of Reproduction, Retrospect and Prospect", on receipt of the Passano Award, Annual Meeting, American Medical Association.

LYMAN C. CRAIG
Chairman and participant, Symposium on Recent Developments in Separation Methods, American Society of Biological Chemists.
Chairman, Gordon Research Conference on Separation and Purification.

ARPAD I. CSAPO
Participant, 17th Growth Symposium, Society for the Study of Development and Growth, Mount Holyoke College.
Participant, Gordon Research Conference on Cell Structure and Metabolism: the Muscle Cell, Kimball Union Academy.
Lecture, Department of Obstetrics, University of Rio de Janeiro.
Lecture, Department of Obstetrics and Physiology, University of Sao Paulo.
Lecture, Department of Obstetrics and Biophysics, University of Montevideo.
Lecture, Endocrinological Society, Buenos Aires.

HOWARD G. DAVIES
Lecture, "On Microscope Interferometry and the Specific Refraction Increment of a Crystalline Protein", the Histochemical Society.
Lecture, "The Nucleic Acid and Protein Content of Nuclei in Mouse Tissue", Department of Zoology, Columbia University.
Participant, Symposium on Microscopy, Chicago.

RENÉ J. DUBOS
Addresses, "The Host in Tuberculosis" and "Tuberculosis in Literature and Art", Canadian Tuberculosis Association, Quebec.
Blackader Oration, "The Evolution of Infectious Diseases in the Course of History"; and "The Production of Immunity to Tuberculosis by Fractions Derived from Killed Tubercle Bacilli", Annual Meeting, Canadian Medical Association.
Address, "Medical Progress and Social Goals", Convention of National Congress of Parents and Teachers, Omaha.
Address, "The Host in Tuberculosis", Dutch Association of Lung Physicians, the Netherlands.
Participant, UNICEF Meeting on BCG Standardization, Paris.
Participant, National Advisory Council Meetings of the National Institute of Allergy and Infectious Diseases.
Lecture, "Tulipomania and the Concept of Disease", New York Academy of Sciences.
Address, "Nutrition, Emotion, and Infection", on receipt of the Howard Taylor Ricketts Award, University of Chicago.

# *FACULTY ACTIVITIES*

*(continued from page nine)*

LARS ERNSTER

Lecture, "Diaphorase Activities in Liver Cytoplasmic Fractions", Federation of American Societies for Experimental Biology.

Lecture, "Recent Studies on Oxidative Phosphorylation", Public Health Research Institute of the City of New York.

Lecture, "Some Recent Aspects of Mitochondrial Oxidative Phosphorylation", Department of Bacteriology, Harvard Medical School, Boston.

Lecture, "Some Recent Studies on Mitochondrial Energy Transfer", Department of Biology, Brown University.

Lecture, "Diaphorase and Its Relation to Cytoplasmic Structures", Department of Biochemistry, Albert Einstein Medical College, Yeshiva University.

Lecture, "Recent Studies on Oxidative Phosphorylation", Department of Physiological Chemistry, The Johns Hopkins Medical School.

Lecture, "Flavin Phosphate, an Intermediate in Oxidative Phosphorylation", Johnson Research Foundation, University of Pennsylvania.

Lecture, "Flavins and Mitochondrial Oxidative Phosphorylation", Department of Cellular Physiology and Metabolism, National Heart Institute.

Participant, Symposium on Subcellular Particles and their Functions, Annual Meeting, Society of General Physiology.

WALTHER F. GOEBEL

Participant, Seminar on Colicine-K, Department of Zoology, Columbia University.

FRANCIS O. HOLMES

Lecture, "Inheritance of Resistance to Diseases Caused by Viruses in Plants", Rutgers University.

FRANK L. HORSFALL, JR.

Medical Advisory Committee Meeting, National Foundation for Infantile Paralysis.

Participant, Panel on Viral Infections of the Respiratory Tract, American Academy of Pediatrics.

Lecture, "Can Viruses be Managed?", Annual Meeting, American Philosophical Society.

Participant, Panel on Viral Diseases, Annual Session, American College of Physicians.

Lecture series, "Introductory Medicine", Cornell University Medical College.

ROLLIN D. HOTCHKISS

Participant, Conference on Genetic Approaches to Somatic Cell Variation, Oak Ridge National Laboratory.

Participant, Biology Seminar, Substrate Analysis of Sulfonamide Resistance in Pneumococcus, Massachusetts Institute of Technology and Harvard University.

Participant, Symposium on Exchange of Genetic Material: Analysis of the Complex Sulfonamide Resistance Locus of Pneumococcus, Cold Spring Harbor.

Participant, 3rd Canadian Cancer Research Conference: Functions and Limitations of the Deoxyribonucleic Acids in the Organization of Biosyntheses.

CHARLES W. JOHNSON

Lecture, "The Relation of Antibody to the Onset of Dermal Hypersensitivity to Chemical Allergens", Society of American Bacteriologists, Chicago.

TE PIAO KING

Participant, Symposium on Recent Developments in Separation Methods, American Society of Biological Chemists.

HENRY G. KUNKEL

Lecture, "Abnormal Gamma-Globulins", New York Academy of Sciences.

FRITZ A. LIPMANN

Chairman, Protein Synthesis Session, Gordon Research Conference on Proteins and Nucleic Acids.

DAVID P. C. LLOYD

James Arthur Lecture on the Evolution of the Human Brain: "The Discrete and the Diffuse in Nervous Action", The American Museum of Natural History.

KARL MARAMOROSCH

Lecture, "Arthropod-borne Plant Viruses and their Multiplication in Plants and in Animals", Rutgers University.

Address, "Plant Viruses and Medical Research", Annual Meeting, Westchester Science Teachers Association.

Lecture, "Viruses, Vectors, Vegetables", Scarsdale Sigma Xi Spring Meeting.

A. GEDEON MATOLTSY

Lecture, "The Chemical Composition of the Horny Layer of the Skin of Normal Persons and Patients with Psoriasis", Durhing Laboratories, University of Pennsylvania.

Lecture, "Keratinization of Embryonic Skin", Nineteenth Annual Meeting, the Society for Investigative Dermatology.

ALFRED E. MIRSKY

Participant, Symposium on the Physiological Relationship Between Nucleus and Cytoplasm, International Society of Cell Biology, Brussels.

DAN H. MOORE

Participant, Symposium on the Factors Influencing Exchange of Substances across the Capillary Wall, American Association of Anatomists.

MONTROSE J. MOSES

Lecture, "Aflagellate Spermiogenesis in the Crayfish", American Association of Anatomists.

Participant, Conference on Preparation of Specimens for Cell Measurements, National Cancer Institute.

Lecture, "Cytochemistry, Electron Microscopy and the Organization of Chromosomes", Department of Biophysics, Yale University.

Lecture, "The Fine Structure and Cytochemistry of Chromosomes", School of Medicine, Duke University.

Lecture, "A Cytochemical and Electron Microscopical Study of the Formation of Tailless Sperm in Crayfish", Department of Zoology, Columbia University.

Chairman, Gordon Research Conference on Cell Structure and Metabolism.

Guest Lecturer, Summer Course in Electron Microscopy, Cornell University.

MAN-CHIANG NIU

Participant, Symposium on Morphogenesis, Annual Meeting, Tissue Culture Association.

GEORGE E. PALADE

Lecture, "Functional Association of Mitochondria and Lipide Inclusions", American Association of Anatomists.

Participant, Symposium on Subcellular Particles and their Function, Annual Meeting, Society of General Physiology.
Participant, Gordon Research Conference on Cell Structure and Metabolism.
Participant, Gordon Research Conference on Nucleic Acid and Proteins.

HARRY D. PECK
Lecture, "The Incorporation of Valine-1-$C^{14}$ into Peptides by a Cell-Free Extract of Pseudomonas Hydrophila", Society of American Bacteriologists, Chicago.

S. WILLIAM PELLETIER
Commencement Address, The Gateway School, Hackensack, New Jersey.

GERTRUDE E. PERLMANN
Lecture, "Studies on Pepsin", National Heart Institute.

KEITH R. PORTER
Lecture, "Cell Fine Structure and Pathology", Armed Forces Institute of Pathology.
Participant, Gordon Research Conference on Cell Structure and Metabolism: The Muscle Cell.
Lecture, Cornell University Summer Course in Electron Microscopy.
Lecture, "The Liver Cell", Institut Divi Thomae, West Palm Beach, Florida.

MURRAY RABINOWITZ
Lecture, "The Reversibility of Phosphate Transfer Between Phosvitin and ATP", Federation of American Societies for Experimental Biology.

MARIA A. RUDZINSKA
Lecture, "Feeding by Malaria Parasites", the New York Society of Tropical Medicine.

HOWARD A. SCHNEIDER
Address, "Metaphysical Elements in the History of Nutrition", Cornell Medical History Society, Cornell Medical School.
Address, "Physiological and Ecological Aspects of Public Health", 18th Eastern States Health Education Conference, New York Academy of Medicine.
Lecture, "Experimental Epidemiology", Fort Detrick, Maryland.
Participant, Neurology Seminar, State University of New York, College of Medicine, Brooklyn.

RICHARD E. SHOPE
Lecture, "Incidental Observations Made on A Medical Mission to Russia", Annual Meeting, American Philosophical Society.

PHILIP SIEKEVITZ
Lecture, "Cytochemical Studies on Protein Synthesis in the Pancreas", National Heart Institute.

NORMAN R. STOLL
Participant, Conference on Axenic Culture of Invertebrate Metazoa: A Goal, New York Academy of Sciences.

ALFRED STRACHER
Lecture, "Separation and Characterization of Proteins and Polypeptides by Partial Dialysis", State University of New York, College of Medicine, Brooklyn.

IGOR TAMM
Participant, Eighth Symposium of the Society for General Microbiology, on the Strategy of Chemotherapy, Royal Institution, London.
Lecture, "Chemical Augmentation of Influenza Virus Multiplication", Max Planck Institute for Virus Research, Tübingen, Germany.

WILLIAM TRAGER
Session Chairman, Conference on Axenic Culture of Invertebrate Metazoa: A Goal, New York Academy of Sciences.
Participant, Meeting of Parasitology and Tropical Medicine Study Section of the National Institutes of Health, San Francisco.

PAUL A. WEISS
Lecture, "Problems of Structure Formation", University of Brussels.
Participant, Seminar on Differentiation, Cell Surface and Cancer, Chester Beatty Research Institute, London.
Lecture, "Experiments on Microstructure", Cambridge University.
Litchfield Lecture in Medicine, Oxford University.
Participant, Symposium on Space Biology, National Research Council.
Lecture, "Current Developments in Biology", Committee on Biology and Medicine, University of Chicago Press.
Lectures, "Trends in Biology", Summer Institute for High School Science Teachers, Alabama College.
Lecture, "Surface Specificity and Surface Interactions of Cells", University of Giessen.
Message of U. S. Science, Symposium on Man at the Threshold of the Atomic Age, Brussels World's Fair.
Lecture, "Cells and Ground Substance in Tissue Organization", University of Milan.
Lecture, "Cell Locomotion", Ciba, A. G., Basel.

SAMUEL B. WEISS
Lecture, "Reaction of Tryptophan with Tryptophan-Activating Enzyme Bound Acceptor", Federation of American Societies for Experimental Biology.
Participant, Gordon Research Conference on Proteins and Nucleic Acids.

STEVEN L. WISSIG
Lecture, "An Electron Microscope Study of the Permeability of Capillaries in Muscle", American Association of Anatomists.

HANS GEORG ZACHAU
Participant, Gordon Research Conference on Proteins and Nucleic Acids.

VLADIMIR K. ZWORYKIN
Lecture, "Ultraviolet Color-translating Microscope", International Conference on Medical Electronics, Paris.

## *Society Elections*

A. G. BEARN
Member, Harvey Society.
Member, American Society for Clinical Investigation.

DETLEV W. BRONK
Elected President of the National Academy of Sciences.
Elected Foreign Member of the Academy of Sciences of the U.S.S.R.

VINCENT P. DOLE
Vice President, American Society for Clinical Investigation.

GABRIEL C. GODMAN
Council, the Histochemical Society.

# FACULTY ACTIVITIES

*(continued from page eleven)*

WALTHER F. GOEBEL
Member, National Academy of Sciences.

ROLLIN D. HOTCHKISS
Fellow, American Academy of Arts and Sciences.

KARL MARAMOROSCH
Secretary-Treasurer, Scarsdale Society of the Sigma Xi.

VICTOR H. WITTEN
Member, American Dermatological Association.

## *Other Appointments and Distinctions*

DETLEV W. BRONK
Trustee, Bucknell University.
Citation, Lord & Taylor Award Luncheon for America's Unofficial Ambassadors.
Honor Award Citation, The Johns Hopkins Alumni Association.
Honorary Member, National Association of Science Writers.
Member, National Science Planning Board Advisory to World Science, Pan-Pacific Exposition.
Member, Health Research Advisory Council, Department of Health, City of New York.
Honorary Civilian Consultant to the Surgeon-General, U. S. Navy.
Member, Medical Advisory Council of MEDICO, New York.
Member, Sponsors Council, 250th Anniversary of Trinity School, New York.

GEORGE W. CORNER
Passano Award for 1958, American Medical Association.
Council, American Association for the History of Medicine.
Member, Committee on Meetings, American Philosophical Society.
Member, Committee for Selection of Fellows, John Simon Guggenheim Foundation.

RENÉ J. DUBOS
Recipient, 1958 Howard Taylor Ricketts Award, University of Chicago.
Member, Committee on Polar Research, National Academy of Sciences.

FRANK L. HORSFALL, JR.
Member, Lasker Awards Committee, American Public Health Association.

HENRY G. KUNKEL
Member, Panel on the Future Status of Germ-free Animal Research, New York Academy of Sciences.

FRITZ A. LIPMANN
Chairman, Nominating Committee, American Society of Biological Chemists, Inc.

THOMAS MILTON RIVERS
Enrolled in the Polio Hall of Fame, 20th Anniversary of the Founding of the National Foundation for Infantile Paralysis.

PAUL A. WEISS
Member, Executive Committee, International Society for Cell Biology, Liège, Belgium.
Member, Committee on the Lashley Award in Neurobiology, American Philosophical Society.

DOUGLAS M. WHITAKER
Member, Committee on Social Sciences, Board of the National Science Foundation.
Member, Board of Trustees, Science Service; nominated by The American Association for the Advancement of Science.

# INSTITUTE MENTION

## *New Appointments to the Faculty*

DR. ELSIMAR COUTINHO, who was in the Department of Physiology at the University of Bahia, has been appointed Guest Investigator in Dr. Csapo's Laboratory, beginning June 15, 1958.

DR. ARTHUR M. CRESTFIELD, who has been a Research Biochemist at the University of California School of Medicine, has been appointed Research Associate in the Laboratory of Drs. Moore and Stein.

DR. JOHN W. FARQUHAR, formerly a member of the University of California School of Medicine, has been appointed Research Associate and Assistant Physician to the Hospital, and will be associated with Dr. Ahrens.

DR. JOHN H. FRENSTER, who has been in the College of Medicine of the University of Illinois, has been appointed Guest Investigator to work in association with Dr. Alfred E. Mirsky, beginning July 1, 1958.

DR. HERMAN H. FUDENBERG, who was a Resident Physician at Peter Bent Brigham Hospital in Boston, has been appointed Research Associate and Assistant Physician to the Hospital, to work in Dr. Henry Kunkel's Laboratory.

DR. AUDREY GLAUERT, of the Microbiology Department at Strangeways Laboratory in Cambridge, England, has been appointed Guest Investigator and Fellow beginning May 1, 1958, to work in the Laboratory of Cytology.

DR. MASAYOSI GOTO, Professor of Physiology at the University of Kagoshima, Japan, was appointed Guest Investigator on June 15, 1958, and will work in association with Dr. Csapo.

DR. SYLVIA F. JACKSON, formerly with the Lovett Memorial Laboratory, Massachusetts General Hospital, has been appointed Assistant Professor, to work in association with Dr. Paul Weiss.

MR. MOSES LIEBERMAN, who has been at New York University-Bellevue College of Medicine, has been appointed a Guest Investigator, effective June 12, 1958, to work with Dr. Norton Zinder.

DR. SVEN LINDSTEDT, formerly in the Department of Physiological Chemistry at the University of Lund, Sweden, has been appointed Guest Investigator in Dr. Ahrens' Laboratory, beginning May 6, 1958.

DR. HEINZ MEINERTZ, formerly at Sundby Hospital in Copenhagen, has been appointed Research Associate and Assistant Physician to the Hospital, and will be associated with Dr. Dole and his colleagues.

MR. EDWARD J. MURPHY, formerly in the Department of Solid State Physics in the Bell Laboratories, Murray Hill, New Jersey, has been appointed Guest Investigator, effective July 1, 1958, to work with Drs. Brink and Shedlovsky.

DR. ELLIOTT ROBBINS, who has been in the Biophysics Department at Yale University, has been appointed Guest Investigator to work in Dr. Paul Weiss' Laboratory, beginning July 1, 1958.

MR. SIDNEY ROSEN, who has been doing electron microscopy in the Neuropathology Department of the New York State Psychiatric Institute, has been appointed a Guest Investigator and Fellow, effective May 1, 1958, and will work with Dr. Dan Moore.

DR. JOEL ROTHSCHILD, who recently received a Ph.D. in Biochemistry from the College of Physicians and Surgeons, Columbia University, has been appointed Guest Investigator, to work with Dr. Palade, effective July 1, 1958.

DR. ROBERT L. SCHOENFELD, Electronic Engineer at the Institute, has been appointed Assistant Professor.

DR. J. ROBERTO SOTELO, formerly at the Instituto de Investigación de Ciencias Biológicas, Montevideo, has been appointed a Guest of the Institute beginning July 1, 1958, and will work with Dr. Keith Porter.

DR. A. SREENIVASAN, formerly Professor in the Department of Chemical Technology at the University of Bombay, has been appointed a Guest Investigator beginning June 1, 1958, and will work with Dr. Siekevitz.

DR. DONALD B. ZILVERSMIT, who was Professor of Physiology at the University of Tennessee, has been appointed Guest Investigator effective June 1, 1958, to work with Dr. Ahrens in his Laboratory.

## *Faculty Promotions*

DR. HALSTED R. HOLMAN, who has been a Research Associate and Assistant Physician to the Hospital, working in Dr. Henry Kunkel's Laboratory, has been appointed an Assistant Professor.

DR. REBECCA C. LANCEFIELD, who has been an Associate Professor in Dr. McCarty's Laboratory, has been made Member and Professor of the Institute.

DR. ROBERT BRUCE MERRIFIELD, who has been an Assistant Professor in Dr. D. Wayne Woolley's Laboratory, has been appointed Associate Professor.

DR. WILLIAM H. MILLER, Research Associate in Dr. H. Keffer Hartline's Laboratory, has been appointed an Assistant Professor.

DR. GERTRUDE E. PERLMANN, formerly Assistant Professor, has been appointed Associate Professor.

DR. FLOYD RATLIFF, who has been an Assistant Professor in Dr. H. Keffer Hartline's Laboratory, has been appointed an Associate Professor.

DR. CLAYTON RICH, formerly Research Associate and Assistant Physician to the Hospital, working in Dr. Archibald's Laboratory, has been appointed an Assistant Professor.

DR. A. CECIL TAYLOR, who has been an Assistant Professor in Dr. Paul Weiss' Laboratory, has been appointed Associate Professor.

DR. VICTOR J. WILSON, formerly a Research Associate in Dr. David Lloyd's Laboratory, has been appointed Assistant Professor.

## *Newly Appointed Graduate Fellows*

PREDOCTORAL FELLOWS

BARRY R. BLOOM, Amherst College.
RICHARD A. CELLARIUS, Reed College.
BRIAN A. CURTIS, University of Rochester.
ERIC H. DAVIDSON, University of Pennsylvania.
JOHN W. B. HERSHEY, Haverford College.
JOHN J. HUTTON, Harvard University.
JOAN KENT, Barnard College.
RICHARD PURPLE, Hamilton College.
CLIFFORD L. SLAYMAN, JR., Kenyon College.
JOSEPH W. VANABLE, JR., Brown University.
RICHARD WOLFENDEN, Princeton University and Oxford University.
PETER WOLK, Massachusetts Institute of Technology.

POSTDOCTORAL FELLOWS

JOHN W. ENSINCK, McGill University.
DAVID J. L. LUCK, Harvard Medical School.
EDWARD REICH, The Johns Hopkins University.
THOMAS B. TOMASI, University of Vermont.
DAVID C. WHITE, Tufts University.

## *Faculty Terminations*

DR. TSUNEHISA AMANO, a Guest Investigator in Dr. Goebel's Laboratory, left the Institute May 20, 1958, to return to Osaka University Medical School in Japan.

DR. JUDITH S. BELLIN, who has been a Research Associate in Dr. Mirsky's Laboratory, left the Institute on June 30, 1958.

DR. JOHN D. BROOME, a Research Associate in Dr. Opie's Laboratory, left the Institute on May 16, 1958, to accept an appointment as Research Associate in Pathology at Cornell University Medical College.

DR. PER E. S. ENGER, who has been a Research Associate in Dr. H. Keffer Hartline's Laboratory, left the Institute on July 1, 1958, to return to the University of Oslo where he is an Assistant Professor at the Institute of Zoophysiology.

DR. LARS ERNSTER, a Guest Investigator in Dr. Porter's Laboratory, returned to the Wenner-Gren Institute, University of Stockholm, on July 1, 1958.

DR. EDWARD C. FRANKLIN, formerly a Research Associate and Assistant Physician to the Hospital in Dr. Henry Kunkel's Laboratory, left the Institute July 1, 1958; he will be an Assistant Professor of Medicine at New York University Medical School.

# *INSTITUTE MENTION*

*(continued from page thirteen)*

DR. CHRISTOPHE H. W. HIRS, an Assistant Professor in the Laboratory of Drs. Moore and Stein, has accepted an appointment as Assistant Biochemist at the Brookhaven National Laboratory, effective July 1, 1958; and he has been appointed Affiliate and Lecturer of The Rockefeller Institute as of this same date.

DR. LUIS M. H. LARRAMENDI, who has been a Research Associate in Dr. Lorente de Nó's Laboratory, left the Institute on July 1, 1958; he has been appointed Associate Professor of Neuroanatomy at the University of Illinois in Chicago.

DR. HIDENOBU MASHIMA, Guest Investigator in Dr. Corner's Laboratory, left April 30, 1958, to return to Japan where he is Professor of Physiology at Juntendo University.

DR. ROY E. RITTS, formerly a Research Associate in Dr. Chase's Laboratory, has accepted an appointment as Assistant Professor of Medicine at Georgetown University School of Medicine; he left the Institute June 30, 1958.

DR. WILLIAM C. ROBBINS, Guest Investigator and Assistant Physician to the Hospital in Dr. Henry Kunkel's Laboratory, left the Institute on June 30, 1958, to accept an appointment in the Department of Medicine, Cornell Medical College, and will be on the attending staff at New York Hospital.

DR. MARTIN F. STURMAN, who has been a Guest Investigator and Assistant Physician to the Hospital, and who worked in Dr. Dole's Laboratory, left the Institute July 1, 1958, to enter private practice in New York.

## *Visiting Professors in Residence*

DR. ALEXANDER VON MURALT, Professor of Physiology, University of Bern, April 21-25, 1958.

DR. LUDWIG EDELSTEIN, Professor of Humanistic Studies, The Johns Hopkins University, April 28-May 2, 1958.

## *Guest Speakers*

ERNST KLENK, Professor of Physiological Chemistry, University of Cologne, April 1, 1958.

JOHN R. BAKER, Reader in Cytology, Oxford University, April 8, 1958.

S. A. BERSON, Chief of Radioisotope Service, Veterans' Administration Hospital, Bronx, April 11, 1958.

EUGEN FRITZE, Professor of Internal Medicine, University of Göttingen, Germany, April 22, 1958.

A. NEUBERGER, Professor of Chemical Pathology, St. Mary's Hospital Medical School, London, April 24, 1958.

F. C. STEWARD, Professor of Botany, Cornell University, April 25, 1958.

LARS ERNSTER, The Wenner-Gren Institute, University of Stockholm, Sweden, April 30, 1958.

H. G. KHORANA, The British Columbia Research Council, University of British Columbia, Vancouver, May 6, 1958.

JORDI FOLCH-PI, Professor of Neurochemistry, Harvard Medical School, and Director of Scientific Research, McLean Hospital, Waverley, Massachusetts, May 14, 1958.

LEWIS K. DAHL, Head, Division of Research Medicine, Brookhaven National Laboratory, May 16, 1958.

A. A. MILES, Director, The Lister Institute of Preventive Medicine, London, May 20, 1958.

ROLF BLOMSTRAND, Assistant Professor in Clinical Chemistry, University Hospital, Lund, Sweden, May 23, 1958.

PIERRE FREDERICQ, Department of Microbiology and Hygiene, University of Liège, Belgium, May 26, 1958.

ARTHUR K. SOLOMON, Associate Professor of Biophysics, Director, Biophysical Laboratory, Harvard Medical School, May 27, 1958.

## *Guest Seminar in Medicine*

KURT W. DEUSCHLE, Assistant Professor of Public Health and Preventive Medicine, Cornell University Medical College, April 2, 1958.

## *New Grants and Contracts*

From the National Foundation for Infantile Paralysis in support of the following work:

Dr. Igor Tamm's investigation of biosynthetic processes in virus multiplication and the development of inhibitors of virus multiplication (2nd year of a 3-year grant, plus a supplement) $69,789

Dr. Henry G. Kunkel's study of tissue protein and tissue nucleic acid constituents and their antibodies $43,157

From the National Science Foundation for:

Mr. E. J. Murphy's work on electrical conduction in hydrogen-bonded substances $32,000

A Symposium on elementary processes in nerve conduction and muscle contraction $23,000

From the United States Public Health Service for the 1st of a 5-year training program in anatomical sciences under Doctors Keith R. Porter and Dan H. Moore $32,076

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