PRAEMIA

Nobelpreise 1965 für Physik, Chemie und Medizin

Der *Nobelpreis für Physik* ist 1965 gemeinsam dem Japaner

S. J. Tomonaga

und den beiden Amerikanern

J. Schwinger und R. Feynman

erteilt worden. Damit hat die Schwedische Akademie drei theoretische Physiker ausgezeichnet, die zur erstaunlichen Weiterentwicklung der Quantenelektrodynamik, welche kurz nach dem Kriege einsetzte, wesentliche Beiträge geliefert haben.

Nachdem Ende der zwanziger Jahre DIRAC eine relativistische Quantentheorie des Elektrons entwickelt, und überdies gezeigt hatte, wie die Prinzipien der Quantenmechanik auch auf die Elektrodynamik – also auch auf die Strahlungstheorie – angewendet werden können, unternahmen JORDAN, PAULI und HEISENBERG den Versuch, eine relativistisch invariante Quantenelektrodynamik zu entwickeln. Das von diesen Forschern durchgeführte Programm ist das folgende: es werden Gleichungen aufgestellt, die das Verhalten von Elektronen im elektromagnetischen Feld, und damit auch die Emission und Absorption von Licht durch Elektronen, beschreiben sollen. Diese Gleichungen erfüllen nicht nur die Forderungen, die sich aus der Quantentheorie, sondern auch diejenigen, die sich aus der speziellen Relativitätstheorie ergeben. Es bestand damals die Hoffnung, dass eine solche Theorie eine Erklärung für den numerischen Wert der Sommerfeldschen Feinstrukturkonstanten $e^2/\hbar\, c = 1/137$ ergeben sollte. Diese Hoffnung hat sich aber nicht erfüllt. Zudem ergaben sich beim Versuch, die aufgestellten Gleichungen zu lösen, ernsthafte Schwierigkeiten. Lösungen werden annäherungsweise gefunden, indem man sie als Potenzreihe in der kleinen Grösse $e^2/\hbar\, c$ ansetzt. Diese Lösungsmethode nennt man Störungstheorie. Während die erste Näherung im allgemeinen sinnvolle, und auch weitgehend der Erfahrung entsprechende, Ergebnisse liefert, führen alle höheren Näherungen zu mathematisch widersinnigen Resultaten. Dadurch wurde das Vertrauen in die Vernunft des mathematisch-physikalischen Ansatzes, welcher der Theorie zugrunde liegt, erschüttert.

Nach dem Kriege, teilweise durch gewisse spektroskopische Ergebnisse angeregt, wurde nun erneut der Versuch gemacht, die genannten Schwierigkeiten zu überwinden. Das Mittel zum Erfolg war dabei, die relativistische Kovarianz der Theorie während des ganzen Rechnungsganges systematisch auszunützen. So gelang der Beweis, dass der ganze Widersinn früherer Rechnungen den folgenden Ursprung hat: die Theorie liefert in allen höheren Näherungen unter anderem Korrekturen zum Massenwert und zum Ladungswert des Elektrons, die aber durch mathematisch unbestimmte Ausdrücke dargestellt werden. Da aber Masse und Ladung als theoretisch willkürliche Parameter in die Formeln eingehen, so kann die Theorie dadurch sinnvoll gemacht werden, dass man in jeder Näherung die unbestimmten Ausdrücke so festlegt, dass Gesamtmasse und Gesamtladung immer die empirisch bekannten Werte behalten. Man nennt dieses Vorgehen «Renormierung» von Masse und Ladung.

Es ist das Verdienst TOMONAGAS und SCHWINGERS, die Störungsrechnung relativistisch invariant formuliert zu haben. Damit haben sie auch den Weg gewiesen, wie die unbestimmten Aussagen der Theorie durch Renormierung von Masse und Ladung zu physikalisch bestimmten Aussagen führen. FEYNMAN aber hat, durch höchst originelle und anschauliche Überlegungen, ein Verfahren entwickelt, mit dessen Hilfe jeder Ausdruck der Störungsreihe unmittelbar konstruiert werden kann, wodurch eine wirkliche Berechnung der oft sehr verwickelten Grössen erst möglich wird. Dadurch ist die Quantenelektrodynamik zu einer Theorie geworden, in welcher auch sehr kleine Grössen, die an der Grenze der heute sehr grossen Messgenauigkeit liegen, in völliger Übereinstimmung mit der Erfahrung berechnet werden können.

Da die Theorie aber die renormierte Ladung e des Elektrons aus der Erfahrung entnehmen muss, ist klar geworden, dass sie vom Werte $e^2/\hbar\, c = 1/137$ keine Rechenschaft geben kann. Ebensowenig legt sie die Elektronenmasse fest, und gilt darum auch für das «schwere Elektron», das man μ-Meson nennt. Darin kann man eine jener «Auswirkungen auf die Elementarteilchenphysik» erblicken, auf welche die Laudatio hinweist.

Dass auch andere Gelehrte zum Aufbau der Quantenelektrodynamik Entscheidendes beigetragen haben, ist jedem Einsichtigen klar. Darum ist der Akademie ihre Entscheidung gewiss nicht leicht gefallen. Ebenso gewiss ist es aber, dass die Entdeckung der «renormierten Quantenelektrodynamik» eines Preises würdig war, und dass die Preisträger die Ehrung voll verdienen.

M. FIERZ

Nobel Prize 1965 in Chemistry

What has long been expected by many organic chemists and what has been hoped for by his friends and by the large number of former and present post-doctorals and students, has finally become true: The award of the Nobel Prize 1965 in chemistry to

Robert Burns Woodward,

Professor of Science at Harvard University, USA.

This well deserved honour was neither given for his reiterative contributions to the 'recent advances in the chemistry of natural products' nor was it especially related to any particular one of his brilliant synthetic achievements which range from the total synthesis of quinine in 1944 over patulin, steroids, strychnine, reserpine, lanosterol, lysergic acid to the total synthesis of chlorophyll in 1960. Since then the synthesis of colchicine and of a physiologically active tetracycline has been announced and the total synthesis of the most complicated natural product, vitamin B_{12}, is already well on its way.

In a most appropriate sense Professor WOODWARD was cited 'for his meritorious contributions to the art of organic synthesis', because in his hands organic synthesis has really become an art.

Meticulous planning of each synthesis and a constant rigorous control of its progress by the most modern pyhsical methods are the foundations on which his work is based. But beyond this his creative imagination and constant inspiration raises his syntheses above all ordinary approaches. The systematic elaboration of the architectural framework of a chemical structure and the surprising conversions of dull and seemingly unrelated portions of molecules into extremely useful and important building blocks give the reader of his publications or the listener at his lectures a rare intellectual and aesthetic pleasure.

Those who have been associated with Professor WOODWARD have many times experienced the delights and joys (as well as the disappointments and false hopes) encountered in this kind of work. But they also know the enthusiasm with which attacks at difficult problems are launched by Professor WOODWARD and they look forward to new victories in the synthesis of even more complex molecules.

K. HEUSLER

This year's *Nobel Prize in Medicine* was awarded to three French scientists at the Pasteur Institute:

François Jacob,

André Lwoff and

Jacques Monod.

Thanks to their imaginative foresight, to the elegance of their careful experimentation, and to their clarity of thought they have been able to combine the three elements of molecular biology – i.e. genetics, microbiology, and biochemistry – into most fruitful general concepts of biological regulatory mechanisms.

ANDRÉ LWOFF, born in 1902 in Aulney-le-Château in France, is head of the Laboratory for Cellular Physiology at the Pasteur Institute in Paris. He also holds the chair of microbiology at the Sorbonne. He has devoted a great part of his scientific work to the study of bacterial mutations, including especially mutants not due to the loss of specific enzymes. Some of these mutations could be explained on the basis of a loss of control factors which normally were inhibitory. Most of the subsequent elucidation of genetic control mechanisms is due to a thorough study of defects in these mutants which was pursued at the Pasteur Institute.

Lysogeny represents an intriguing example of altered regulation, since lysogenic bacteria are immune to bacteriophage infection. EMANUEL WOLLMAN of the Pasteur Institute, as far back as 1928, considered that lysogeny might represent an hereditary property of the bacterium to generate phage. LWOFF and GUTMANN (1950) proved the correctness of this concept. They demonstrated that the capacity to produce phage can be inherited through many generations without the appearance of a single phage particle. Thus, virus infection results in a latent potentiality to produce new virus, which is inherited like any other genetic property and can manifest itself at any time either spontaneously or upon induction with a cell-damaging agent. LWOFF has designated this non-infectious hereditary factor as prophage and was able to define the state of lysogeny as a genetic inheritance of the latent bacteriophage. This concept has greatly helped in understanding viruses as genetic carriers.

FRANÇOIS JACOB was born in 1920 and, like LWOFF, he studied medicine. He is head of the Laboratory for Microbial Genetics at the Pasteur Institute and professor of cellular genetics at the Collège de France. JACOB investigated the lysogeny of *E. coli* and thereby contributed to the understanding of the phenomenon of transduction, a process whereby the DNA of a bacteriophage enters a bacterium carrying along with it a fraction of genetic material from its previous host (ZINDER and LEDERBERG, 1952). This, together with the prophage, is incorporated into the genetic apparatus of the infected bacterium. JACOB was thus able to demonstrate that a mutant of *E. coli* which is unable to ferment galactose can acquire the ability to ferment galactose when it is infected with a bacteriophage from a wild type bacterium.

Bacterial conjugation is a process first reported in 1946 by LEDERBERG and TATUM. During conjugation the genetic material of one bacterium is transferred into another recipient bacterium like the fertilization of an egg cell. JACOB and WOLLMAN (1957) found that lysogeny can also be transferred by conjugation, but that the outcome is greatly influenced by the sex of the bacterium. If the female, the recipient bacterium, is non-lysogenic and the prophage is located in the male, phage growth will begin at once. This process is now known as zygotic induction. If the female bacterium is lysogenic, however, no phage production occurs whether the donor bacterium carries prophage or not. JACOB and WOLLMAN concluded that in the cytoplasm of the female an immune substance is present which prevents the prophage of the male bacterium from producing phage particles. This was the first indication that a gene can produce a repressor substance which blocks the expression of another gene. This recognition that a cell can acquire new genetic properties as well as potentially lethal factors through infection with a virus has opened up new aspects with regard to the problem of cancer. Thus, a virus which is incorporated in a cell emits certain chemical signals which block its own multiplication. Only when this control mechanism is disturbed does the virus multiply and destroy the cell.

JACQUES MONOD, born in 1910, is professor at the Faculté des Sciences, Paris, and head of the Laboratory for Cellular Biochemistry at the Pasteur Institute. MONOD entered the field of molecular biology as an enzymologist. His first major contribution was the elucidation of enzyme induction, i.e. the phenomenon by which an enzyme normally absent is suddenly produced in great amounts. The β-galactosidase of *E. coli* proved to be an ideal model for this kind of study. This enzyme splits the disaccharide lactose into glucose and galactose, and is only formed when the bacteria are grown on lactose. MONOD, COHEN-BAZIRE, and COHN (1951) found that sugars which cannot be cleaved by the enzyme are nevertheless capable of inducing the synthesis of β-galactosidase. The phenomenon of enzyme induction, therefore, involved the ability to induce the synthesis of new enzyme. It was the outcome of the results of the re-

combination of various mutants by bacterial conjugation which led JACOB and MONOD to their remarkable concept of gene expression. These experiments, like those of JACOB and WOLLMANN, proved the existence of a cytoplasmic regulating factor. The model proposed by JACOB and MONOD postulates that three different genes are necessary for the regulation of a particular enzyme: a) a structural gene which produces the so-called messenger RNA and which contains the information for the structure of a particular enzyme, b) a repressor gene producing (normally) a repressor which blocks the function of the structural genes, and c) an operator gene closely linked to the structural gene which is responsible for taking up the message from the repressor gene. This ingenious concept takes into account all the known phenomena relating to the regulation of β-galactosidase synthesis in *E. coli*.

That, despite all these important discoveries we are only just beginning to understand biological regulations, is apparent from one of the more recent contributions emanating from the Pasteur Institute, i.e. the concept of allosteric transition. MONOD, CHANGEUX, and JACOB (1963) draw attention to the fact that many proteins with a regulatory function are built of subunits. These complex molecules are subject to configurational alterations by their interactions with small molecules. These, in turn, are accompanied by a change in the specific activity of the protein. This unified concept of macromolecules undergoing subtle modifications in response to small molecular regulators is applicable to enzymes as well as to the repressor whose existence is still only inferred. It is to be expected that it will soon find as wide an application as the many other discoveries of the three Nobel laureates and so enable scientists to delve even deeper into the mysteries of life.

MATTHYS STAEHELIN

CONGRESSUS

USA

Third International Biomagnetic Symposium

University of Illinois College of Pharmacy, Chicago
March 22–23, 1966

Abstracts – which will be edited and printed in lieu of proceedings – should be mailed to Dr. M. F. BARNOTHY, University of Illinois, 833 South Wood Street, Chicago, by December 1, 1965. Abstracts should be 900 to 1000 words long, and should describe the research in detail. One drawing or graph can be submitted with each.

The printed abstracts will be mailed to all preregistered participants in the Symposium one month before the meeting, to enable thorough preparation for discussion.

Those interested in the Symposium may write to Dr. BARNOTHY or to DANIEL J. HOPPE, extension specialist in short courses and conferences, 116 Illini Hall, University of Illinois, Champaign.

USA

Sixth International Symposium on Condensation Nuclei

Albany (New York) and University Park (Pennsylvania)
May 9–14, 1966

For further information concerning attendance and participation in the symposium, address: Chairman of the Organizing Committee, Office of the Director, ASRC-SUNY, Post Office Box 7112, Albany, New York, 12224 (USA).

Etats-Unis

7e Conference internationale sur la Transplantation

New York, le 14, 15 et 16 Février 1966

organisée par l'Académie des Sciences de New York. Président John Marquis Converse.

Pour tous renseignements s'adresser aux Secrétariats:

pour les Etats-Unis: Félix T. Rapaport, New York University Medical Center, 550 First Avenue, New York 16 (N.Y.), USA.

pour l'Europe: Jean Dausset, Hôpital Saint-Louis, 2, Place du Docteur Fournier, Paris 10e.

Poland

Third Meeting of the Federation of European Biochemical Societies

Warsaw, April 4–7, 1966

As indicated in the Preliminary Programme of the Meeting, the main events are as follows: (1) Symposium, entitled *The Structure and Function of Genetic Elements*, arranged by D. SHUGAR (Warsaw). (2) Colloquium, entitled *The Biochemistry of Blood Platelets*, arranged by E. KOWALSKI (Warsaw) and S. NIEWIAROWSKI (Bialystock). (3) Colloquium, entitled *The Biochemistry of Mitochondria*, arranged by E. C. SLATER (Amsterdam) and organized by L. WOJTCZAK and Z. KANIUGA (Warsaw).

Secretariat: Polskie Towarzystwo Biochemiczne, Freta 16, Warsaw 40 (Poland).