gation now of the chemical equilibrium of the resulting cancer and of all other possibly significant properties. Here we have made considerable progress; but much remains to be done, and the chances of expansion by adding other unit projects, as parts of the whole, are almost unlimited.

And on the fourth, or highest level, are purposeful efforts based on knowledge of the equilibrium in the cancer to disturb it and cure the cancer, and also to determine the specific vulnerability of the cancer cells by bringing to bear on them influences of wide variety, for again an unexpected agent may prove to be most effective. To concentrate on the first and third levels requires restraint bolstered by the belief that so doing will pay in the long run.

At all four levels, whether of fact-finding or of control, so many opportunities unfold that it requires no stretch of the imagination to see how at least 100 workers could profitably be employed, all integrated through investigation of the same biological equation by quantitative methods so that the results will all stack up. Our project is not unique in this regard. It is not difficult to think of others which can likewise be organized in such a way as fully to justify an almost wholesale approach.

What is needed is for the public to shed its colossal complacency concerning cancer and to insist on research being carried on as an "essential" activity, dominated by the spirit of *must,* not being shocked by the *cost,* which has achieved wonders in the war. The least we can do is to support the National Campaign of the American Cancer Society and to let our Senators and Representatives in Washington know that we confidently look to them to support the plans of the U. S. Public Health Service for Cancer Research.

OBITUARY

MAX BERGMANN
1886–1944

MAX BERGMANN, member of the Rockefeller Institute for Medical Research, died in New York on November 7, 1944, in his fifty-ninth year and at the height of his powers as an investigator in the field of organic biochemistry.

Born in Fuerth, Bavaria, on February 12, 1886, Bergmann received his college training in Munich. Like several other distinguished biochemists, he approached chemistry through the biological sciences. His original inclination had been towards botany, but in his early studies he was so much impressed by the need for chemical answers to botanical questions that he decided to acquire a fundamental training in organic chemistry. To this end he enrolled in the chemical department of the University of Berlin, then under the leadership of Emil Fischer; there he graduated in 1911, the work for his dissertation, on acyl polysulfides, having been directed by Ignaz Bloch. He then joined Fischer's group of collaborators in the investigation of amino acids and carbohydrates.

With the outbreak of war in 1914 Bergmann was selected by his chief as confidential scientific assistant, an appointment which brought with it exemption from military service. During the subsequent five years he was thus closely associated with all of Emil Fischer's research activities, which included not only the topics mentioned above, but the investigations of tannins and polyhydroxylic phenols. Among the important publications that bear Bergmann's name during that period are reports on the acylation of polyhydroxylic compounds partially protected by combination with acetone, on the synthesis of glucosides of gallic acid and mandelonitrile, on new methods for the preparation of α-monoglycerides and on the chemistry of glucal. After Fischer's death Bergmann almost automatically became his scientific executor, assuming the responsibility for the completion and publication of unfinished researches.

In 1921 he was appointed to the Kaiser Wilhelm Institut für Lederforschung in Dresden, where he continued his investigations in the field of carbohydrates and initiated his studies of the synthesis of unsymmetrical glycerides. A logical extension of this work to amino alcohols led on the one hand to the recognition of the migration of acyl groups and on the other to his abiding interest in amino acids and peptides.

Bergmann's duties in Dresden comprised, besides academic research, chemical studies of leather and tanning processes, and he was obliged to spend a large part of his time in consultation with industrialists. In view of the extensive traveling involved in this phase of his activities, his scientific productivity through the following decade was truly remarkable. Among the major problems which he attacked during this period was the general theory of the structure of polysaccharides and proteins. In 1925 he published his first papers on the chemistry of diketopiperazines derived from serine and cystine, with the aid of which he established a general method for the preparation of derivatives of dehydro amino acids. In the following year he first exploited the useful properties of azlactones for the synthesis of dipeptides, particularly those of phenylalanine, which he produced by the condensation of benzaldehyde and oxazolone with subsequent hydrogenation and con-

densation with other amino acids. Of unusual interest was his demonstration of the transference of the acylated amidine group of triacetyl arginine to the nitrogen atom of amino compounds, a process which could later be adduced as an analogue to the metabolic mechanism whereby urea is formed. A synthesis of creatine was devised on the basis of this reaction.

In the course of his work on amino acids and peptides, in which Bergmann was joined in 1927 by Zervas, the useful process for the racemization of amino acids by means of acetic anhydride was discovered. The mechanism of this reaction, at first obscure, was several years later elucidated by du Vigneaud, who in 1929 collaborated with Bergmann on the synthesis of tyrosylarginine and in a study of acyl migration from diacyl diketopiperazines to amino acids.

At the same time, investigations fundamental to carbohydrate chemistry were continued; the reactions of glucal were further explored and its pyranoid constitution was established. Bergmann also attacked the difficult problem of the intermediate products in the hydrolysis of cellulose and starch. Amino acids, however, occupied the center of the stage. It was shown that acylation of amino acids by ketene can proceed satisfactorily in aqueous solution. In 1930 an extended study of the action of proteolytic enzymes upon peptides of dehydro amino acids was undertaken, and Bergmann demonstrated the presence in pancreas and in yeast of enzymes which split glycyl dehydrophenylalanine into glycine and phenylpyruvic acid. With Grafe he developed an essentially converse synthesis of peptides of dehydroalanine from pyruvic acid. A characteristic example of Bergmann's chemical ingenuity is his application to glucosaminic acid of the information which he had gained in his studies of dehydro amino acids.

In 1932 Bergmann developed the carbobenzoxy method for the protection of amino groups during the synthesis of peptides. This was immediately adopted as standard practice by other workers; being as versatile as it is elegant, it has become one of the most effective weapons in the armamentarium of the amino acid chemist. More than any other device it helped to make possible the synthesis of the many types of peptide which Bergmann later employed as models in his classic studies of enzyme specificity.

In 1933 political and social conditions in Germany had reached a stage at which no self-respecting and sensitive Jew could continue to serve his State in a post of responsibility. As Bergmann arrived in this country without prior plan, New York, his port of entry, could take the opportunity to capture him for its own. The Rockefeller Institute provided him with an associate membership and generous working facilities; three years later, on the retirement of the late Phoebus A. Levene, Bergmann became a member of the institute and the head of the laboratory of chemistry, a position which he held until his death.

The last scientific report to be written in the Dresden laboratory dealt with the mode of linkage of proline in gelatin, in which the existence of peptide bonds involving the nitrogen of proline was demonstrated. With characteristic delicacy of sentiment, Bergmann continued to publish in German journals the results of researches carried out in Germany. These were of high importance, for in them he laid the foundations of his studies of the specificity of proteolytic enzymes. His views on the subject are set forth in the published forms of lectures delivered before the Rockefeller Institute, the American Leather Chemists' Association and the Harvey Society. His exploration of this field was continued unremittingly in New York with the collaboration at first of Zervas, who had followed him from Dresden, and later of his younger American colleagues Fruton, Ross and Behrens. These investigations, in which his powers of experimentation and imaginative interpretation reached their zenith, culminated in the theories, developed with Fruton, of the specificity of proteinases and the relation of structure to kinetics of enzyme action.

Bergmann's demonstration of the ability of a proteolytic enzyme to effect the synthesis of peptides and the redistribution of peptide bonds between substrates carried far-reaching implications with respect to the intermediary metabolism of proteins, and it led him to advance the hypothesis that the structural pattern of a protein, in all its details, is a consequence of the specificity of the intracellular proteinases. His suggestion that in living organisms the synthetic reactions incident to protein formation are made possible through the coupling of proteolytic systems with other equilibrium systems by means of which the synthetic products are removed from the zones of degradative activity is likely to have a profound effect on biochemical thought.

It was natural that his constant preoccupation with theories of proteolysis and protein synthesis should have involved Bergmann in speculation as to the structure of proteins. In order to attack the fundamental problem of the order in which the constituent amino acids are arranged in a polypeptide chain he devised, with Zervas, an elegant procedure for stepwise degradation which started at the free carboxyl group and permitted the identification of each successive component. However, exploitation of the possibilities inherent in this technique had to await the realization of pure peptide fragments of proteins. He therefore approached the problem from a more theoretical standpoint. From analytical data secured largely by methods developed by himself he calculated

that in gelatin every third amino acid could be glycine, every sixth proline, and every ninth hydroxyproline. This finding led him to postulate a systematic periodicity in the location of these amino acids in the peptide chain. With Niemann he extended the application of this concept to a wider series of amino acids in other proteins, and advanced the general hypothesis that the individual amino acids are situated in proteins in regularly recurrent orders dependent on periodicities the numerical values of which are multiples of powers of 2 and 3. Though later evidence suggests that this hypothesis represents an oversimplification, the basic idea has stimulated many useful studies, not the least of which has been the development in Bergmann's own laboratory of precise methods, novel in principle, for the analytical determination of amino acids for which no reliable procedures had previously been available.

Max Bergmann possessed in a high degree the capacity for forming and maintaining affectionate friendships. He was incapable of malice, and never displayed rancor towards those who had wrecked his career in his native land. He was gifted with an inextinguishable fund of quiet humor, he was invariably generous towards younger men and towards the scientific work of his colleagues, and his innate modesty was never clouded by his objective though unexpressed recognition of the value of his own achievements.

He is survived by his wife, a son and a daughter.

HANS T. CLARKE

COLUMBIA UNIVERSITY

DEATHS AND MEMORIALS

DR. ROBERT H. MACKNIGHT, research associate in biology at the University of Rochester, died on August 3. He was twenty-nine years old.

GEORGE WILLETT, since 1928 curator of ornithology at the Los Angeles County Museum, died on August 2 at the age of sixty-six years. He had been connected with the museum since 1927. He was vice-president of the American Ornithological Union and secretary of the Cooper Ornithological Club, Inc.

DR. E. HADORN, professor of zoology at the University of Zurich, Switzerland, has written to Dr. Curt Stern, of the University of Rochester, that the following German zoologists have been killed in action: E. Ries, E. Becker and W. Köhler.

A TABLET to commemorate the work of the late Sir William Bragg, O.M., and of his son, Professor Sir Lawrence Bragg, presented by Mrs. Smithells, the widow of Professor Arthur Smithells, of the University of Leeds, was unveiled on July 20 by Professor R. Whiddington, F.R.S. The inscription on the tablet reads: "Near this place in the old Physics Laboratory in the year 1913 William Henry Bragg, Cavendish professor of physics in this university from 1909 to 1915, and his son, William Lawrence Bragg, began their joint researches and established with the first x-ray spectrometer the nature of x-ray spectra and the principles of crystal analysis for which they were awarded the Nobel Prize in 1915."

SCIENTIFIC EVENTS

SCIENCE IN DENMARK AND NORWAY

THE scientific correspondent of *The Times*, London, reports that the Royal Society is taking a very active part in renewing the cordial relations which have by long tradition existed between men of science of Great Britain and of the lands recently liberated from Germany. In this connection Professor A. V. Hill has paid a visit to Denmark and Norway. *The Times* describes his visit as follows:

He went as the delegate of the society, to bear its greetings, to present to the academies of the two countries copies of all that the Royal Society has published since 1940, and to request the academies to be instrumental in distributing to scientific workers of their respective countries certain sums of money from a fund founded, in memory of Sir Horace Darwin, for the purchase of scientific instruments.

He received a most cordial and sincere welcome at Copenhagen and at Oslo, and has returned with the greatest admiration for the spirit that he found abroad, and with high hopes for the future of Danish and Norwegian science.

Science in Denmark has not suffered as badly as in most countries occupied by the Germans. Until the autumn of 1943 the invaders were on their best behavior, but at that time the *Gestapo* became active and students ceased to attend the colleges. Professor Rehberg, the zoologist, was brutally mishandled by the Germans for lack of cooperation, and he and a good many other men of science were imprisoned, but escaped when the prison was very skillfully bombed by us. Research, however, continued in the laboratories which were not despoiled, and much excellent work has been published in the *Proceedings* of the academy.

Food is in good supply and the generous Danes have done and are doing sterling work in collecting food for Norway and Holland. Their chief scientific need is books and journals, and English text-books for students. To show how quickly the Danes have been able to establish themselves, they are contemplating an expedition next year for marine biological investigation, a subject in