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| **Medicine\_1945-** | |
| ID | 0681 |
| Biographical | Sir Alexander Fleming was born at Lochfield near Darvel in Ayrshire, Scotland on August 6th, 1881. He attended Loudoun Moor School, Darvel School, and Kilmarnock Academy before moving to London where he attended the Polytechnic. He spent four years in a shipping office before entering St. Mary’s Medical School, London University. He qualified with distinction in 1906 and began research at St. Mary’s under Sir Almroth Wright, a pioneer in vaccine therapy. He gained M.B., B.S., (London), with Gold Medal in 1908, and became a lecturer at St. Mary’s until 1914. He served throughout World War I as a captain in the Army Medical Corps, being mentioned in dispatches, and in 1918 he returned to St.Mary’s. He was elected Professor of the School in 1928 and Emeritus Professor of Bacteriology, University of London in 1948. He was elected Fellow of the Royal Society in 1943 and knighted in 1944.  Early in his medical life, Fleming became interested in the natural bacterial action of the blood and in antiseptics. He was able to continue his studies throughout his military career and on demobilization he settled to work on antibacterial substances which would not be toxic to animal tissues. In 1921, he discovered in «tissues and secretions» an important bacteriolytic substance which he named Lysozyme. About this time, he devised sensitivity titration methods and assays in human blood and other body fluids, which he subsequently used for the titration of penicillin. In 1928, while working on influenza virus, he observed that mould had developed accidently on a staphylococcus culture plate and that the mould had created a bacteria-free circle around itself. He was inspired to further experiment and he found that a mould culture prevented growth of staphylococci, even when diluted 800 times. He named the active substance penicillin.  Sir Alexander wrote numerous papers on bacteriology, immunology and chemotherapy, including original descriptions of lysozyme and penicillin. They have been published in medical and scientific journals.  Fleming, a Fellow of the Royal College of Surgeons (England), 1909, and a Fellow of the Royal College of Physicians (London), 1944, has gained many awards. They include Hunterian Professor (1919), Arris and Gale Lecturer (1929) and Honorary Gold Medal (1946) of the Royal College of Surgeons; Williams Julius Mickle Fellowship, University of London (1942); Charles Mickle Fellowship, University of Toronto (1944); John Scott Medal, City Guild of Philadelphia (1944); Cameron Prize, University of Edinburgh (1945); Moxon Medal, Royal College of Physicians (1945); Cutter Lecturer, Harvard University (1945); Albert Gold Medal, Royal Society of Arts (1946); Gold Medal, Royal Society of Medicine (1947); Medal for Merit, U.S.A. (1947); and the Grand Cross of Alphonse X the Wise, Spain (1948).  He served as President of the Society for General Microbiology, he was a Member of the Pontifical Academy of Science and Honorary Member of almost all the medical and scientific societies of the world. He was Rector of Edinburgh University during 1951-1954, Freeman of many boroughs and cities and Honorary Chief Doy-gei-tau of the Kiowa tribe. He was also awarded doctorate, *honoris causa,* degrees of almost thirty European and American Universities.  In 1915, Fleming married Sarah Marion McElroy of Killala, Ireland, who died in 1949. Their son is a general medical practitioner.  Fleming married again in 1953, his bride was Dr. Amalia Koutsouri-Voureka, a Greek colleague at St. Mary’s.  In his younger days he was a keen member of the Territorial Army and he served from 1900 to 1914 as a private in the London Scottish Regiment.  Dr Fleming died on March 11th in 1955 and is buried in St. Paul’s Cathedral.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0681 |
| Interview |  |
|  |  |
| ID | 0682 |
| Biographical | Ernst Boris Chain was born on June 19, 1906, in Berlin, his father, Dr. Michael Chain, being a chemist and industrialist. He was educated at the Luisengymnasium, Berlin, where he soon became interested in chemistry, stimulated by visits to his father’s laboratory and factory. He next attended the Friedrich-Wilhelm University, Berlin, where he graduated in chemistry in 1930. He was from an early age interested in biochemistry and after graduation he worked for three years at the Charité Hospital, Berlin, on enzyme research. In 1933, after the access to power of the Nazi regime in Germany, he emigrated to England. Here, his first two years were spent working on phospholipids at the School of Biochemistry, Cambridge, under the direction of [Sir Frederick Gowland Hopkins](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1929/index.html), for whose personality and scientific ability he came to have a great admiration.  In 1935 he was invited to Oxford University where he worked in the Sir William Dunn School of Pathology, becoming, in 1936, demonstrator and lecturer in chemical pathology. In 1948 he was appointed Scientific Director of the International Research Centre for Chemical Microbiology at the Istituto Superiore di Sanità, Rome. He became Professor of Biochemistry at Imperial College, University of London, in 1961, which position he still holds.  His research has covered a wide range of topics in addition to those already detailed. From 1935 to 1939 he worked on snake venoms, tumour metabolism, the mechanism of lysozyme action and the invention and development of methods for biochemical microanalysis. In 1939 he began, with [H. W. (now Sir Howard) Florey](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/index.html), a systematic study of antibacterial substances produced by micro-organisms. This led to his best known work, the reinvestigation of penicillin, which had been described by [Sir Alexander Fleming](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/index.html) nine years earlier, and to the discovery of its chemotherapeutic action. Later he worked on the isolation and elucidation of the chemical structure of penicillin and other natural antibiotics. Since 1948 his research topics have included carbohydrate-amino acid relationship in nervous tissue, a study of the mode of action of insulin, fermentation technology, 6-aminopenicillanic acid and penicillinase-stable penicillins, lysergic acid production in submerged culture, and the isolation of new fungal metabolites.  Professor Chain is author or co-author of many scientific papers and contributor to important monographs on penicillin and antibiotics. He was in 1946 awarded the Silver Berzelius Medal of the Swedish Medical Society, the Pasteur Medal of the Institut Pasteur and of the Societé de Chimie Biologique, and a prize from the Harmsworth Memorial Fund. In 1954 he was awarded the Paul Ehrlich Centenary Prize; in 1957 the Gold Medal for Therapeutics of the Worshipful Society of Apothecaries of London; and in 1962 the Marotta Medal of the Società Chimica Italiana. He was elected a Fellow of the Royal Society in 1949. He holds honorary degrees of the Universities of Liège, Bordeaux, Turin, Paris, La Plata, Cordoba, Brasil, and Montevideo, and is a member or fellow of many learned societies in several countries: these include the Societé Philomatique, Paris; the New York Academy of Medicine; the Accademia dei Lincei and the Accademia dei XL, Rome; the Académie de Médicine, Académie des Sciences, Paris; the Real Academia de Ciencias, Madrid; the Weizmann Institute of Science, Rehovoth, Israel; the National Institute of Sciences, India; the Società Chimica Italiana; and the Finnish Biochemical Society.  He is a Commander of the Légion d’Honneur and Grande Ufficiale al Merito della Repubblica Italiana.  Professor Chain married Dr. Anne Beloff in 1948. They have two sons, Benjamin and Daniel, and one daughter, Judith. Music is one of his recreations.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Ernst B. Chain died on August 12, 1979.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0682 |
| Interview |  |
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| ID | 0683 |
| Biographical | Sir Howard Walter Florey was born on September 24, 1898, at Adelaide, South Australia, the son of Joseph and Bertha Mary Florey. His early education was at St. Peter’s Collegiate School, Adelaide, following which he went on to Adelaide University where he graduated M.B., B.S. in 1921. He was awarded a Rhodes Scholarship to Magdalen College, Oxford, leading to the degrees of B.Sc. and M.A. (1924). He then went to Cambridge as a John Lucas Walker Student. In 1925 he visited the United States on a Rockefeller Travelling Fellowship for a year, returning in 1926 to a Fellowship at Gonville and Caius College, Cambridge, receiving here his Ph.D. in 1927. He also held at this time the Freedom Research Fellowship at the London Hospital. In 1927 he was appointed Huddersfield Lecturer in Special Pathology at Cambridge. In 1931 he succeeded to the Joseph Hunter Chair of Pathology at the University of Sheffield.  Leaving Sheffield in 1935 he became Professor of Pathology and a Fellow of Lincoln College, Oxford. He was made an Honorary Fellow of Gonville and Caius College, Cambridge in 1946 and an Honorary Fellow of Magdalen College, Oxford in 1952. In 1962 he was made Provost of The Queen’s College, Oxford.  During World War II he was appointed Honorary Consultant in Pathology to the Army and in 1944 he became Nuffield Visiting Professor to Australia and New Zealand.  His best-known work dates from his collaboration with [Chain](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/index.html), which began in 1938 when they conducted a systematic investigation of the properties of naturally occurring antibacterial substances. Lysozyme, an antibacterial substance found in saliva and human tears, was their original interest, but their interest moved to substances now known as antibiotics. The work on penicillin was a result of this interest.  Penicillin had been discovered by Fleming in 1928 as a result of observations on a mould which developed on some germ culture plates but the active substance was not isolated. In 1939, Florey and Chain headed a team of British scientists, financed by a grant from the Rockefeller Foundation, whose efforts led to the successful small-scale manufacture of the drug from the liquid broth in which it grows. In 1940 a report was issued describing how penicillin had been found to be a chemotherapeutic agent capable of killing sensitive germs in the living body. Thereafter great efforts were made, with government assistance, to enable sufficient quantities of the drug to be made for use in World War II to treat war wounds.  Florey was a contributor to, and Editor of, *Antibiotics* (1949). He was also part-author of a book of lectures on general pathology and has had many papers published on physiology and pathology.  Dr. Florey has had many honours bestowed upon him. Among these may be mentioned the Lister Medal of the Royal College of Surgeons, the Berzelius Medal of the Swedish Medical Society, the Royal and Copley Medals of the Royal Society, the Medal of Merit of the U. S. Army, and many others.  He is President of the Royal Society since 1960 and a Fellow of the Royal College of Physicians, and among other honorary fellowships he holds is that of the Royal Australian College of Physicians.  He has been awarded honorary degrees by seventeen universities and is a member or honorary member of many learned societies and academies in the field of medicine and biology.  In 1944 he was created a Knight Bachelor.  He married Mary Ethel Hayter Reed in 1926. They have two children, Paquita Mary Joanna and Charles du Vé.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Sir Howard Florey died on February 21, 1968.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0683 |
| Interview |  |
|  |  |
| ID | 0684 |
| Biographical | Joseph Erlanger was born on January 5, 1874, at San Francisco, California. He is the son of Herman and Sarah Erlanger.  Studying chemistry at the University of California, he received the degree of B.S. of that University and later went to Johns Hopkins University to study medicine, where he obtained his M.D. degree in 1899. After a year of hospital training at the Johns Hopkins Hospital, he was appointed assistant in the Department of Physiology at the Medical School there. Until 1906 he stayed there, being successively Instructor, Associate, and Associate Professor. He was then appointed the first Professor of Physiology in the newly established Medical School of the University of Wisconsin, where one of his pupils was [H. S. Gasser](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1944/index.html), who later collaborated with him. In 1910 he was appointed Professor of Physiology in the reorganized Medical School of the Washington University, St. Louis. In 1946 he retired as chairman of this school and is now emeritus professor there.  Erlanger’s chief research has been done in the fields of electrophysiology and the physiology of the circulatory system. He has studied the principles of sphygmomanometry and devised a recording sphygmomanometer, with which he studied, in man, the influence of pulse pressure on kidney secretion and on orthostatic albuminuria. Later, he devised a clamp with which the auriculo-ventricular bundle of the mammalian heart could be reversibly blocked, and with this device he studied the problems associated with the functions of this bundle.  In 1922, in collaboration with Gasser, Erlanger adapted the cathode-ray oscillograph for the study of nerve action potentials and this led to the work for which Erlanger and Gasser were given the Nobel Prize for Medicine or Physiology in 1944. Erlanger has also worked on metabolism of dogs with shortened intestines, on traumatic shock and on the mechanism of the production of sound in arteries.  Erlanger has received honorary doctorates of the Universities of California, Wisconsin, Pennsylvania, and Michigan.  In 1906, he married Aimée Hirstel, who died in 1959. They had three children, Margaret (b. 1908), Ruth Josephine (b. 1910), Herman (1912-1959).  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Joseph Erlanger died on December 5, 1965.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0684 |
| Interview |  |
|  |  |
| ID | 0685 |
| Biographical | Herbert Spencer Gasser was born in Platteville, Wisconsin, on July 5, 1888, the son of Herman Gasser end Jane Elisabeth Griswold. After attending the State Normal School he went on to the University of Wisconsin, where he graduated A.B. in 1910 and A.M. in 1911. Here he studied physiology under Dr. [Erlanger](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1944/index.html), with whom he was later to have such a fruitful collaboration. He then went to the Johns Hopkins Medical School for his clinical studies, obtaining his M.D. in 1915. After a year in pharmacology at Wisconsin he went to Washington University (St. Louis), where he was associated with Dr. Erlanger, becoming Professor of Pharmacology in 1921.  From 1923-1925 he was granted leave of absence to study in Europe, working with Profs. [A. V. Hill](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1922/index.html), W. Straub and L. Lapicque and [Sir Henry Dale](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1936/index.html). In 1931 he was appointed Professor of Physiology and Head of the Medical Department at Cornell University, New York City. From 1935 to 1953 he was Director of the Rockefeller Institute for Medical Research, being later a member emeritus of the Institute.  When he was at Johns Hopkins Medical School, Dr. Gasser worked for a time on a problem concerning blood coagulation. His major work, however, dates from his collaboration with Prof. Erlanger and was concerned with the electrophysiology of the nerves. The first paper from him on the subject dealt with action currents in the phrenic nerve. Later, the newly perfected low – voltage cathode – ray oscillograph was utilized in the work. Soon it was possible to demonstrate that the complexity of the oscillograph results was due to the different conductivity rates of different groups of nerve fibres. The work led to advances in our knowledge of the mechanism of pain and of reflex action and has inspired a large school of neurophysiologists.  Dr. Gasser was a co-author of the book *Electrical Signs of Nervous Activity* (1937). He has also published, alone or with his collaborators, many scientific papers on neurophysical topics, being appointed an Editor of *The Journal of Experimental Medicine* in 1936.  He held honorary doctorates from the Universities of Pennsylvania, Rochester, Wisconsin, Columbia, Oxford, Harvard, Paris, Washington (St. Louis), and Johns Hopkins. He was a doctor, honoris causa, of the Free University of Brussels and of the University of Paris, and honorary M.D. of the Catholic University of Louvain. He was a member of the National Academy of Sciences (USA), the Philosophical Society, the Association of American Physicians (Kobel Medallist, 1954), the American Physiological Society, and many others. He held honorary memberships of the Physiological Society (Great Britain) and Asociación Médica Argentina. He was a foreign member of several learned societies, including the Royal Society (London). Dr. Gasser was also President of the Board of Directors of the Russel Sage Institute of Pathology. He was unmarried.  Dr Gasser died on May 11th, 1963.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0685 |
| Interview |  |
|  |  |
| ID | 0686 |
| Biographical | Carl Peter Henrik Dam was born in Copenhagen on 21st February 1895, to Emil Dam, apothecary, and his wife Emilie (née Peterson), a teacher.  The young man graduated in chemistry from the Polytechnic Institute, Copenhagen in 1920, and the same year was appointed instructor (assistant) in chemistry at the School of Agriculture and Veterinary Medicine, progressing to instructor in biochemistry at the Physiological Laboratory of the University of Copenhagen, 1923. The following year saw his marriage, to Inger, née Olsen.  In 1925 Dam studied microchemistry in Graz (Austria) with [F. Pregl](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1923/index.html). He became Assistant Professor at the Institute of Biochemistry, Copenhagen University, in 1928, and was promoted to Associate Professor at the same place in 1929, continuing to hold this post although he was working abroad part of the time, till 1941. On submitting a thesis *Nogle Undersøgelser over Sterinernes Biologiske Betydning* (Some investigations on the biological significance of the sterines) to the University of Copenhagen in 1934, Dam was awarded Ph.D. in Biochemistry.  To further his studies of the metabolism of sterols, Dam obtained a Rockefeller Fellowship and worked in Rudolph Schoenheimer’s Laboratory in Freiburg, Germany, during 1932-1933, and later worked with [P. Karrer](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1937/index.html), of Zurich, in 1935. He discovered vitamin K while studying the sterol metabolism of chicks in Copenhagen. He studied this vitamin further with respect to its occurrence and biological function in animals and plants, as well as its application in human medicine, its fundamental chemical and physical properties and its purification and isolation – the latter part of this research being carried out in collaboration with P. Karrer. From the study of vitamin K arose the observation of some new symptoms in experimental animals, such as increased capillary permeability and colouration of adipose tissue, which turned out to be due to the ingestion of certain fats in the absence of vitamin E.  He was on a lecture tour of Canada and the United States under the auspices of the American Scandinavian Foundation in 1940-1941, this tour having been planned before the occupation of Denmark by German troops in April, 1940. He was able to carry out research in Woods Hole Marine Biological Laboratories during the summer and autumn of 1941, and at the University of Rochester, N.Y., between 1942-1945 as a Senior Research Associate – it was during this period that he was awarded the 1943 Nobel Prize for Physiology or Medicine – and at the Rockefeller Institute for Medical Research in 1945 as an Associate Member.  During his absence, Dam was appointed Professor of Biochemistry at the Polytechnic Institute, Copenhagen, in 1941, though the designation of his Chair at the Polytechnic Institute was changed to Professor of Biochemistry and Nutrition in 1950.  After his return to Denmark in 1946, Dam’s main research subjects were vitamin K, vitamin E, fats, cholesterol, and, in recent years, nutritional studies in relation to gall-stone formation. He has been leader of the Biochemical Division of the Danish Fat Research Institute from 1956 to 1962.  He has published or has collaborated in the publication of about 315 articles on biochemical problems, mainly concerning the biochemistry of sterols, vitamins K and E, and fats.  Professor Dam is a member of the Danish Academy of Technical Sciences (1947); the Royal Danish Academy of Sciences and Letters (1948); he was Correspondant Étranger, Académie Royale de Médecine de Belgique (1951); elected Hon. Fellow of the Royal Society, Edinburgh (1953); became Joint Honorary President, International Union of Nutritional Sciences in 1954, and was Corresponding Member of the German Association for Nutrition in 1961, following on the award of the Norman Medal by the German Association for Fat Research the previous year.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Henrik Dam died on April 17, 1976.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0686 |
| Interview |  |
|  |  |
| ID | 0687 |
| Biographical | Edward Adelbert Doisy was born at Hume, Illinois, on November 13, 1893. He was the son of Edward Perez and his wife Ada, *née* Alley.  He was educated at the University of Illinois, where he took his A.B. degree in 1914 and his M.S. degree in 1916. From there he went to Harvard University, where he took his Ph.D. degree in 1920.  From 1915 until 1917 he was assistant in biochemistry at Harvard Medical School and from 1917 until 1919 he did war service in the Sanitary Corps of the United States Army. From 1919 until 1923 he was Instructor, Associate, and Associate Professor at Washington University School of Medicine and in 1923 he became Professor of Biochemistry at St. Louis University School of Medicine. In 1924 he was appointed Director of the Department of Biochemistry.  Doisy has been concerned chiefly with biochemical studies of the sex hormones and vitamins K1 and K2. At the St. Louis School of Medicine he worked in collaboration with Edgar Allen on the refinement of the vaginal cytology (or smear) technique for the big-assay of the potency of oestrogenic hormones in ovariectomized rats.  In 1929-1930 he succeeded in isolating oestrone, a feat independently accomplished at about the same time by [Butenandt](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1939/index.html) in Germany.  In 1936, in collaboration with MacCorquodale and Thayer, he recovered oestradiol from the ovaries of swine and estimated its concentration in the liquor folliculi.  In 1939 he succeeded in isolating vitamin K, which had been found, in 1935, by Almquist and Stokstad in alfalfa. Vitamin K was isolated in an almost pure form as a yellow oil by [Henrik Dam](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1943/index.html), in collaboration with [Paul Karrer](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1937/index.html).  In 1940 Doisy, in collaboration with Thayer, MacCorquodale, McKee, and Binkley, studied the analogues of vitamin K and established the distinction between vitamin K1 which they isolated from alfalfa, and vitamin K2, isolated from fish meal, which has an action similar to that of vitamin K1, but has a slightly different constitution.  Vitamin K was synthesized in 1939 by Louis Frederick Fieser and by Almquist and Klose, and by Doisy and his collaborators.  For their work on vitamin K, Doisy and Dam were jointly awarded the Nobel Prize in Physiology or Medicine for 1943.  In addition to the work just mentioned, Doisy has improved the methods used for the isolation and identification of insulin and he has also made important contributions to the knowledge of antibiotics and blood buffer systems, and bile acid metabolism.  In 1939 Doisy published, in collaboration with Edgar Allen and C. H. Danforth, a book entitled *Sex and Internal Secretions.*  Apart from several medals and awards, Doisy holds honorary degrees of Yale, Washington, Chicago, Illinois, St. Louis, Central College; Gustavus Adolphus College, and Paris Universities. In 1932 and 1935, he was a member of the League of Nations Committee for the Standardization of Sex Hormones. He was President of the American Society of Biological Chemists in 1943-1945, of the Endocrine Society in 1949-1950, and of the Society for Experimental Biology and Medicine in 1949-1951.  In 1955 his Department was renamed the Edward A. Doisy Department in his honour.  Doisy married Alice Ackert in 1918. They live at St. Louis, Mo, and have four sons, Edward A. Jr., Robert, Philip, and Richard.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1942-1962*, Elsevier Publishing Company, Amsterdam, 1964  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Edward A. Doisy died on October 23, 1986.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0687 |
| Interview |  |
|  |  |
| ID | 0688 |
| Biographical | Gerhard Johannes Paul Domagk was born on October 30, 1895, at Lagow, a beautiful, small town in the Brandenburg Marches. Until he was fourteen he went to school in Sommerfeld, where his father was assistant headmaster. His mother, Martha Reimer, came from farming stock in the Marches, where she lived in Sommerfeld until 1945 when she was expelled from her home; she died from starvation in a refugee camp.  Domagk himself was, from the age of 14, at school in Silesia until he reached the upper sixth form. He then became a medical student at Kiel and, when the 1914-1918 War broke out, he served in the Army, and in December 1914 was wounded. Later he was sent to join the Sanitary Service and served in, among other places, the cholera hospitals in Russia. During this time he was decisively impressed by the helplessness of the medical men of that time when they were faced with cholera, typhus, diarrhoeal infections and other infectious diseases. He was especially strongly influenced by the fact that surgery had little value in the treatment of these diseases and even amputations and other forms of radical treatment were often followed by severe bacterial infections, such as gas gangrene.  In 1918 he resumed his medical studies at Kiel and in 1921 he took his State Medical Examinations and graduated. He undertook laboratory work under Max Bürger on creatin and creatinin, and later metabolic studies and analysis under Professors Hoppe-Seyler and Emmerich.  In 1923 he moved to Greifswald and there became, in 1924, University Lecturer in Pathological Anatomy. In 1925 he held the same post in the University of Münster and in 1958 became professor of this subject. During the years 1927-1929 he was, however, given leave of absence from the University of Münster to do research in the laboratories of the I.G. Farbenindustrie, at Wuppertal. In 1929 a new research institute for pathological anatomy and bacteriology was built by the I.G. Farbenindustrie and there, in 1932, Domagk made the discovery for which his name is so well known, the discovery that earned him the Nobel Prize in Physiology or Medicine for 1939, namely, the fact that a red dye-stuff, to which the name «prontosil rubrum» was given, protected mice and rabbits against lethal doses of staphylococci and haemolytic streptococci. Prontosil was a derivative of sulphanilamide (*p*-aminobenzenesulphonamide) which the Viennese chemist, Gelmo, had synthesized in 1908.  Domagk was, however, not satisfied that prontosil, so effective in mice, would be equally effective in man, but it so happened that his own daughter became very ill with a streptococcal infection, and Domagk, in desperation, gave her a dose of prontosil. She made a complete recovery, but Domagk omitted mentioning the recovery of his daughter from the report on the effect of the drug, waiting until 1935 when results were available from clinicians who had tested the new drug on patients. During subsequent years much work was done in various countries on this class of antibacterial compound and some thousands of derivatives of sulphanilamide have been produced and tested for their antibacterial properties. Domagk’s work has thus given to medicine, and also to surgery, a whole new series of weapons that are effective against many infectious diseases.  The discovery of the antibacterial action of the sulphonamides was not, however, Domagk’s only contribution to chemotherapy. He also discovered the therapeutic value of the quaternary ammonium bases and he also extended, in collaboration with Klarer and Mietzsch, his work on the sulphonamides. Later, he attacked the problem of the chemotherapy of tuberculosis, developing for this the thiosemicarbazones (Conteben) and isonicotinic acid hydrazide (Neoteben). His work has undoubtedly resulted in more effective control of many infectious diseases which nowadays have lost the terrors they formerly caused. The supreme aim of chemotherapy is, in Domagk’s opinion, the cure and control of carcinoma and he was convinced that this will be, in the future, achieved.  Domagk held honorary doctorates of the Universities of Bologna, Münster, Cordoba, Lima, Buenos Aires, and Giessen. He was made Knight of the Order of Merit in 1952, was awarded the Grand Cross of the Civil Order of Health of Spain in 1955. Other honours and distinctions bestowed upon him were: Paul Ehrlich Gold Medal and Paul Ehrlich Prize, University of Frankfurt (1956); Foreign Member of the British Academy of Science and of the Royal Society (1959); Honorary Member of the German Dermatological Society (1960); Japanese Order of Merit of the Rising Sun (1960).  In 1925 Domagk married Gertrud Strübe. They had three sons and one daughter.  Retiring to his old university of Münster, when laboratory work was no longer possible for him, he had devoted himself to the experimental (chemotherapeutic) study of carcinoma and to the dissemination of modern knowledge about it among the students and others interested in it. His recreation was painting.  Dr Domagk died on April 24, 1964.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0688 |
| Interview |  |
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| ID | 0689 |
| Biographical | Corneille Jean François Heymans was born in Ghent, Belgium, on March 28, 1892. His father was J. F. Heymans, formerly Professor of Pharmacology and Rector of the University of Ghent, who founded the J. F. Heymans Institute of Pharmacology and Therapeutics at the same University.  Corneille received his secondary education at the St. Lievenscollege (Ghent), St. Jozefscollege (Turnhout), and St. Barbaracollege (Ghent). He had his medical education at the University of Ghent, where he obtained his doctor’s degree in 1920. After his graduation he worked at the Collège de France, Paris (Prof. E. Gley), University of Lausanne (Prof. M. Arthus), University of Vienna (Prof. H. H. Meyer), University College of London (Prof. E. H. Starling) and Western Reserve Medical School (Prof. C. F. Wiggers).  In 1922 he became Lecturer in Pharmacodynamics at the University of Ghent. In 1930 he succeeded his father as Professor of Pharmacology, being also appointed Head of the Department of Pharmacology, Pharmacodynamics, and Toxicology; at the same time he became Director of the J. F. Heymans Institute. He is Professor Emeritus since 1963.  The scientific investigations carried out at the Heymans Institute are mainly directed towards the physiology and pharmacology of respiration, blood circulation, metabolism, and numerous pharmacological problems. These studies led, in particular, to the discovery of the chemoreceptors, situated in the cardio-aortic and carotid sinus areas, and also to contributions regarding the proprioceptive regulation of arterial blood pressure and hypertension. The discovery of the reflexogenic role of the cardio-aortic and the carotid sinus areas in the regulation of respiration, above all, earned C. Heymans the Nobel Prize in 1938.  Another series of investigations by Heymans and his collaborators was devoted to the physiology of cerebral circulation and of the physiopathology of arterial hypertension of nervous and renal origin; also to the study of blood circulation during muscular exercise; to the physiology and pharmacology of animals totally sympathectomized; to the study of the survival and revival of different nervous centres after the arrest of blood circulation; to the pharmacology of stimulating substances of cellular metabolism, to the pharmacology of the lungs and many other problems.  A prolific author, Heymans has since 1920 issued about 800 papers, published in different periodicals. The results of his investigations have been mainly reported by him in the following general publications: *Le Sinus Carotidien et les autres Zones vasosensibles réflexogènes* (1920); *Le Sinus Carotidien et la Zone Homologue Cardio-aortique*, with J. J. Bouckaert and P. Regniers (1933); *Sensibilité réflexogène des vaisseaux aux excitants chimiques*, with J. J. Bouckaert (1934); «Le centre respiratoire», with D. Cordier in *Ann. Physiol. Physicochim*., II (1935) 335; «Survival and revival of nerve centers after arrest of circulation», *Physiol. Rev.*, 30 (1950) 375; «New aspects of blood pressure regulation», with G. van den Heuvel, *Circulation*, 4 (1951) 581;«Pharmakologische Wirkungen auf die Selbststeuerung des Blutdruckes», *Arch. Exp. Pathol. Pharmakol.*, 216 (1952) 114; «Action of drugs on carotid sinus and body», *Pharmacol. Rev.*, 7 (1955) 119; *Reflexogenic Areas of the Cardiovascular System*, with E. Neil (1958), «Vasomotor control and the regulation of blood pressure», with B. Folkow, in *Circulation of the Blood-Men and Ideas*, edit. by A. P. Fishman and D. W. Richards.  Heymans is publisher and Editor-in-Chief of the *Archives Internationales de Pharmacodynamie et de Thérapie*, founded in 1895 by his father and Professor E. Gley, Paris.  From 1945 to 1962 Heymans has lectured at numerous universities in Europe, North and South America, Africa, and Asia. He was in 1934 «Herter Lecturer» at the University of New York; and in 1937 he was «Lecturer of the Dunham Memorial Foundation» at Harvard University, as well as «Hanna Foundation Lecturer» at the Western Reserve University, and «Greensfelder Memorial Lecturer» at the University of Chicago. In 1939 he was «Lecturer of the Purser Memorial Foundation» at Trinity College, University of Dublin.  Commissioned with special missions by the Belgian Government, the International Union of Physiological Sciences, and by the World Health Organization, he has travelled to Iran and India (1953), Egypt (1955), the Belgian Congo (1957), Latin America (1958), China (1959), Japan (1960), Iraq (1962), Tunisia (1963), Cameroun (1963).  He has been President of the International Union of Physiological Sciences and of the International Council of Pharmacologists and has presided over the 20th International Congress of Physiology held in Brussels in 1956. His vast knowledge of pharmacology has justified his nomination as Member of the Committee of Experts of the International Pharmacopoeia of the World Health Organization. In his own country he is Vice-President of the National Council on Scientific Policy.  Heymans is Member or Honorary Member of a large number of leading scientific societies concerned with physiology or medicine in Europe and in North and South America, including the Pontificia Academia Scientiarum, the Royal Society of Arts of Great Britain, the Académie des Sciences de Paris (Institut de France), Académie de Médecine de Paris, the Heidelberger Akademie für Wissenschaften, and the New York Academy of Sciences. He has been appointed Professor honoris causa of the University of Montevideo, and doctor honoris causa of the Universities of Utrecht, Louvain, Montpellier, Torino, Santiago de Chile, Lima, Bogotá, Rio de Janeiro, Algiers, Paris, Montpellier, Münster, Bordeaux, Toulouse, and Georgetown University, Washington.  Besides the Nobel Prize, his scientific awards include the Alvarenga Prize of the Académie Royale de Médicine de Belgique, the Gluge Prize of the Académie Royale des Sciences de Belgique, the Quinquennial Prize (1931-1935) for Medicine of the Belgian Government, the «Alumni» Prize for Medicine of the Belgian University Foundation, the Bourceret Prize of the Académie de Médecine de Paris (1930), the Monthyon Prize of the Institut de France (1934), the Pius XI Prize of the Pontificia Academia Scientiarum (1938), the Burgi Prize of the University of Bern and the de Cyon Prize (1931) of the University of Bologna, etc.  Heymans is Officer in the Order of the Crown with Swords, Grand Officer in the Order of the Polar Star (Sweden), Grand Officer of the Order of Leopold, Commander in the Order of St. Sylvester (Vatican City), Commander in the Knightly Order of the Holy Sepulchre of Jerusalem; other distinctions include the Civilian Cross (First Class) for Distinguished Services Rendered to the Fatherland, the Belgian War Cross 1914-1918, the Fire Cross with 8 bars 1914-1918. (He was Field Artillery Officer during the first World War. )  Professor Heymans married Berthe May, M. D. in 1921. There are four children by the marriage: Marie-Henriette, Pierre, Jean, and Berthe; and 18 grandchildren. He loves painting and is greatly interested in ancient literature dealing with the history of medicine; he is also a keen hunter.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Corneille Heymans died on July 18, 1968.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0689 |
| Interview |  |
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| ID | 0690 |
| Biographical | Albert von Szent-Györgyi was born in Budapest on September 16, 1893, the son of Nicolaus von Szent-Györgyi, a great landed proprietor and Josefine, whose father, Joseph Lenhossék, and brother Michael were both Professors of Anatomy in the University of Budapest. He matriculated in 1911 and entered his uncle’s laboratory where he studied until the outbreak of World War I when he was mobilized. He served on the Italian and Russian fronts, gaining the Silver Medal for Valour, and he was discharged in 1917 after being wounded in action. He completed his studies in Budapest and then worked successively with the pharmacologist, G. Mansfeld at Pozsony, with Armin von Tschermak at Prague, where he studied electrophysiology, and with L. Michaelis in Berlin, before he went to Hamburg for a two-year course in physical chemistry at the Institute for Tropical Hygiene.  In 1920 he became an assistant at the University Institute of Pharmacology in Leiden and from 1922 to 1926 he worked with H. J. Hamburger at the Physiology Institute, Groningen, The Netherlands. In 1927 he went to Cambridge as a Rockefeller Fellow, working under F. G. Hopkins, and spent one year at the Mayo Foundation, Rochester, Minnesota, before returning to Cambridge. In 1930 he obtained the Chair of Medical Chemistry at the University of Szeged and in 1935 he also took the Chair in Organic Chemistry. At the end of World War II, he took the Chair of Medical Chemistry at Budapest and in 1947 he left Hungary to settle in the United States where he is Director of Research, Institute of Muscle Research, Woods Hole, Massachusetts.  Szent-Györgyi’s early researches at Groningen concerned the chemistry of cell respiration. He described the interdependence of oxygen and hydrogen activation and made his first observations on co-dehydrases and the polyphenol oxidase systems of plants. He also demonstrated the existence of a reducing substance in plant and animal tissues. At Cambridge and during his early spell in the United States, he isolated from adrenals this reducing substance, which is now known as ascorbic acid. Returning to Cambridge in 1929, he later described the pharmacological activity of the nucleotides with Drury.  On his return to Hungary, he noted the anti-scorbutic activity of ascorbic acid and discovered that paprika (*Capsicum annuum*) was a rich source of vitamin C. His persistent studies of biological oxidation led to the recognition of the catalytic function of the C4-dicarboxylic acids, the discovery of «cytoflav» (flavin) and a recognition of the biological activity and probable vitamin nature of flavanone (vitamin P).  In 1938 he commenced work on muscle research and quickly discovered the proteins actin and myosin and their complex. This led to a reproduction of the fundamental reaction of muscle contraction which formed the foundation of muscle research in the following decades. The preservation of biological material in glycerine, which has had extensive application including agricultural use in the preservation of sperm, has resulted from his more recent work. He has also developed the use of rabbit psoas muscle as an experimental material, published theories on the problems of energetics and investigated the regulation of growth and cell membrane potential, and the hormonal function of the thymus gland.  Szent-Györgyi, a member of many scientific societies, is a Past President of the Academy of Sciences, Budapest, and a Vice-President of the National Academy, Budapest. He was Visiting Professor, Harvard University in 1936 and Franchi Professor, University of Liège, 1938. He received the Cameron Prize (Edinburgh) in 1946 and the Lasker Award in 1954. His many publications include *Oxidation, Fermentation, Vitamins, Health and Disease* (1939); *Muscular Contraction* (1947); *The Nature of Life* (1947); *Contraction in Body and Heart Muscle* (1953); and *Bioenergetics* (1957).  Szent-Györgyi married Cornelia Demény, daughter of the Hungarian Postmaster-General, in 1917: they have one daughter. During the 1930’s he was actively anti-Nazi and during World War II he became a Swedish citizen – he was given extensive help by the Swedish Embassy in Budapest. In 1941, he married Marta Borbiro, a co-worker at Woods Hole.  He is interested in sport of all kinds, his favourites being sailing and alpinism.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Albert Szent-Györgyi died on 22 October 1986.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0690 |
| Interview |  |
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| ID | 0691 |
| Biographical | Henry Hallett Dale was born in London on June 9, 1875. He attended Leys School, Cambridge, and in 1894 he entered Trinity College with a scholarship. He graduated through the Natural Sciences Tripos, specializing in physiology and zoology. From 1898 to 1900 he was a Coutts-Trotter Student in Physiology at Trinity College, working then under J. N. Langley. In 1900 he gained a scholarship and entered St. Bartholomew’s Hospital, London, for the clinical part of the medical course. He qualified as B.Ch., Cambridge in 1903 and became M.D. in 1909. Meanwhile, he had been awarded the George Henry Lewes Studentship in Physiology and he used it to carry out research under Professor Starling at University College London. It was here that he met his lifelong friend, [Otto Loewi](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1936/index.html). During 1903, he spent four months with [Paul Ehrlich](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1908/index.html) in Frankfurt before returning to University College as Sharpey Scholar. He held this post for only six months before he took an appointment as pharmacologist at the Wellcome Physiological Research Laboratories in 1904. He became Director of these laboratories in 1906, working for some six years with the chemical cooperation of George Barger.  In 1914, Dale was appointed Director of the Department of Biochemistry and Pharmacology at the National Institute for Medical Research in London, becoming in 1928 Director of this Institute; and he served in this capacity until his retirement in 1942 when he became Professor of Chemistry and a Director of the Davy-Faraday Laboratory at the Royal Institution, London. Since 1946, he has devoted his knowledge and energies to the administration of the Wellcome Trust for the support of medical research and medical scholarships. He has been a Trustee since 1936 and served as Chairman of the Board from 1938 until 1960. He was elected a Fellow of the Royal Society in 1914 and served as Secretary from 1925 to 1935. During World War II, Sir Henry served on several Advisory Committees to His Majesty’s Government. He was knighted in 1932 and appointed to the Order of Merit in 1944.  Sir Henry’s researches have involved a painstaking investigation of the pharmacology of ergot alkaloids and a study of the effects of incidental bases of a simpler nature, such as tyramine and histamine. He discovered the oxytocic action of pituitary extracts, and his continued work on the action of histamine led to studies on anaphylaxis and on conditions of shock. He identified acetylcholine as a constituent of certain ergot extracts, and an analysis of its action served as a basis for later researches, extending the application of Loewi’s discoveries, which have been recognized in the joint award of the Nobel Prize for 1936, given on account of the discoveries relating to chemical transmission of nerve impulses. In addition to numerous articles in medical and scientific journals which record his work, Sir Henry is the author of *Adventures in Physiology* (1953), and *An Autumn Gleaning* (1954).  Sir Henry was President of the Royal Society (1940-1945), President of the British Association (1947), and President of the Royal Society of Medicine (1948-1950). He has received many public honours including the G.B.E. (Knight Grand Cross, Order of the British Empire) in 1948, Medal of Freedom (Silver Palm), U.S.A., in 1947, the Grand-Croix de l’Ordre de la Couronne (Belgium) in 1950, and l’Ordre pour le Mérite (Western Germany) in 1955. The Royal and Copley Medals of the Royal Society, the Gold Albert Medal of the Royal Society of Arts, the Baly Medal of the Royal College of Physicians (London), the Cameron Prize (Edinburgh) and the Schmiedeberg plaquette from the German Pharmacological Society are among the many awards he has gained, and, in addition, he has been awarded fellowships of numerous learned societies and institutions throughout the world, including the Royal Society of Edinburgh and Trinity College, Cambridge. He is also a Foreign Associate of the National Academy of Sciences (Washington), Académie de Médecine (Paris) and l’Académie Royale de Belgique, as well as Academies in Denmark, Germany, Italy, Rumania, Spain, Sweden, U.S.A. (New York). He is the recipient of over twenty honorary degrees, and amongst the many lectures he has given are the Nothnagel Lecture (Vienna) and the Pilgrim Trust Lecture to the National Academy of Sciences, Philadelphia.  Sir Henry married Ellen Harriet Hallett, his first cousin, in 1904. Their eldest daughter, Alison Sarah, is married to [Lord Todd](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1957/index.html), Nobel Laureate in Chemistry, 1957.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Sir Henry Dale died on July 23, 1968.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0691 |
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| ID | 0692 |
| Biographical | Otto Loewi was born on June 3, 1873, in Frankfurt-am-Main, Germany, the son of Jacob Loewi, a merchant, and Anna Willstätter.  After having attended the humanistic Gymnasium (grammar school) in his native town, he entered in 1891 the Universities of Munich and Strassburg (at that time part of Germany) as a medical student. Apart from his attendance at the inspiring anatomy courses of Gustav Schwalbe, however, he seldom went to the medical lectures, being more inclined towards those held at the philosophical faculty. Only in the summer of 1893 did he seriously prepare for his «Physicum», the first medical examination, which he just managed to pass. It was not until the autumn of 1894 that his indifference to medicine suddenly gave way to almost enthusiastic interest. In 1896 he took his doctor’s degree at Strassburg University, his thesis dealing with a subject suggested by Professor Oswald Schmiedeberg, the famous «Father of Pharmacology». Also responsible for his medical education were: Bernhard Naunyn, distinguished clinician and experimental pathologist, Oscar Minkowski, and Adolph Magnus-Levy.  After his graduation he followed a course in inorganic analytical chemistry with Martin Freund, in Frankfurt, and afterwards spent a few months working in the biochemical institute of Franz Hofmeister in Strassburg. During 1897-1898 he was assistant to Carl von Noorden, clinician at the City Hospital in Frankfurt. Soon, however, after seeing the high mortality in countless cases of far-advanced tuberculosis and pneumonia, left without any treatment because of lack of therapy, he decided to drop his intention to become a clinician and instead to carry out research in basic medical science, in particular pharmacology. In 1898 he succeeded in becoming an assistant of Professor Hans Horst Meyer, the renowned pharmacologist at the University of Marburg-an-der-Lahn, from 1904 Professor of Pharmacology in Vienna. In 1905 Loewi became Associate Professor at Meyer’s laboratory, and in 1909 he was appointed to the Chair of Pharmacology in Graz.  During his first years in Marburg, Loewi’s studies were in the field of metabolism. As a result of his work on the action of phlorhizin, a glucoside provoking glycosuria, and another one on nuclein metabolism in man, he was appointed «Privatdozent» (Lecturer) in 1900. Two years later he published his paper «Über Eiweiss-synthese im Tierkörper» (On protein synthesis in the animal body), proving that animals are able to rebuild their proteins from their degradation products, the amino acids – an essential discovery with regard to nutrition.  That same year he also published the first part of a series of papers about experimental contributions to the physiology and pharmacology of kidney function.  In 1902 Loewi also spent some months in Starling’s laboratory, in London, where he also worked with W. M. Bayliss, Starling’s brother-in-law. And it was in this laboratory that he first met his lifelong friend Henry Dale, who was later to share the Nobel Prize with him.  After his return to Marburg in 1902 Loewi continued to study the function of the kidney and the mechanism of the action of diuretics. On his arrival in Vienna in 1905 he again took up the problems connected with carbohydrate metabolism. He proved thereby that preference for fructose rather than glucose is not only characteristic of pancreatectomized dogs, as earlier demonstrated by Minkowski, but also of dogs deprived of their glycogen by other means, e.g. by phosphorus poisoning. He also proved that the heart in contrast to the liver, cannot utilize fructose. And finally that epinephrine injections into rabbits completely depleted of their liver glycogen by starvation brought the glycogen back to almost normal values in spite of continued starvation. His other investigations in Vienna, done jointly with Alfred Fröhlich, dealt with the vegetative nervous system (stimulated by the discovery made by Gaskell and Langley of the existence of two divisions of this nervous system, and also as a result of his coming into contact with T.R. Elliott in Cambridge, where the latter was conducting his final experiments on the action of epinephrine). His classic paper in this field was published in 1905, the best-known result of these studies being the observation that small doses of cocaine potentiate the responses of sympathetically innervated organs to epinephrine and sympathetic nerve stimulation.  It was as Professor in Graz that Loewi cultivated his gifts as a lecturer. A number of his associates during this period came from the U.S.A. Loewi continued his studies of carbohydrate metabolism, investigating among other things the conditions responsible for epinephrine hyperglycaemia.  In 1921 Loewi discovered the chemical transmission of nerve impulses the research of which was greatly developed by him and his co-workers in the years following, culminating ultimately in his demonstration that the parasympathetic substance («Vagusstoff») is acetylcholine and that a substance closely related to adrenaline played a corresponding role at the sympathetic nerve endings. It was for these researches that he received the Nobel Prize in 1936, jointly with Sir Henry Dale. This and other discoveries in the fields of chemistry, physics, and pharmacology have since then led to a complete renewal of the concepts of the sympathetic nervous system.  When the Germans invaded Austria in 1938, Loewi was forced to leave his homeland. (But only after he had been compelled to instruct the Swedish bank in Stockholm to transfer the Nobel Prize money to a prescribed Nazi-controlled bank.)  After spending some time as Visiting Professor at the Université Libre in Brussels, and at the Nuffield Institute, Oxford, Loewi accepted an invitation to join the College of Medicine, New York University, as Research Professor of Pharmacology, and to work in George Wallace’s Laboratory. He arrived in the United States in 1940. In America Loewi came into close contact with many outstanding biologists from all over the world and here he found much inspiration for his work.  Loewi held honorary degrees from New York University, Yale University, and from the Universities of Graz and Frankfurt. He was recipient of the Physiology Prize of the Royal Academy of Sciences of Bologna, of the Lieben Prize of the Academy of Vienna, and of the Cameron Prize of the University of Edinburgh (1944). He was an Honorary Member of the Physiological Society (London), of the Harvey Society (New York), and of the Società Italiana di Biologia Sperimentale; he was also Corresponding Member of the Society of Physicians in Vienna, of the Viennese Biological Society, and of the Society for the Advancement of Natural Sciences in Marburg-an-der-Lahn; and was Member of the Deutsche Akademie der Naturforscher Leopoldina, in Halle. In 1954 he was appointed Foreign Member of the Royal Society.  Since his schooldays, Loewi showed keen interest in the humanities. He always enjoyed music, architecture, and painting, and in his younger years seldom missed an opportunity to visit museums and exhibitions.  In 1908 he married Guida Goldschmiedt, daughter of Dr. Guido Goldschmiedt, then Professor of Chemistry in Prague, and later in Vienna. They had three sons, Hans, Victor, Guido; and one daughter, Anna. Professor Loewi became an American citizen in 1946. He died December 25, 1961.  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| Biographical | Hans Spemann was born on June 27, 1869, at Stuttgart. He was the eldest son of the publisher, Wilhelm Spemann. From 1878 until 1888 he went to the Eberhard-Ludwig School at Stuttgart and when he left school in 1888 he spent a year in his father’s publishing business.  From 1889-1890 he did his military service and then, after a period as a retail bookseller, he entered, in 1891, the University of Heidelberg. There, until he took his preliminary examination in 1893, he studied medicine, and was especially attracted by the work of the comparative anatomist there, Carl Gegenbaur.  During the winter of 1893-1894 he studied at the University of Munich, where he became more closely acquainted with August Pauly – a fact of great importance to him. From the spring of 1894 to the end of 1908, he worked in the Zoological Institute at the University of Würzburg. In 1895 he took his degree in zoology, botany, and physics (subjects to serve his anatomical studies), having worked under Theodor Boveri, Julius Sachs, and [Wilhelm Röntgen](https://www.nobelprize.org/nobel_prizes/physics/laureates/1901/index.html), all of whom had the greatest influence on his scientific development.  In 1898 he qualified as a lecturer in zoology at the University of Würzburg, and in 1908 he was asked to become Professor of Zoology and Comparative Anatomy at Rostock, and in 1914 he became Associate Director of the Kaiser Wilhelm Institute of Biology at Berlin-Dahlem. In 1919 he was appointed Professor of Zoology at the University of Freiburg-im-Breisgau, in succession to Hans Doflein, a post which he held until he retired and became Emeritus Professor in 1935.  Spemann’s name will always be associated with his work on experimental embryology. He made himself a master of micro-surgical technique and, working on the relatively large eggs of amphibians he discovered in 1924, together with Hilde Mangold, the existence of an area in the embryo, the portions of which, upon transplantation into an indifferent part of a second embryo there organized (induced) secondary embryonic primordia. The name «organizer centre» or «organizer» was therefore given by him to those parts. For this discovery of the organizer effect in embryonic development, he was awarded the Nobel Prize in 1935.  Later Spemann showed that different parts of the organization centre produce different parts of the embryo. The anterior parts of it tend to produce parts of the head, and the posterior parts of it parts of the tail. Further, tail organizers, when they are grafted into the head region of another embryo, may produce heads instead of tails, the reason being that they are influenced by the head organizer in their new environment.  Earlier Spemann had transplanted the optic cups of new embryos into the outermost layer of the region of the abdomen and had found that they induced the production, in this new situation, of a lens of the eye. This was interpreted as being evidence of the existence of secondary organizers which operate after the induction exerted by the primary organizer has been completed.  By these and other experiments of a similar kind Spemann laid the foundations of the theory of embryonic induction by organizers, which led later to biochemical studies of this process and the ultimate development of the modern science of experimental morphogenesis. He described his researches in his book *Embryonic Development and Induction* (1938).  Spemann died at Freiburg on September 9, 1941.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
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| Biographical | George Hoyt Whipple was born on August 28, 1878, in Ashland, New Hampshire, U.S.A., the son of Dr. Ashley Cooper Whipple and his wife Frances Hoyt. His paternal grandfather and his father, both physicians, were born and bred in New Hampshire.  Whipple was educated at Andover Academy and then went to Yale University, where he took his A.B.degree in 1900. Subsequently he went to Johns Hopkins University, where he took his M.D. degree in 1905.  In 1905 he was appointed Assistant in Pathology at the Johns Hopkins Medical School and, although he spent a year as pathologist to the Ancon Hospital, Panama, he remained at Johns Hopkins University until 1914, being successively Assistant, Instructor, Associate and Associate Professor in Pathology.  In 1914 he was appointed Professor of Research Medicine at the University of California Medical School, and Director of the Hooper Foundation for Medical Research at that University, being Dean of the Medical School during the years 1920 and 1921. In 1921 he was appointed Professor of Pathology and Dean of the School of Medicine and Dentistry at the University of Rochester.  Whipple’s main researches were concerned with anaemia and the physiology and pathology of the liver. For a year he worked under General William Gorgas and Dr. S. T. Darling on anaemia caused by parasitic infections and especially on the lesions found in the intestinal tract in people suffering from these infections. He also studied the histology of the tissues in patients suffering from blackwater fever.  When he went to Johns Hopkins University as an assistant in the Department of Pathology, Whipple worked under William H. Welch on pigments related to liver necrosis caused by chloroform anaesthesia, his aim being to gather information about repair and regeneration of the liver cells. This problem was studied in the dog, and Whipple found that the liver cells had an almost limitless power of regeneration. He then became interested in jaundice, which is always associated with chloroform poisoning and injury to the liver. He studied the route by which the bile pigments pass into the blood and thus produce jaundice of various parts of the body and he found that the lympathic system was of little importance in transporting them. He then studied, by means of bile fistulas and other means, the bile pigments and their production outside the liver, and in this work he collaborated with C. W. Hooper.  After his appointment at the Hooper Foundation, Whipple continued his work with bile fistulas, and soon found that a better understanding of the production of haemoglobin was needed if the metabolism of bile pigments was to be understood. In collaboration with C. W. Hooper and Mrs. Robscheit-Robbins, he did experiments on short-term anaemia in dogs due to loss of blood, and further work was done on this subject and on diets consisting of liver in relation to the regeneration of blood. In Rochester, however, he decided to use anaemias due to blood loss which were uniformly sustained and were long maintained, and to study the effects on these of various factors in diets added to the rations. This work showed that the most effective addition to the diets was raw liver itself. For this work on the therapeutic value of liver in the treatment of pernicious anaemia he was awarded, together with [George R. Minot](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1934/minot-bio.html) and [William P. Murphy](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1929/index.html), the Nobel Prize for Physiology or Medicine in 1934.  Whipple has, in addition to the researches just described, worked on tuberculosis, pancreatitis, chloroform poisoning in animals, the metabolism of pigments and iron, the constituents of the bile, and the regeneration of plasma protein, and he has studied protein metabolism by means of lysine labelled with 14C, and also vitamin B12 labelled with 60Co, and its distribution and functions in the body. He has also made studies of the stroma of red blood cells.  Among the many honours and distinctions he received are honorary doctorates of several American Universities as well as of the Universities of Athens and Glasgow; the Popular Science Monthly Gold Medal and Annual Award in 1930 (with Dr. Minot), and the William Wood Gerhard Gold Medal of the Pathological Society of Philadelphia, in 1934.  He is a Trustee of the Rockefeller Foundation. He is also a Corresponding Member of the Association of Physicians in Vienna and of the Royal Society of Physicians in Budapest, and of the European Society of Haematology, and a Foreign Corresponding Member of the British Medical Association. He is an Honorary Member of the Pathological Society of Great Britain and Ireland, and of the American Philosophical Society and the Society of Experimental Biology and Medicine. He was, from 1936-1953, a member of the Board of Scientific Directors of the Rockefeller Institute, a member of the Board of Trustees of this Foundation from 1939-1953, Vice-Chairman of its Board of Trustees from 1953-1960, and in 1960 he was appointed Trustee Emeritus.  In 1914 Whipple married Katherine Ball Waring of Charleston, South Carolina. He has one son George Hoyt (b. 1917) and one daughter Barbara (b. 1921), and seven grandchildren.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *George H. Whipple died on February 1, 1976.* |
| Autobiographical |  |
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| Biographical | George Richards Minot was born on December 2, 1885, at Boston, Massachusetts, U.S.A. His ancestor, George Minot, had migrated to America in 1630, from Saffron Walden, England. His father, James Jackson Minot, was a physician, and his mother was Elizabeth Whitney.  In his youth Minot was interested in butterflies and moths, and he published two articles on butterflies. He went to Harvard University and there took his A.B. degree in 1908, his M.D. in 1912, and gained an honorary degree of Sc.D. in 1928.  He did his hospital training at the Massachusetts General Hospital and then worked at Johns Hopkins Hospital and Medical School, under W. S. Thayer and W. H. Howell.  In 1915 he was appointed Assistant in Medicine at the Harvard Medical School and the Massachusetts General Hospital and was later appointed to a more senior post there.  In 1922 he became Physician-in-Chief of the Collis P. Huntington Memorial Hospital of Harvard University, and later was appointed to the Staff of the Peter Bent Brigham Hospital.  In 1928 he was elected Professor of Medicine at Harvard University and Director of the Thorndike Memorial Laboratory and Visiting Physician to the Boston City Hospital.  Minot early became, when he was a medical student, interested in the disorders of the blood with which his name is associated and he published during his life many papers on this and other subjects. Arthritis, cancer, dietary deficiencies, the part played by diet (vitamin B deficiency) in the production of so-called alcoholic polyneuritis and the social aspects of disease were among the subjects of his papers. Further he studied the coagulation of the blood, blood transfusion, the blood platelets and the reticulocytes as well as certain blood disorders, and he described an atypical familial haemorrhagic condition associated with prolonged anaemia. He also studied the condition of the blood in certain cases of industrial poisoning.  Among his other interests were leucaemia, disorders of the lymphatic tissues and polycythaemia, but his most important contributions to knowledge were made in his studies of anaemia. His name will always be associated with the therapy of pernicious anaemia, in which he first became interested in 1914, but it was not until later that he, like [William P. Murphy](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1934/murphy-bio.html), became impressed by the work of [George Hoyt Whipple](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1934/whipple-bio.html) on the treatment of experimental forms of anaemia in dogs, and in 1926 he and Murphy described the effective treatment of pernicious anaemia by means of liver. For this work he and Murphy and Whipple were awarded, in 1934, the Nobel Prize for Physiology or Medicine. Subsequently, Minot, in collaboration with Edwin J. Cohn, extended this work by showing the efficacy of certain fractions of liver substance and he demonstrated the value of reticulocyte reactions in the evaluation of therapeutic procedures. He also added to knowledge of gastro-intestinal functions and of iron therapy for anaemia, and to knowledge of other aspects of this group of diseases.  Minot was member or fellow of numerous medical and allied organizations in his own country and abroad, and served as Editor of several medical publications. Among the many honours and distinctions he received, may be mentioned: the Cameron Prize in Practical Therapeutics of the University of Edinburgh, in 1930 (jointly with W. P. Murphy), the Popular Science Monthly Gold Medal and Annual Award for 1930 (jointly with G. H. Whipple), and the John Scott Medal of the City of Philadelphia.  On June 29, 1915, Minot married Marian Linzee Weld; there were two daughters and one son by this marriage.  After a long and busy life, during which he made many important contributions to medical knowledge, especially to that of diseases of the blood, Minot died, full of honours, in 1950.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *George R. Minot died on February 25, 1950.* |
| Autobiographical |  |
| Podcast |  |
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| ID | 0696 |
| Biographical | William Parry Murphy was born on February 6, 1892, at Stoughton Wisconsin, U.S.A. He is the son of Thomas Francis Murphy and Rose Anna Parry, his father being a congregational minister with various pastorates in Wisconsin and Oregon. William Parry was educated at the public schools of Wisconsin and Oregon and at the University of Oregon, where he took his A.B. degree in 1914.  For the next two years he taught physics and mathematics at the high schools of Oregon, and then spent one year at the University of Oregon Medical School at Portland, where he also acted as a laboratory assistant in the Department of Anatomy. He then attended a summer course at the Rush Medical School in Chicago and was later awarded the William Stanislaus Murphy Fellowship at Harvard Medical School, Boston. He held this Fellowship for three years and graduated as a Doctor of Medicine in 1922.  Two years as House Officer at the Rhode Island Hospital followed and he then became Assistant Resident Physician at the Peter Bent Brigham Hospital under Professor Henry A. Christian. This appointment he held for eighteen months and then he was appointed Junior Associate in Medicine at this hospital.  In 1924 he was appointed Assistant in Medicine at Harvard, and from 1928 until 1935 he was Instructor in Medicine there. From 1935 until 1938 he was Associate in Medicine at Harvard and from 1948 until 1958 Lecturer in Medicine, becoming in 1958 Senior Associate in Medicine, and subsequently Emeritus Lecturer in that subject.  In 1923 Murphy practised medicine for a time and subsequently engaged in research on diabetes mellitus and on diseases of the blood. Murphy’s work on pernicious and other forms of anaemia was outstanding. For the treatment of pernicious and hypochromic anaemia and for granulocytopenia he used intramuscular injections of extract of liver and he was associated with [George Richards Minot](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1934/minot-bio.html) and [George Hoyt Whipple](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1934/whipple-bio.html) in work on pernicious anaemia and the treatment of it by means of a diet of uncooked liver. For this work he was awarded, together with George Richards Minot and George Hoyt Whipple, the Nobel Prize for Physiology or Medicine for 1934. He wrote *Anemia in Practice: Pernicious Anemia* (1939).  He has been consulting haematologist to several hospitals, and he now lives at Brooklyn, Mass., U.S.A. Among his many distinctions and honours are the Cameron Prize of the University of Edinburgh, together with George Richards Minot for their work on pernicious anaemia (1930), the Bronze Medal of the American Medical Association for an exhibit demonstrating his methods of treating anaemias with liver extract (1934), the First Rank of Decoration-Commander of the Order of the White Rose, Finland (1934), and the National Order of Merit, Carlos J. Finlay, Official, Cuba (1952).  He is member of numerous medical and allied societies at home and abroad, including the Deutsche Akademie der Naturforscher Leopoldina.  Murphy married Pearl Harriett Adams on September 10, 1919, and they have one son, Dr. William P. Murphy, Jr. Their only daughter, Priscilla Adams, died in 1936.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *William P. Murphy died on October 9, 1987.* |
| Autobiographical |  |
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| ID | 0697 |
| Biographical | Thomas Hunt Morgan was born on September 25, 1866, at Lexington, Kentucky, U.S.A. He was the eldest son of Charlton Hunt Morgan.  He was educated at the University of Kentucky, where he took his B.S. degree in 1886, subsequently doing postgraduate work at Johns Hopkins University, where he studied morphology with W. K. Brooks, and physiology with H. Newell Martin.  As a child he had shown an immense interest in natural history and even at the age of ten, he collected birds, birds’ eggs, and fossils during his life in the country; and in 1887, the year after his graduation, he spent some time at the seashore laboratory of Alphaeus Hyatt at Annisquam, Mass. During the summer of 1888, he was engaged in research for the United States Fish Commission at Woods Hole. In 1890 he spent the summer at the Marine Biological Laboratory (MBL) in Woods Hole, thus beginning a long-term association with the MBL as a summer investigator and trustee. In 1890 he obtained his Ph.D. degree at Johns Hopkins University. ln that same year he was awarded the Adam Bruce Fellowship and visited Europe, working especially at the Marine Zoological Laboratory at Naples which he visited again in 1895 and 1900. At Naples he met Hans Driesch and Curt Herbst. The influence of Driesch with whom he later collaborated, no doubt turned his mind in the direction of experimental embryology.  In 1891 he became Associate Professor of Biology at Bryn Mawr College for Women, where he stayed until 1904, when he became Professor of Experimental Zoology at Columbia University, New York. He remained there until 1928, when he was appointed Professor of Biology and Director of the G. Kerckhoff Laboratories at the California Institute of Technology, at Pasadena. Here he remained until 1945. During his later years he had his private laboratory at Corona del Mar, California.  During Morgan’s 24-years period at Columbia University his attention was drawn toward the bearing of cytology on the broader aspects of biological interpretation. His close contact with E. B. Wilson offered exceptional opportunities to come into more direct contact with the kind of work which was being actively carried out in the zoological department, at that time.  Morgan was a many-sided character who was, as a student, critical and independent. His early published work showed him to be critical of Mendelian conceptions of heredity, and in 1905 he challenged the assumption then current that the germ cells are pure and uncrossed and, like Bateson was sceptical of the view that species arise by natural selection. «Nature», he said, «makes new species outright.» In 1909 he began the work on the fruitfly *Drosophila melanogaster* with which his name will always be associated.  It appears that Drosophila was first bred in quantity by C. W. Woodworth, who was working from 1900-1901, at Harvard University, and Woodworth there suggested to W. E. Castle that Drosophila might be used for genetical work. Castle and his associates used it for their work on the effects of inbreeding, and through them F. E. Lutz became interested in it and the latter introduced it to Morgan, who was looking for less expensive material that could be bred in the very limited space at his command. Shortly after he commenced work with this new material (1909), a number of striking mutants turned up. His subsequent studies on this phenomenon ultimately enabled him to determine the precise behaviour and exact localization of genes.  The importance of Morgan’s earlier work with Drosophila was that it demonstrated that the associations known as *coupling* and *repulsion*, discovered by English workers in 1909 and 1910 using the Sweet Pea, are in reality the obverse and reverse of the same phenomenon, which was later called *linkage*. Morgan’s first papers dealt with the demonstration of sex linkage of the gene for white eyes in the fly, the male fly being heterogametic. His work also showed that very large progenies of Drosophila could be bred. The flies were, in fact, bred by the million, and all the material thus obtained was carefully analysed. His work also demonstrated the important fact that spontaneous mutations frequently appeared in the cultures of the flies. On the basis of the analysis of the large body of facts thus obtained, Morgan put forward a theory of the *linear arrangement* of the genes in the chromosomes, expanding this theory in his book, *Mechanism of Mendelian Heredity* (1915).  In addition to this genetical work, however, Morgan made contributions of great importance to experimental embryology and to regeneration. So far as embryology is concerned, he refuted by a simple experiment the theory of Roux and Weismann that, when the embryo of the frog is in the two-cell stage, the blastomeres receive unequal contributions from the parent blastoderm, so that a «mosaic» results. Among his other embryological discoveries was the demonstration that gravity is not, as Roux’s work had suggested, important in the early development of the egg.  Although so much of his time and effort was given to genetical work, Morgan never lost his interest in experimental embryology and he gave it, during his last years increasing attention.  To the study of regeneration he made several important contributions, an outstanding one being his demonstration that parts of the organism which are not subject to injury, such as the abdominal appendages of the hermit crab, will nevertheless regenerate, so that regeneration is not an adaptation evolved to meet the risks of loss of parts of the body. On this part of his work he wrote his book *Regeneration*.  Apart from the books previously mentioned Morgan wrote: *Heredity and Sex* (1913), *The Physical Basis of Heredity*(1919), *Embryology and Genetics* (1924), *Evolution and Genetics* (1925), *The Theory of the Gene* (1926), *Experimental Embryology* (1927), *The Scientifc Basis of Evolution* (2nd. ed., 1935), all of them classics in the literature of genetics.  Morgan was made a Foreign Member of the Royal Society of London in 1919, where he delivered the Croonian Lecture in 1922. In 1924, he was awarded the Darwin Medal, and in 1939 the Copley Medal of the Society.  For his discoveries concerning the role played by the chromosome in heredity, he was awarded the Nobel Prize in 1933.  Among his collaborators at Columbia may be mentioned [H. J. Muller](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1946/index.html), who was awarded the Nobel Prize in 1946 for his production of mutations by means of X-rays.  Morgan married Lilian Vaughan Sampson, in 1904, who had been a student at Bryn Mawr College, and who often assisted him in his research. They had one son and three daughters.  Professor Morgan died in 1945.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Thomas H. Morgan died on 4 December 1945.* |
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| Biographical | Charles Scott Sherrington was born on November 27, 1857, at Islington, London. He was the son of James Norton Sherrington, of Caister, Great Yarmouth, who died when Sherrington was a young child. Sherrington’s mother later married Dr. Caleb Rose of Ipswich, a good classical scholar and a noted archaeologist, whose interest in the English artists of the Norwich School no doubt gave Sherrington the interest in art that he retained throughout his life.  In 1876 Sherrington began medical studies at St. Thomas’s Hospital and in 1878 passed the primary examination of the Royal College of Surgeons, and a year later the primary examination for the Fellowship of that College. After a short stay at Edinburgh he went, in 1879, to Cambridge as a noncollegiate student studying physiology under Michael Foster, and in 1880 entered Gonville and Caius College there.  In 1881 he attended a medical congress in London at which Sir Michael Foster discussed the work of Sir Charles Bell and others on the experimental study of the functions of nerves that was then being done in England and elsewhere in Europe. At this congress controversy arose about the effects of excisions of parts of the cortex of the brains of dogs and monkeys done by Ferrier and Goltz of Strasbourg. Subsequently, Sherrington worked on this problem in Cambridge with Langley, and with him published, in 1884, a paper on it. In this manner Sherrington was introduced to the neurological work to which he afterwards devoted his life.  In 1883 Sherrington became Demonstrator of Anatomy at Cambridge under Professor Sir George Humphrey, and during the winter session of 1883-1884 at St. Thomas’s Hospital he demonstrated histology.  The years 1884 and 1885 were eventful ones for Sherrington, for during the winter of 1884-1885 he worked with Goltz at Strasbourg, in 1884 he obtained his M.R.C.S., and in 1885 a First Class in the Natural Sciences Tripos at Cambridge with distinction. During this year he published a paper of his own on the subject of Goltz’s dogs. In 1885 he also took his M.B. degree at Cambridge and in 1886 his L.R.C.P.  In 1885 Sherrington went, as a member of a Committee of the Association for Research in Medicine, to Spain to study an outbreak of cholera, and in 1886 he visited the Venice district also to investigate the same disease, the material then obtained being examined in Berlin under the supervision of Virchow, who later sent Sherrington to [Robert Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html) for a six weeks’ course in technique. Sherrington stayed with Koch to do research in bacteriology for a year, and in 1887 he was appointed Lecturer in Systematic Physiology at St. Thomas’s Hospital, London, and also was elected a Fellow of Gonville and Caius College, Cambridge. In 1891 he was appointed in succession to Sir Victor Horsley, Professor and Superintendent of the Brown Institute for Advanced Physiological and Pathological Research in London. In 1895 he became Professor of Physiology at the University of Liverpool.  During his earlier years in Cambridge, Sherrington, influenced by W. H. Gaskell and by the Spanish neurologist, [Ramón y Cajal](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1906/index.html), whom he had met during his visit to Spain, took up the study of the spinal cord. By 1891 his mind had turned to the problems of spinal reflexes, which were being much discussed at that time, and Sherrington published several papers on this subject and, during 1892-1894, others on the efferent nerve supply of muscles. Later, from 1893-1897, he studied the distribution of the segmented skin fields, and made the important discovery that about one-third of the nerve fibres in a nerve supplying a muscle are efferent, the remainder being motor.  At Liverpool he returned to his earlier study of the problem of the innervation of antagonistic muscles and showed that reflex inhibition played an important part in this. In addition to this, however, he was studying the connection between the brain and the spinal cord by way of the pyramidal tract, and he was at this time visited by the American surgeon Harvey Cushing, then a young man, who stayed with him for eight months.  In 1906 he published his well-known book: *The Integrative Action of the Nervous System*, being his Silliman Lectures held at Yale University the previous year, and in 1913 he was invited to become Waynfleet Professor of Physiology at Oxford, a post for which he had unsuccessfully applied in 1895, and here he remained until his retirement in 1936. Here he wrote, and published in 1919, his classic book entitled *Mammalian Physiology: a Course of Practical Exercises*, and here he regularly taught the students for whom this book was written.  In physique Sherrington was a well-built, but not very tall man with a strong constitution which enabled him to carry out prolonged researches.  During the First World War, as Chairman of the Industrial Fatigue Board, he worked for a time in a shell factory at Birmingham, and the daily shift of 13 hours, with a Sunday shift of 9 hours, did not, at the age of 57, tire him. From his early years he was short-sighted, but he often worked without spectacles.  The predominant notes of his character as a man were his humility and friendliness and the generosity with which he gave to others his advice and valuable time. An interesting feature of him is that he published, in 1925, a book of verse entitled *The Assaying of Brabantius and other Verse*, which caused one reviewer to hope that «Miss Sherrington» would publish more verse. He was also sensitive to the music of prose, and this and the poet in him, but also the biologist and philosopher, were evident in his Rede Lecture at Cambridge in 1933 on *The Brain and its Mechanism*, in which he denied our scientific right to join mental with physiological experience.  The philosopher in him ultimately found expression in his great book, *Man on his Nature*, which was the published title of the Gifford Lectures for 1937-1938, which Sherrington gave. As is well known, this book, published in 1940, centres round the life and views of the 16th century French physician Jean Fernel and round Sherrington’s own views. In 1946 Sherrington published another volume entitled *The Endeavour of Jean Fernel*.  Sherrington was elected a Fellow of the Royal Society of London in 1893, where he gave the Croonian Lecture in 1897, and was awarded the Royal Medal in 1905 and the Copley Medal in 1927. In 1922 the Knight Grand Cross of the Order of the British Empire and in 1924 the Order of Merit were conferred upon him. He held honorary doctorates of the Universities of Oxford, London, Sheffield, Birmingham, Manchester, Liverpool, Wales, Edinburgh, Glasgow, Paris, Strasbourg, Louvain, Uppsala, Lyons, Budapest, Athens, Brussels, Berne, Toronto, Montreal, and Harvard.  As a boy and a young man Sherrington was a notable athlete both at Queen Elizabeth’s School, Ipswich, where he went in 1871, and later at Gonville and Caius College, Cambridge, for which College he rowed and played rugby football; he was also a pioneer of winter sports at Grindelwald.  In 1892 Sherrington married Ethel Mary, daughter of John Ely Wright, of Preston Manor, Suffolk. After some years of frail health, during which, however, he remained mentally very alert, he died suddenly of heart failure at Eastbourne in 1952.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). 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| Interview |  |
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| ID | 0699 |
| Biographical | Edgar Douglas Adrian was born on November 30, 1889, in London. He was the second son of Alfred Douglas Adrian, C.B., K.C., legal adviser to the British Local Government Board. Adrian went to school at Westminster School, London, and in 1908 he went to Trinity College, Cambridge, at which College he had won a Scholarship in Science. At Cambridge University he studied physiology and the other subjects of the Natural Sciences Tripos and in 1911 he took his B.A. degree with first classes in five separate subjects.  In 1913 he was elected to a Fellowship of Trinity College on account of his investigation of the «all or none» principle in nerve. He then studied medicine, doing his clinical work at St. Bartholomew’s Hospital, London, and taking his medical degree in 1915. After working for a time on clinical neurology, he returned to Cambridge in 1919, to lecture on the nervous system. He was made Fellow of the Royal Society in 1923. In 1925 he began investigating the sense organs by electrical methods.  In 1929 he was elected Foulerton Professor of the Royal Society. In 1937 he succeeded Sir Joseph Barcroft as Professor of Physiology at the University of Cambridge, a post which he held until 1951.  In 1951 Adrian was elected Master of Trinity College, Cambridge, a post which he still, at the time of writing, holds.  When Adrian graduated at Cambridge, the Department of Physiology there included several distinguished research workers. Among them were J. N. Langley (1852-1925), who had succeeded Sir Michael Foster (1836-1907), W. H. Gaskeh (1847-1914), Sir Hugh K. Anderson (1865-1928), Sir Walter Morley Fletcher (1873-1933), Sir Joseph Barcroft (1872-1947), Keith Lucas (1879-1916) and [Archibald Vivian Hill](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1922/index.html) (b. 1886) who was then beginning his work on heat production in muscle. [Sir Frederick Gowland Hopkins](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1929/index.html) (1861-1947) was then doing his pioneer work on the vitamins.  Adrian’s first research work was done with Keith Lucas, who was working on the impulses transmitted by motor nerves; he showed that, when a muscle fibre contracts, the passage of the nerve impulse that causes the contractions leaves the motor nerve in a state of diminished excitability. Keith Lucas was, at the time of the First World War, thinking of improving the study of the electrical currents in nerves by amplifying them by means of valves, a method which Adrian was later to employ.  First, however, Adrian went to London to take his medical degree and was, until the end of the First World War occupied with work on military patients suffering from nerve injuries or nervous disorders. Returning to Cambridge in 1919 to take over Keith Lucas’s laboratory, he began the work with which his name will always be associated. In order to obtain a more sensitive detection of nerve impulses, he used the cathode ray tube, the capillary electrometer and amplification of the electrical impulses by means of thermionic valves, and was thus able to amplify them 5,000 times. He succeeded in setting up a preparation consisting of a single end organ in a muscle of the frog, together with the single nerve fibre related to it and he found that, when the end organ is stimulated, the nerve fibre showed regular impulses with a variable frequency.  With this apparatus he was able to record the electrical discharges in single nerve fibres which were produced by tension on the muscle, pressure on it, touch, the movement of a hair and pricking with a needle. By 1928 he was able to publish his conclusion that a stimulus of constant intensity applied to the skin, immediately excites the end organ, but that this excitation progressively decreases for as long as the stimulation continues. At the same time sensory impulses of constant intensity pass along the nerve from the end organ. These sensory impulses are at first very frequent, but their frequency gradually decreases and as they decrease the sensation in the brain progressively diminishes. As A. V. Hill (The Ethical Dilemma of Science, 1960) has said, Adrian, by thus showing that the afferent effect in a given neurone depends on the pattern in time of the impulses travelling in it, has provided a new quantitative basis of nervous behaviour.  Later Adrian extended his investigations to a study of the electrical impulses caused by stimuli likely to cause pain, he concluded that, as Sir Henry Head had postulated as a result of his clinical studies, the nerve fibres which conduct impulses excited by pain probably do not pass further into the brain than the optic thalamus, but that all other sensory impulses can be distinguished in the sensory area of the cortex of the brain and he showed that the part of the cerebral cortex devoted to any particular kind of end organ is related to the special needs of the animal concerned. Thus in man and the monkey the sensory area of the cerebral cortex devoted to the face and hand is relatively large, and relatively little is given to the trunk of the body. In the pony the area devoted to the nostrils is as large as that devoted to the rest of the body; in the pig almost the whole of the sensory area of the cerebral cortex devoted to the sense of touch is given to fibres from the snout, which the pig uses to explore its environment.  Subsequently, Adrian studied the sense of smell and the electrical activity of the brain and the variations and abnormalities of waves shown in the encephalogram, which Hans Berger, of Jena, had described in 1929. This work opened up new fields of investigation in the study of epilepsy and other lesions of the brain.  For his work about the functions of neurones Adrian was awarded, jointly with Sir Charles Sherrington, the Nobel Prize for 1932.  The results of Adrian’s brilliant researches on the electrophysiology of the brain and nervous system were published in numerous scientific papers and in his three books, *The Basis of Sensation* (1927), *The Mechanism of Nervous Action* (1932) and *The Physical Basis of Perception* (1947). With others he wrote *Factors Determining Human Behaviour* (1937).  Adrian had numerous honours bestowed upon him. During 1950-1955 he was President of the Royal Society, and during 1960-1962 of the Royal Society of Medicine. In 1954, he was President of the British Association for the Advancement of Science. He is Chevalier of the French Legion of Honour and a trustee of the Rockefeller Institute. He holds honorary degrees, memberships, and fellowships of numerous universities and other learned bodies. He was knighted Baron of Cambridge in 1955.  A man of tireless energy and continuous industry, Adrian has, throughout his busy life, and as a Member of the Medical Research Council and many other scientific advisory bodies, exerted great influence, not only on his pupils and collaborators, but also on the development of physiological research and the sciences in general.  To the citizens of Cambridge he has long been familiar as a lean, small figure, dominated by the forward thrust of the nose and chin and the set expression of purpose, as he threads his way at high speed on a bicycle through the crowded streets of the city. An expert fencer, he is also an enthusiastic mountaineer, a recreation which he shares with Lady Adrian, who is a Justice of the Peace and does much social work in the City. Among Lord Adrian’s other recreations are sailing and his great interest in the arts. A superb after-dinner speaker, all his lectures and speeches have been the result of very careful preparation.  In 1923 Adrian married Hester Agnes Pinsent, daughter of the late Hume Pinsent of Birmingham, England, and a relative of the philosoper David Hume. They have one son and two daughters.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Edgar Adrian died on August 8, 1977.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0699 |
| Interview |  |
|  |  |
| ID | 0700 |
| Biographical | Otto Heinrich Warburg was born on October 8, 1883, in Freiburg, Baden. His father, the physicist Emil Warburg, was President of the Physikalische Reichsanstalt, Wirklicher Geheimer Oberregierungsrat. Otto studied chemistry under the great [Emil Fischer](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1902/index.html), and gained the degree, Doctor of Chemistry (Berlin), in 1906. He then studied under von Krehl and obtained the degree, Doctor of Medicine (Heidelberg), in 1911. He served in the Prussian Horse Guards during World War I. In 1918 he was appointed Professor at the Kaiser Wilhelm Institute for Biology, Berlin-Dahlem. Since 1931 he is Director of the Kaiser Wilhelm Institute for Cell Physiology, there, a donation of the Rockefeller Foundation to the Kaiser Wilhelm Gesellschaft, founded the previous year.  Warburg’s early researches with Fischer were in the polypeptide field. At Heidelberg he worked on the process of oxidation. His special interest in the investigation of vital processes by physical and chemical methods led to attempts to relate these processes to phenomena of the inorganic world. His methods involved detailed studies on the assimilation of carbon dioxide in plants, the metabolism of tumors, and the chemical constituent of the oxygen transferring respiratory ferment. Warburg was never a teacher, and he has always been grateful for his opportunities to devote his whole time to scientific research. His later researches at the Kaiser Wilhelm Institute have led to the discovery that the flavins and the nicotinamide were the active groups of the hydrogen-transferring enzymes. This, together with the iron-oxygenase discovered earlier, has given a complete account of the oxidations and reductions in the living world. For his discovery of the nature and mode of action of the respiratory enzyme, the Nobel Prize has been awarded to him in 1931. This discovery has opened up new ways in the fields of cellular metabolism and cellular respiration. He has shown, among other things, that cancerous cells can live and develop, even in the absence of oxygen.  In addition to many publications of a minor nature, Warburg is the author of *Stoffwechsel der Tumoren (1926)*, *Katalytische Wirkungen der lebendigen Substanz (1928)*, *Schwermetalle als Wirkungsgruppen von Fermenten (1946)*, *Wasserstoffübertragende Fermente (1948)*, *Mechanism of Photosynthesis (1951)*, *Entstehung der Krebszellen (1955)*, and *Weiterentwicklung der zellphysiologischen Methoden (1962)*. In the last years he added to the problems of his Institute: chemotherapeutics of cancer, and the mechanism of X-ray’s action. In photosynthesis he discovered with Dean Burk the I-quantum reaction that splits the CO2, activated by the respiration.  Otto Warburg is a Foreign Member of the Royal Society, London (1934) and a member of the Academies of Berlin, Halle, Copenhagen, Rome, and India. He has gained l’Ordre pour le Mérite, the Great Cross, and the Star and Shoulder Ribbon of the Bundesrepublik. In 1965 he was made doctor honoris causa at Oxford University.  He is unmarried and has always been interested in equine sport as a pastime.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Otto Warburg died on August 1, 1970.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0700 |
| Interview |  |
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| ID | 0701 |
| Biographical | Karl Landsteiner was born in Vienna on June 14, 1868. His father, Leopold Landsteiner, a doctor of law, was a well-known journalist and newspaper publisher, who died when Karl was six years old. Karl was brought up by his mother, Fanny Hess, to whom he was so devoted that a death mask of her hung on his wall until he died. After leaving school, Landsteiner studied medicine at the University of Vienna, graduating in 1891. Even while he was a student he had begun to do biochemical research and in 1891 he published a paper on the influence of diet on the composition of blood ash. To gain further knowledge of chemistry he spent the next five years in the laboratories of Hantzsch at Zurich, [Emil Fischer](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1902/index.html) at Wurzburg, and E. Bamberger at Munich.  Returning to Vienna, Landsteiner resumed his medical studies at the Vienna General Hospital. In 1896 he became an assistant under Max von Gruber in the Hygiene Institute at Vienna. Even at this time he was interested in the mechanisms of immunity and in the nature of antibodies. From 1898 till 1908 he held the post of assistant in the University Department of Pathological Anatomy in Vienna, the Head of which was Professor A. Weichselbaum, who had discovered the bacterial cause of meningitis, and with Fraenckel had discovered the pneumococcus. Here Landsteiner worked on morbid physiology rather than on morbid anatomy. In this he was encouraged by Weichselbaum, in spite of the criticism of others in this Institute. In 1908 Weichselbaum secured his appointment as Prosector in the Wilhelminaspital in Vienna, where he remained until 1919. In 1911 he became Professor of Pathological Anatomy in the University of Vienna, but without the corresponding salary.  Up to the year 1919, after twenty years of work on pathological anatomy, Landsteiner with a number of collaborators had published many papers on his findings in morbid anatomy and on immunology. He discovered new facts about the immunology of syphilis, added to the knowledge of the Wassermann reaction, and discovered the immunological factors which he named haptens (it then became clear that the active substances in the extracts of normal organs used in this reaction were, in fact, haptens). He made fundamental contributions to our knowledge of paroxysmal haemoglobinuria.  He also showed that the cause of poliomyelitis could be transmitted to monkeys by injecting into them material prepared by grinding up the spinal cords of children who had died from this disease, and, lacking in Vienna monkeys for further experiments, he went to the Pasteur Institute in Paris, where monkeys were available. His work there, together with that independently done by Flexner and Lewis, laid the foundations of our knowledge of the cause and immunology of poliomyelitis.  Landsteiner made numerous contributions to both pathological anatomy, histology and immunology, all of which showed, not only his meticulous care in observation and description, but also his biological understanding. But his name will no doubt always be honoured for his discovery in 1901 of, and outstanding work on, the blood groups, for which he was given the Nobel Prize for Physiology or Medicine in 1930.  In 1875 Landois had reported that, when man is given transfusions of the blood of other animals, these foreign blood corpuscles are clumped and broken up in the blood vessels of man with the liberation of haemoglobin. In 1901-1903 Landsteiner pointed out that a similar reaction may occur when the blood of one human individual is transfused, not with the blood of another animal, but with that of another human being, and that this might be the cause of shock, jaundice, and haemoglobinuria that had followed some earlier attempts at blood transfusions.  His suggestions, however, received little attention until, in 1909, he classified the bloods of human beings into the now well-known A, B, AB, and O groups and showed that transfusions between individuals of groups A or B do not result in the destruction of new blood cells and that this catastrophe occurs only when a person is transfused with the blood of a person belonging to a different group. Earlier, in 1901-1903, Landsteiner had suggested that, because the characteristics which determine the blood groups are inherited, the blood groups may be used to decide instances of doubtful paternity. Much of the subsequent work that Landsteiner and his pupils did on blood groups and the immunological uses they made of them was done, not in Vienna, but in New York. For in 1919 conditions in Vienna were such that laboratory work was very difficult and, seeing no future for Austria, Landsteiner obtained the appointment of Prosector to a small Roman Catholic Hospital at The Hague. Here he published, from 1919-1922, twelve papers on new haptens that he had discovered, on conjugates with proteins which were capable of inducing anaphylaxis and on related problems, and also on the serological specificity of the haemoglobins of different species of animals. His work in Holland came to an end when he was offered a post in the Rockefeller Institute for Medical Research in New York and he moved there together with his family. It was here that he did, in collaboration with Levine and Wiener, the further work on the blood groups which greatly extended the number of these groups, and here in collaboration with Wiener studied bleeding in the new-born, leading to the discovery of the Rh-factor in blood, which relates the human blood to the blood of the rhesus monkey.  To the end of his life, Landsteiner continued to investigate blood groups and the chemistry of antigens, antibodies and other immunological factors that occur in the blood. It was one of his great merits that he introduced chemistry into the service of serology.  Rigorously exacting in the demands he made upon himself, Landsteiner possessed untiring energy. Throughout his life he was always making observations in many fields other than those in which his main work was done (he was, for instance, responsible for having introduced dark-field illumination in the study of spirochaetes). By nature somewhat pessimistic, he preferred to live away from people.  Landsteiner married Helen Wlasto in 1916. Dr. E. Landsteiner is a son by this marriage.  In 1939 he became Emeritus Professor at the Rockefeller Institute, but continued to work as energetically as before, keeping eagerly in touch with the progress of science. It is characteristic of him that he died pipette in hand. On June 24, 1943, he had a heart attack in his laboratory and died two days later in the hospital of the Institute in which he had done such distinguished work.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Karl Landsteiner died on June 26, 1943.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0701 |
| Interview |  |
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| ID | 0702 |
| Biographical | Christiaan Eijkman was born on August 11, 1858, at Nijkerk in Gelderland (The Netherlands), the seventh child of Christiaan Eijkman, the headmaster of a local school, and Johanna Alida Pool.  A year later, in 1859, the Eijkman family moved to Zaandam, where his father was appointed head of a newly founded school for advanced elementary education. It was here that Christiaan and his brothers received their early education. In 1875, after taking his preliminary examinations, Eijkman became a student at the Military Medical School of the University of Amsterdam, where he was trained as a medical officer for the Netherlands Indies Army, passing through all his examinations with honours.  From 1879 to 1881, he was an assistant of T. Place, Professor of Physiology, during which time he wrote his thesis *On Polarization of the Nerves*, which gained him his doctor’s degree, with honours, on July 13, 1883. That same year he left Holland for the Indies, where he was made medical officer of health first in Semarang later at Tjilatjap, a small village on the south coast of Java, and at Padang Sidempoean in W. Sumatra. It was at Tjilatjap that he caught malaria which later so impaired his health that he, in 1885, had to return to Europe on sick-leave.  For Eijkman this was to prove a lucky event, as it enabled him to work in E. Forster’s laboratory in Amsterdam, and also in [Robert Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html)‘s bacteriological laboratory in Berlin; here he came into contact with A. C. Pekelharing and C. Winkler, who were visiting the German capital before their departure to the Indies. In this way medical officer Christiaan Eijkman was seconded as assistant to the Pekelharing-Winkler mission, together with his colleague M. B. Romeny. This mission had been sent out by the Dutch Government to conduct investigations into beriberi, a disease which at that time was causing havoc in that region.  In 1887, Pekelharing and Winkler were recalled, but before their departure Pekelharing proposed to the Governor General that the laboratory which had been temporarily set up for the Commission in the Military Hospital in Batavia should be made permanent. This proposal was readily accepted, and Christiaan Eijkman was appointed its first Director, at the same time being made Director of the “Dokter Djawa School” (Javanese Medical School). Thus ended Eijkman’s short military career – now he was able to devote himself entirely to science.  Eijkman was Director of the “Geneeskundig Laboratorium” (Medical Laboratory) from January 15, 1888 to March 4, 1896, and during that time he made a number of his most important researches. These dealt first of all with the physiology of people living in tropical regions. He was able to demonstrate that a number of theories had no factual basis. Firstly he proved that in the blood of Europeans living in the tropics the number of red corpuscles, the specific gravity, the serum, and the water content, undergo no change, at least when the blood is not affected by disease which will ultimately lead to anaemia. Comparing the metabolism of the European with that of the native, he found that in the tropics as well in the temperate zone, this is entirely governed by the work carried out. Neither could he find any disparity in respiratory metabolism, perspiration, and temperature regulation. Thus Eijkman put an end to a number of speculations on the acclimatization of Europeans in the tropics which had hitherto necessitated the taking of various precautions.  But Eijkman’s greatest work was in an entirely different field. He discovered, after the departure of Pekelharing and Winkler, that the real cause of beriberi was the deficiency of some vital substance in the staple food of the natives, which is located in the so-called “silver skin” (pericarpium) of the rice. This discovery has led to the concept of vitamins. This important achievement earned him the Nobel Prize in Physiology or Medicine for 1929. This late recognition of his outstanding merits has ended all criticism of his work. In addition to his work on beriberi, he occupied himself with other problems such as arach fermentation, and indeed still had time to write two textbooks for his students at the Java Medical School, one on physiology and the other on organic chemistry.  In 1898 he became successor to G. Van Overbeek de Meyer, as Professor in Hygiene and Forensic Medicine at Utrecht. His inaugural speech was entitled *Over Gezondheid en Ziekten in Tropische Gewesten* (On health and diseases in tropical regions). At Utrecht, Eijkman turned to the study of bacteriology, and carried out his well-known fermentation test, by means of which it can be readily established if water has been polluted by human and animal defaecation containing coli bacilli. Another research was into the rate of mortality of bacteria as a result of various external factors, whereby he was able to show that this process could not be represented by a logarithmic curve. This was followed by his investigation of the phenomenon that the rate of growth of bacteria on solid substratum often decreases, finally coming to a halt. Beyerinck’s auxanographic method was applied on several occasions by Eijkman, as for example during the secretion of enzymes which break down casein or bring about haemolysis, whereby he could demonstrate the hydrolysis of fats under the influence of lipases.  As a lecturer he was known for his clarity of speech and demonstration, his great practical knowledge standing him in good stead. He had a preeminently critical mind and he continuously warned his students against the acceptance of dogmas. But Eijkman did not confine himself to the University he also engaged himself in problems of water supply, housing, school hygiene, physical education; as a member of the Gezondheidsraad (Health Council) and the Gezondheidscommissie (Health Commission) he participated in the struggle against alcoholism and tuberculosis. He was the founder of the Vereeniging tot Bestrijding van de Tuberculose (Society for the struggle against tuberculosis ).  His unassuming personality has contributed to the fact that his great merits were at first not really appreciated in his own country; but anyone who had the privilege of coming into close contact with him, quickly perceived his keen intellect and extensive knowledge.  In 1907, Eijkman was appointed Member of the Royal Academy of Sciences (The Netherlands), after having been Correspondent since 1895. The Dutch Government conferred upon him several orders of knighthood, whereas on the occasion of the 25th anniversary of his professorship a fund has been established to enable the awarding of the Eijiman Medal. But the crown of all his work was the award of the Nobel Prize in 1929.  Eijkman was holder of the John Scott Medal, Philadelphia, and Foreign Associate of the National Academy of Sciences in Washington. He was also Honorary Fellow of the Royal Sanitary Institute in London.  In 1883, before his departure to the Indies, Eijkman married Aaltje Wigeri van Edema, who died in 1886. In Batavia, Professor Eijkman married Bertha Julie Louise van der Kemp in 1888; a son, Pieter Hendrik, who became a physician, was born in 1890.  He died in Utrecht, on November 5, 1930, after a protracted illness.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0702 |
| Interview |  |
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| ID | 0703 |
| Biographical | Frederick Gowland Hopkins was born on June 20, 1861, at Eastbourne, England. His father, a bookseller in Bishopsgate Street, London, was much interested in science, but he died when Gowland was an infant. For the next ten years Gowland lived with his mother at Eastbourne, showing as a child literary rather than scientific tastes, although, when his mother gave him a microscope, he studied life on the seashore. But he read much and wrote rhymes, and in later life speculated as to whether he might not have become, if he had been encouraged to do so, a classical scholar or a naturalist. Later in his life, however, his literary ability added much to all his scientific papers and addresses.  In 1871 his mother went to live at Enfield, and Hopkins went to the city of London School. He was a bright schoolboy in several subjects, and was given a first-class in chemistry in 1874. Later, as a result of an examination at the College of Preceptors he was given a prize for science, and, at the early age of 17, when he finally left school, he published a paper in *The Entomologist* on the bombardier beetle.  After working for six months as an insurance clerk, Hopkins was articled to a consulting chemist, and subsequently, after taking a course in chemistry at the Royal School of Mines, South Kensington, London, he went to University College, London, where he took the Associateship Examination of the Institute of Chemistry, and did so well that Sir Thomas Stevenson, Home Office Analyst and expert on poisoning, engaged him as his assistant. He was then 22 years old, and he took part in several important legal cases. He then decided to take his London B.Sc. degree and graduated in the shortest possible time. In 1888, when he was 28, he went as a medical student to Guy’s Hospital, London, and was immediately given the Sir William Gull Studentship there. He was awarded, during this period, a Gold Medal for Chemistry, and Honours in Materia Medica.  In 1894, when he was 32 years old, he graduated in medicine and taught for four years physiology and toxicology at Guy’s Hospital. For two years he was in charge of the Chemical Department of the Clinical Research Association. In 1896 he published, with H.W. Brook, work on the halogen derivatives of proteins, and in 1898, work with S. N. Pinkus on the crystallization of blood albumins. In 1898, when attending a meeting of the Physiological Society at Cambridge, he was invited by Sir Michael Foster to move to Cambridge to develop there the chemical aspects of physiology. Biochemistry was not, at that time, recognized as a separate branch of science and Hopkins accepted the appointment. Given a lectureship at a salary of £200 a year, he added to his income by supervising undergraduates and giving tutorials, doing also for a few years, after the death of Sir Thomas Stevenson, part-time work for the Home Office. Later he was appointed Fellow and Tutor at Emmanuel College, Cambridge.  In 1902 he was given a readership in biochemistry, and in 191O he became a Fellow of Trinity College, and an Honorary Fellow of Emmanuel College. In 1914 he was elected to the Chair of Biochemistry at Cambridge University. During all this time he had to be content with, at first, one small room in the Department of Physiology, and later with accommodation in the Balfour Laboratory; but in 1925 he was able to move his Department into the new Sir William Dunn Institute of Biochemistry which had been built to accommodate it.  Among his outstanding contributions to science was his discovery of a method for isolating tryptophan and for identifying its structure.  Subsequently he did the work which was to gain him in 1929, together with [Christiaan Eijkman](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1929/index.html), who had demonstrated the association between beriberi and the consumption of decorticated rice, the Nobel Prize.  Later, Hopkins worked with Walter Fletcher on the metabolic changes occurring in muscular contractions and rigor mortis. Hopkins supplied exact methods of analysis, and devised a new colour reaction for lactic acid, and the pioneer work then done laid the foundations for the work of the Nobel Laureates, [A.V. Hill](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1922/index.html) and [Otto Meyerhof](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1922/index.html), and also for that of many other later workers.  In 1921 he isolated a substance which he named glutathione, which is, he showed, widely distributed in the cells of plants and animals that are rapidly multiplying. Later he proved it to be the tripeptide of glutamic acid, glycine and cystein. He also discovered xanthine oxidase, a specific enzyme widely distributed in tissues and milk, which catalyzes the oxidation of the purine bases xanthine and hypoxanthine to uric acid. Hopkins thus returned to the uric acids of his earliest work, a method of determining uric acid in urine, which he first published in 1891.  Hopkins was knighted in 1925 and received the Order of Merit in 1935.  He was awarded the Royal Medal of the Royal Society of London in 1918, and its Copley Medal in 1926. From 1930 until 1935 he was President of the Royal Society, and found little time for research. During this period, however, he exerted great influence on his contemporaries.  In 1898 Hopkins married Jessie Anne Stevens. They had two daughters, one of whom Jacquetta Hawkes, is married to J. B. Priestley, the author.  Hopkins died in 1947, at the age of 86.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Sir Frederick Hopkins died on May 16, 1947.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0703 |
| Interview |  |
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| Biographical | Charles Jules Henry Nicolle was born in Rouen on September 21, 1866, where his father, Eugène Nicolle, was a doctor in a local hospital. Charles received, together with his brothers, early tuition in biology from his father and, after education at the Lycée Corneille de Rouen, he entered the local medical school where he studied for three years before following his elder brother, Maurice, who was working in Paris hospitals. (Maurice later became Director of the Bacteriological Institute of Constantinople and a Professor at the Pasteur Institute, Paris.) Meanwhile, Charles had studied under A. Gombault in the Faculty of Medicine and under Roux at the Pasteur Institute (serving at the same time as demonstrator in the microbiology course) to complete a thesis “Recherches sur la chancre mou” (Researches on the soft chancre), which gained him his M.D. degree in 1893. He returned to Rouen to become a member of the Medical Faculty and in 1896 he was appointed Director of the Bacteriological Laboratory. He continued in this capacity until 1903 when he was appointed Director of the Pasteur Institute in Tunis, a position he held until his death in 1936.  Early in his career, Nicolle worked on cancer, and at Rouen he investigated the preparation of diphtheria antiserum. In North Africa, under his influence, the Institute at Tunis quickly became a world-famous centre for bacteriological research and for the production of vaccines and serums to combat most of the prevalent infectious diseases. His discovery in 1909 that typhus fever is transmitted by the body louse helped to make a clear distinction between the classical louse-bound epidemic typhus and murine typhus, which is conveyed to man by the rat flea. He also made invaluable contributions to present-day knowledge of Malta fever, where he introduced preventive vaccination; tick fever, where he discovered the means of transmission; scarlet fever, by experimental reproduction with streptococci; rinderpest, measles, influenza, by his work on the nature of the virus; tuberculosis and trachoma. He was responsible for the introduction of many new techniques and innovations in bacteriology. Nicolle was one of the first to recognize the protective properties of the convalescence serum against typhus and measles; and succeeded in cultivating Leishmania donovani and Leishmania tropica on artificial culture media. His discovery of the mechanism of the transmission of typhus fever has created the basis for the preventive precautions against this disease, during the 1914-1918 and 1939-1945 Wars.  Nicolle wrote several important books including *Le Destin des Maladies infectieuses*; *La Nature, conception et morale biologiques*; *Responsabilités de la Médecine*, and *La Destinée humaine*.  Nicolle was an Associate of l’Academie de Médecine and he was awarded the Prix Montyon in 1909, 1912, and 1914; the Prix Osiris in 1927, and a special Gold Medal to commemorate his Silver Jubilee in Tunis in 1928. On this occasion he was also appointed member of the Académie des Sciences, Paris. In 1932, he was elected Professor in the College of France.  Charles Nicolle also enjoyed considerable reputation as a philosopher and as a writer of fanciful stories, such as *Le Pâtissier de Bellone*, *Les deux Larrons*, and *Les Contes de Marmouse*. He was said by Jean Rostand to be “a poet and realist, a man of dreams and a man of truth”.  Nicolle married Alice Avice in 1895; two children came from this marriage, Marcelle (b. 1896) and Pierre (b. 1898).  He died on February 28, 1936.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0704 |
| Interview |  |
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| Biographical | Julius Wagner – his father Adolf Johann Wagner was granted the title “Ritter von Jauregg” only in 1883 – was born on March 7, 1857, in Wels, Austria. He attended the famous old Schottengymnasium in Vienna and started reading medicine at Vienna University in 1874.  From 1874 to 1880 he studied with Salomon Stricker, in the Institute of General and Experimental Pathology, obtaining his doctor’s degree in 1880 with a thesis entitled “L’origine et la fonction du coeur accélére” (Origin and function of the accelerated heart). He left the Institute in 1882. It was during this period that Wagner-Jauregg became acquainted with the use of laboratory animals in experimental work – a practice little followed at that time.  For a short period he worked in the Department for Internal Diseases under Bamberger, but gladly accepted the post of assistant to Leidesdorf in the Psychiatric Clinic in 1883, although he had never previously considered the possibility of becoming a psychiatrist and had practically no experience of this specialized field. Nevertheless, he was invited to lecture on the pathology of the nervous system already in 1885 and three years later this field was extended to include psychiatry. In 1887 his chief, Leidesdorf, fell ill and Wagner-Jauregg took charge of the clinic. In 1889 he was appointed Extraordinary Professor at the Medical Faculty of the University of Graz as successor to Krafft-Ebing and Director of the Neuro-Psychiatric Clinic. It was there that he started his investigations on the connections between goitre and cretinism; on his advice the Government, some time later, started selling salt to which iodine had been added, in the areas most affected by goitre.  In 1892 followed the appointment to the “Landesirrenanstalt” (State Lunatic Asylum) and in 1893 he became Extraordinary Professor of Psychiatry and Nervous Diseases, and Director of the Clinic for Psychiatry and Nervous Diseases in Vienna, as successor to Meynert. Ten years later, in 1902, Wagner-Jauregg moved to the psychiatric clinic at the “Allgemeines Krankenhaus” (General Hospital) as this offered more scope and a more varied activity. However, when in 1911 the “Landesirrenanstalt” was rebuilt and enlarged on the outskirts of Vienna at Steinhof, thus making the setting up of a larger psychiatric-neurological department, Wagner-Jauregg returned to his former post.  Wagner-Jauregg’s initial study was concerned with the origin and function of the N. accelerantes, and this was followed by another on the respiratory function of the N. vagus.  The main work that concerned Wagner-Jauregg throughout his working life was the endeavour to cure mental disease by inducing a fever. Already in 1887 he systematically investigated the effects of febrile diseases on psychoses, later also making use of tuberculin (discovered in 1890 by [Robert Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html)). As this and similar methods of treatment did not yield satisfactory results, he turned in 1917 to malaria inoculation, which proved to be very successful in the case of dementia paralytica. This discovery earned him the Nobel Prize in 1927. His numerous other distinctions included the Cameron Prize (1935)  Among his numerous publications may be mentioned: *Myxödem und Kretinismus*, in the *Handbuch der Psychiatrie*, (1912); *Lehrbuch der Organotherapie* (Textbook of organotherapy), with G. Bayer, (1914); *Verhütung und Behandlung der progressiven Paralyse durch Impfmalaria* (Prevention and treatment of progressive paralysis by malaria inoculation) in the Memorial Volume of the *Handbuch der experimentellen Therapie*, (1931).  Wagner-Jauregg occupied himself also intensively with questions concerning forensic medicine and the legal aspects of insanity; he assisted in formulating the law regarding certification of the insane, which is still in force in Austria today. In recognition of his services to forensic medicine he was awarded the diploma of Doctor of Law.  Wagner-Jauregg was judged by his pupils and friends to be rather reserved, cool and aloof, but was generally respected, and all his students were proud to work under him. He worked very hard and conscientiously, and was well known for his sense of justice. Among his numerous pupils should be mentioned C. von Economo, who in 1917 isolated epidemic encephalitis (since then also called Economo’s disease) – a discovery giving rise to the abolishment of certain classical views in neurology.  Professor Wagner-Jauregg married Anna Koch. There were two children from this marriage: Julia (b. 1900) now Mrs. Humann-Wagner Jauregg, and Theodor (b. 1903) now “Privatdozent” in Chemistry at the University of Vienna.  In 1928, Wagner-Jauregg retired from his post in Steinhof, but was by no means idle, publishing about 80 scientific papers after his retirement. He enjoyed good health and remained active until his death on September 27, 1940.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). 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| Autobiographical |  |
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| Biographical | Johannes Andreas Grib Fibiger was born at Silkeborg (Denmark) on April 23, 1867. His father, C. E. A. Fibiger, was a local medical practitioner and his mother, Elfride Muller, was a writer. Fibiger gained his bachelor’s degree in 1883 and qualified as a doctor in 1890. After a period of working in hospitals and studying under [Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html) and [Behring](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1901/index.html) he was, from 1891 to 1894, assistant to Professor C. J. Salomonsen at the Department of Bacteriology of Copenhagen University. While serving as an Army reserve doctor at the Hospital for Infectious Diseases (Blegdam Hospital) in Copenhagen from 1894 to 1897 he completed his doctorate thesis on «Research into the bacteriology of diphtheria». He received his doctorate of the University of Copenhagen in 1895, and was subsequently appointed prosector at the University’s Institute of Pathological Anatomy (1897-1900), Principal of the Laboratory of Clinical Bacteriology of the Army (1890-1905), and (in 1905) Director of the Central Laboratory of the Army and Consultant Physician to the Army Medical Service. After studying for some time under Orth and Weichselbaum, Fibiger was appointed Professor of Pathological Anatomy at Copenhagen University and Director of the Institute of Pathological Anatomy (1900).  Fibiger fulfilled a large number of official missions and took part in the direction of numerous institutions. He was First Secretary, and later President of the Danish Medical Society, Consultant to the Council of Forensic Medicine, member of the Planning Commission for the Construction of the Medical Institutes of the National Hospital; Vice-President, and later President of the Danish Medical Association’s Cancer Commission, member of the National Radium Committee, member of the Administrative Council of the Rask-Ørsted Foundation, of the Northern Society to Promote a Biological Station in the Tropics, of the Pasteur Society; he was a founder-member and joint-editor of the *Acta Pathologica et Microbiologica Scandinavica*, co-editor of *Ziegler’s Beiträge zur pathologischen Anatomie und zur allgemeinen Pathologie*, member of the International Commission for Intellectual Cooperation with Other Countries, representing his country at numerous congresses and meetings, and member of a great many academies and societies, both Danish and foreign. Fibiger was also Vice-President, and afterwards President, of «Die internationale Vereinigung für Krebsforschung», member of the Royal Academy of Science and Literature of Denmark, of the Swedish Medical Association, of the Finnish Medical Association, corresponding member of the «Association française pour l’Étude du Cancer», of the «Société de Biologie» of Paris, of the Helmintological Society of Washington, founder-member of «Van Leeuwenhoekvereeniging» for cancer study by experiment, honorary member of the Royal Academy of Medicine of Belgium and of the «Wiener dermatologischen Gesellschaft», member of the Royal Society of Physiography of Lund and of the Royal Society of Science of Uppsala, honorary doctor of the Universities of Paris and Louvain, etc. Fibiger was the winner of numerous prizes, among which should be mentioned the Nordhoff-Jung Cancer Prize and the Nobel Prize for Physiology or Medicine, 1927, for his work on cancer.  Fibiger died on January 30, 1928, at Copenhagen after a short illness (cardiac failure with multiple emboli and massive pulmonary infarcts; cancer of the colon: caecostomy), survived by his wife Mathilde, *née* Fibiger, whom he married in 1894.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0706 |
| Interview |  |
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| ID | 0707 |
| Biographical | Willem Einthoven was born on May 21, 1860, in Semarang on the island of Java, in the former Dutch East Indies (now Indonesia). His father was Jacob Einthoven, born and educated in Groningen, The Netherlands, an army medical officer in the Indies, who later became parish doctor in Semarang. His mother was Louise M.M.C. de Vogel, daughter of the then Director of Finance in the Indies. Willem was the eldest son, and the third child in a family of three daughters and three sons.  At the age of six, Einthoven lost his father. Four years later his mother decided to return with her six children to Holland, where the family settled in Utrecht.  After having passed the “Hogere Burgerschool” (secondary school), he in 1878 entered the University of Utrecht as a medical student, intending to follow in his father’s footsteps. His exceptional abilities, however, began to develop in quite a different direction. After being assistant to the ophthalmologist H. Snellen Sr. in the renowned eye-hospital “Gasthuis voor Ooglidders”, he made two investigations, both of which attracted widespread interest. The first was carried out after Einthoven had gained his “candidaat” diploma (approximately equivalent to the B.Sc. degree), under the direction of the anatomist W. Koster, and was entitled “Quelques remarques sur le mécanisme de l’articulation du coude” (Some remarks on the elbow joint). Later he worked in close association with the great physiologist F.C. Donders, under whose guidance he undertook his second study, which was published in 1885 as his doctor’s thesis: “Stereoscopie door kleurverschil.” (Stereoscopy by means of colour variation) – one of Einthoven’s teachers was the physicist C.H.D. Buys Ballot, who discovered the well-known law in meteorology.  That same year, 1885, he was appointed successor to A. Heynsius, Professor of Physiology at the University of Leiden, which he took up after having qualified as general practitioner in January, 1886. His inaugural address was entitled “De leer der specifieke energieen” (The theory of specific energies). His first important research in Leiden was published in 1892: “Über die Wirkung der Bronchialmuskeln nach einer neuen Methode untersucht, und über Asthma nervosum” (On the function of the bronchial muscles investigated by a new method, and on nervous asthma), a study of great merit, mentioned as “a great work” in Nagel’s “Handbuch der Physiologie”. At that time he also began research into optics, the study of which occupied him ever since. Some publications in this field were: “Eine einfache physiologische Erklärung für verschiedene geometrisch-optische Täuschungen” (A simple physiological explanation for various geometric-optical illusions ) in 1898; “Die Accommodation des menschlichen Auges” (The accommodation of the human eye) in 1902; “The form and magnitude of the electric response of the eye to stimulation by light at various intensities”, with W.A. Jolly in 1908.  Up till now, his talents had not yet been developed to the full. This opportunity came when he began the task of registering accurately the heart sounds, using a capillary electrometer. With this in view, he investigated the theoretical principles of this instrument, and devised methods of obtaining the necessary stability, and of correcting mathematically the errors in the photographically registered results due to the inertia of the instrument. Having found these methods he decided to carry out a thorough analysis of A.D. Waller’s electrocardiogram – a study which has remained classic in its field.  This investigation led Einthoven to intensify his research. To avoid complex mathematical corrections, he finally devised the string galvanometer which did not involve these calculations. Although the principle in itself was obvious, and practical applications of it were made in other fields of study, the instrument had to be precisioned and refined to make it usable for physiologists, and this took three years of laborious work. As a result of this, a galvanometer was produced which could be used in medical science as well as in technology; an instrument which was incomparable in its adaptability and speed of adjustment.  He then, with P. Battaerd, took up the study of the heart sounds, followed by research into the retina currents with W.A. Jolly (begun earlier with H. K. de Haas). The electrocardiogram itself he studied in all its aspects with numerous pupils and with visiting scientists. It was this last research which earned him the Nobel Prize in Physiology or Medicine for 1924. In addition to this the string galvanometer has proved of the highest value for the study of the periphery and sympathetic nerves.  In the remaining years of his life, problems of acoustics and capacity studies came within the sphere of his interests. The construction of the string phonograph (1923) could be considered as a consequence of this.  Einthoven possessed the gift of being able to devote himself entirely to a particular field of study. (His genius was actually more orientated towards physics than physiology.) As a result he was able to make penetrating inquiries into almost any subject which came within the scope of his interests, and to carry out his work to its logical conclusion.  Einthoven was a great believer in physical education. In his student days he was a keen sportsman, repeatedly urging his comrades “not to let the body perish”. (He was President of the Gymnastics and Fencing Union, and was one of the founders of the Utrecht Student Rowing Club.) His first study on the elbow joint resulted from a broken wrist suffered while pursuing one of his favourite sports, and during the somewhat involuntary confinement his interest was awakened in the pro- and supination movements of the hand and the functions of the shoulder and elbow joints.  The string galvanometer has led countless investigators to study the functions and diseases of the heart muscle. The laboratory at Leiden became a place of pilgrimage, visited by scientists from all over the world. For this, suffering mankind has much to owe to Einthoven. In electrocardiography the string galvanometer is the most reliable tool. Although it has been superseded by portable types and by models utilizing amplification techniques used in radio communication (Einthoven has always mistrusted the use of condensers, fearing the distortion of curves), cardiograms from the string galvanometer have remained the standard of reference in numerous cases to this day.  Einthoven was a member of the Dutch Royal Academy of Sciences, the meetings of which he hardly ever missed. He frequently took part in the debates himself, and his sharp criticism frequently found weaknesses in many a lecture.  Einthoven married in 1886 Frédérique Jeanne Louise de Vogel, a cousin, and sister of Dr. W.Th. de Vogel, former Director of the Dienst der Volksgezondheid (Public Health Service) in the Dutch East Indies. There were four children: Augusta (b. 1887), who was married to R. Clevering, an engineer; Louise (b. 1889), married to J.A.R. Terlet, pastor emeritus; Willem (1893-1945) – a brilliant electro-technical engineer who was responsible for the development of the vacuum model of the string galvanometer and for its use in wireless communication, and who was Director of the Radio Laboratory in Bandung, Java; and Johanna (b. 1897), a physician.  He died on the 29th of September, 1927, after long suffering.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). 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| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0707 |
| Interview |  |
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| ID | 0708 |
| Biographical | Frederick Grant Banting was born on November 14, 1891, at Alliston, Ont., Canada. He was the youngest of five children of William Thompson Banting and Margaret Grant. Educated at the Public and High Schools at Alliston, he later went to the University of Toronto to study divinity, but soon transferred to the study of medicine. In 1916 he took his M.B. degree and at once joined the Canadian Army Medical Corps, and served, during the First World War, in France. In 1918 he was wounded at the battle of Cambrai and in 1919 he was awarded the Military Cross for heroism under fire.  When the war ended in 1919, Banting returned to Canada and was for a short time a medical practitioner at London, Ontario. He studied orthopaedic medicine and was, during the year 1919-1920, Resident Surgeon at the Hospital for Sick Children, Toronto. From 1920 until 1921 he did part-time teaching in orthopaedics at the University of Western Ontario at London, Canada, besides his general practice, and from 1921 until 1922 he was Lecturer in Pharmacology at the University of Toronto. In 1922 he was awarded his M.D. degree, together with a gold medal.  Earlier, however, Banting had become deeply interested in diabetes. The work of Naunyn, Minkowski, Opie, Schafer, and others had indicated that diabetes was caused by lack of a protein hormone secreted by the islets of Langerhans in the pancreas. To this hormone Schafer had given the name insulin, and it was supposed that insulin controls the metabolism of sugar, so that lack of it results in the accumulation of sugar in the blood and the excretion of the excess of sugar in the urine. Attempts to supply the missing insulin by feeding patients with fresh pancreas, or extracts of it, had failed, presumably because the protein insulin in these had been destroyed by the proteolytic enzyme of the pancreas. The problem, therefore, was how to extract insulin from the pancreas before it had been thus destroyed.  While he was considering this problem, Banting read in a medical journal an article by Moses Baron, which pointed out that, when the pancreatic duct was experimentally closed by ligatures, the cells of the pancreas which secrete trypsin degenerate, but that the islets of Langerhans remain intact. This suggested to Banting the idea that ligation of the pancreatic duct would, by destroying the cells which secrete trypsin, avoid the destruction of the insulin, so that, after sufficient time had been allowed for the degeneration of the trypsin-secreting cells, insulin might be extracted from the intact islets of Langerhans.  Determined to investigate this possibility, Banting discussed it with various people, among whom was [J.J.R. Macleod](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1923/index.html), Professor of Physiology at the University of Toronto, and Macleod gave him facilities for experimental work upon it. Dr. Charles Best, then a medical student, was appointed as Banting’s assistant, and together, Banting and Best started the work which was to lead to the discovery of insulin.  In 1922 Banting had been appointed Senior Demonstrator in Medicine at the University of Toronto, and in 1923 he was elected to the Banting and Best Chair of Medical Research, which had been endowed by the Legislature of the Province of Ontario. He was also appointed Honorary Consulting Physician to the Toronto General Hospital, the Hospital for Sick Children, and the Toronto Western Hospital. In the Banting and Best Institute, Banting dealt with the problems of silicosis, cancer, the mechanism of drowning and how to counteract it. During the Second World War he became greatly interested in problems connected with flying (such as blackout).  In addition to his medical degree, Banting also obtained, in 1923, the LL.D. degree (Queens) and the D.Sc. degree (Toronto). Prior to the award of the Nobel Prize in Physiology or Medicine for 1923, which he shared with Macleod, he received the Reeve Prize of the University of Toronto (1922). In 1923, the Canadian Parliament granted him a Life Annuity of $7,500. In 1928 Banting gave the Cameron Lecture in Edinburgh. He was appointed member of numerous medical academies and societies in his country and abroad, including the British and American Physiological Societies, and the American Pharmacological Society. He was knighted in 1934.  As a keen painter, Banting once took part of a painting expedition above the Arctic Circle, sponsored by the Government.  Banting married Marion Robertson in 1924; they had one child, William (b. 1928). This marriage ended in a divorce in 1932, and in 1937 Banting married Henrietta Ball.  When the Second World War broke out, he served as a liaison officer between the British and North American medical services and, while thus engaged, he was, in February 1941, killed in an air disaster in Newfoundland.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  *Frederick G. Banting died on February 21, 1941.*  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). 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| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0708 |
| Interview |  |
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| ID | 0709 |
| Biographical | John James Rickard Macleod was born on September 6, 1876 at Cluny, near Dunkeld, Perthshire, Scotland. He was the son of the Rev. Robert Macleod. When later the family moved to Aberdeen, Macleod went to the Grammar School there and later entered the Marischal College of the University of Aberdeen to study medicine.  In 1898 he took his medical degree with honours and was awarded the Anderson Travelling Fellowship, which enabled him to work for a year at the Institute for Physiology at the University of Leipzig.  In 1899 he was appointed Demonstrator of Physiology at the London Hospital Medical School under Professor Leonard Hill and in 1902 he was appointed Lecturer in Biochemistry at the same College. In that year he was awarded the McKinnon Research Studentship of the Royal Society, which he held until 1903, when he was appointed Professor of Physiology at the Western Reserve University at Cleveland, Ohio, U.S.A.  During his tenure of this post he was occupied by various war duties and acted, for part of the winter session of 1916, as Professor of Physiology at McGill University, Montreal.  In 1918 he was elected Professor of Physiology at the University of Toronto, Canada. Here he was Director of the Physiological Laboratory and Associate Dean of the Faculty of Medicine.  In 1928 he was appointed Regius Professor of Physiology at the University of Aberdeen, a post which he held, together with that of Consultant Physiologist to the Rowett Institute for Animal Nutrition, in spite of failing health, until his early death.  Macleod’s name will always be associated with his work on carbohydrate metabolism and especially with his collaboration with [Frederick Banting](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1923/index.html) and Charles Best in the discovery of insulin. For this work on the discovery of insulin, in 1921, Banting and Macleod were jointly awarded the Nobel Prize for Physiology or Medicine for 1923.  Macleod had, before this discovery, been interested in carbohydrate metabolism and especially in diabetes since 1905 and he had published some 37 papers on carbohydrate metabolism and 12 papers on experimentally produced glycosuria. Previously he had followed the earlier great work of von Mering and Minkowski, which has been published in 1889, and although he believed that the pancreas was the organ involved, he had not been able to prove exactly what part it played. Although Laguesse had suggested, in 1893, that the islets of Langerhans possibly produced an internal secretion which controlled the metabolism of sugar, and Sharpey-Schafer had, in 1916, called this hypothetical substance “insuline”, nobody had been able to prove its actual existence. Others had made extracts of the pancreas, some of which had proved to be active in affecting the metabolism of sugar, but none of these products had been found reliable, until Banting and Best, jointly with Macleod, could announce their great discovery in February 1922. The process of manufacturing the pancreatic extract which could be used for the treatment of human patients was patented; the financial proceeds of the patent were given to the British Medical Research Council for the Encouragement of Research, the discoverers receiving no payment at all. Subsequently, the active principle of these earlier pancreatic extracts, insulin, was isolated in pure form by John Jacob Abel in 1926, and eventually it became available as a manufactured product.  Earlier, in 1908, Macleod had done experimental work on the possible part played by the central nervous system in the causation of hyperglycaemia and in 1932 he returned to this subject, basing his work on the experiments done by Claude Bernard on puncture diabetes, and Macleod then concluded, from experiments done on rabbits, that stimulation of gluconeogenesis in the liver occurred by way of the parasympathetic nervous system.  Macleod also did much work in fields other than carbohydrate metabolism. His first paper, published in 1899, when he was working at the London Hospital, had been on the phosphorus content of muscle and he also worked on air sickness, electric shock, purine bases, the chemistry of the tubercle bacillus and the carbamates.  In addition he wrote 11 books and monographs, among which were his *Recent Advances in Physiology* (with Sir Leonard Hill) (1905); *Physiology and Biochemistry of Modern Medicine*, which had reached its 9th edition in 1941; *Diabetes: its Pathological Physiology* (1925); *Carbohydrate Metabolism and Insulin* (1926); and his Vanuxem lectures, published in 1928 as the *Fuel of Life*.  In 1919 Macleod was elected a Fellow of the Royal Society of Canada, in 1923 of the Royal Society, London, in 1930 of the Royal College of Physicians, London, and in 1932 of the Royal Society of Edinburgh. During 1921-1923 he was President of the American Physiological Society, and during 1925-1926 of the Royal Canadian Institute. He held honorary doctorates of the Universities of Toronto, Cambridge, Aberdeen and Pennsylvania, the Western Reserve University and the Jefferson Medical College. He was an honorary fellow of the Accademia Medica, Rome, and also a corresponding member of the Medical and Surgical Society, Bologna, the Societá Medica Chirurgica, Rome, and the Deutsche Akademie der Naturforscher Leopoldina, Halle, and Foreign Associate Fellow of the College of Physicians, Philadelphia.  Macleod was a very successful teacher and director of research. His lucid lectures were delivered in an attractive manner and his pupils and research associates found him a sympathetic and stimulating worker, who demanded exact work and the humility that was a feature of his character. He would not tolerate careless work. He was much interested in the development of medical education and especially in the introduction of scientific methods of investigation into clinical work.  Outside the laboratory he was keenly interested in golf and gardening and the arts, especially painting. A sensitive, loyal and affectionate man of engaging personality, his serene spirit met with courage and optimism the painful and crippling disabilities which troubled the final years of his busy life.  Macleod was married to Mary McWalter. He died on March 16, 1935.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0709 |
| Interview |  |
|  |  |
| ID | 0710 |
| Biographical | Archibald Vivian Hill was born in Bristol on September 26,1886. His early education was at Blundell’s School, Tiverton, whence he obtained scholarships to Trinity College, Cambridge. Here he studied mathematics and took the Mathematical Tripos, being Third Wrangler (1907). After graduating, he was urged to take up physiology by his teacher, Dr. (later Sir) Walter Morley Fletcher.  Hill started his research work in 1909. It was due to J.N. Langley, Head of the Department of Physiology at that time that Hill took up the study on the nature of muscular contraction. Langley drew his attention to the important (later to become classic) work carried out by Fletcher and [Hopkins](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1929/index.html) on the problem of lactic acid in muscle, particularly in relation to the effect of oxygen upon its removal in recovery. During his initial studies Hill made use of the Blix’ apparatus, obtaining his first knowledge of the subject from papers of this Swedish physiologist. This led him to study the dependence of heat production on the length of muscle fibre (a relation later developed by Starling in his investigation of the mechanism of the heart beat).  After having obtained a Fellowship at Trinity in 1910, Hill spent the winter of 1910-1911 in Germany, working among others with Bürker (who taught him much about the technique of myothermic observations) and Paschen (who introduced the galvanometer to him, which he since used for his investigations). From 1911-1914, until the outbreak of World War I, he continued his work on the physiology of muscular contraction at Cambridge. During this for him important period, however, he also took up other studies: on the nervous impulse (with Keith Lucas), on haemoglobin (with Barcroft), and on calorimetry of animals (partly with T. B. Wood), having also as colleagues Gaskell, Anderson, W. B. Hardy, Mines, [Adrian](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1932/index.html), Hartridge, and others.  In 1914 he tended to drift away from physiology and was actually appointed University Lecturer in Physical Chemistry at Cambridge. During the war he served for the entire period as captain and brevet-major, and as Director of the Anti-Aircraft Experimental Section, Munitions Inventions Department.  In 1919 he took up again his study of the physiology of muscle, and came into close contact with [Meyerhof](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1922/index.html) of Kiel who, approaching the problem from a different angle, has arrived at results closely analogous to his study. They have cooperated continuously ever since, by personal contact and through correspondence. In 1919 Hill’s friend W. Hartree, mathematician and engineer, joined in the myothermic investigations – a cooperation which had rewarding results.  In 1920 Hill was appointed Brackenburg Professor of Physiology at Manchester University; there he continued the work on muscular activity and began to apply the results obtained on isolated muscles to the case of muscular exercise in man. From 1923 to 1925 he became Jodrell Professor of Physiology at University College, London, succeeding E.H. Starling. In 1926 he was appointed the Royal Society’s Foulerton Research Professor and was in charge of the Biophysics Laboratory at University College until 1952. After retiring he returned to the Physiology Department, where he continues with his experiments to the present.  His work on muscle function, especially the observation and measurement of thermal changes associated with muscle function, was later extended to similar studies on the mechanism of the passage of nerve impulses. Very sensitive techniques had to be developed and he was eventually able to measure temperature changes of the order of 0.003°C over periods of only hundredths of a second. He was the discoverer of the phenomenon that heat was produced as a result of the passage of nerve impulses. His researches gave rise to an enthusiastic following in the field of biophysics, a subject whose growth owes much to him.  Dr. Hill is the author of many scientific papers, lectures, and books. Perhaps his best-known books are *Muscular Activity* (1926), *Muscular Movement in Man* (1927); also *Living Machinery* (1927), *The Ethical Dilemma of Science and Other Writings* (1960), and *Traits and Trials in Physiotogy* (1965).  He was elected a Fellow of the Royal Society in 1918, serving as Secretary for the period 1935-1945, and Foreign Secretary in 1946. He was awarded the Society’s Copley Medal in 1948. He holds honorary degrees of many universities, British and foreign. He was decorated with the Order of the British Empire in 1918 and became a Companion of Honour in 1948. He also holds the Medal of Freedom with Silver Palm (U.S.A., 1947) and is a Chevalier of the Legion of Honour (1950). He has also been prominent in public life, being a Member of Parliament during the period 1940-1945, when he represented Cambridge University in the House of Commons as an Independent Conservative. He was a member of the University Grants Committee for 1937-1944 and served on the Science Committee of the British Council, 1946-1956. He was appointed a Trustee of the British Museum in 1947.  During World War II, he served on many commissions concerned with defence and scientific policy. He was a member of the War Cabinet Scientific Advisory Committee (1940-1946). He was Chairman of the Research Defence Society (1940-1951) and Chairman of the Executive Committee of the National Physical Laboratory (1940-1945).  He is also a member of the Society for the Protection of Science and Learning, and was President in 1952 of the British Society for the Advancement of Science.  Dr. Hill married Margaret Neville Keynes in 1913. They have two sons and two daughters.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1922-1941*, Elsevier Publishing Company, Amsterdam, 1965  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  *Archibald V. Hill died on June 3, 1977.* |
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His work went on, however, in the private laboratory at Gjentofte, erected for him with the aid of the Carlsberg and the Scandinavian Insulin Foundations.  Krogh’s scientific work embraces a number of different fields. As a young student he started (1896) in his private room some experiments on the hydrostatic mechanism of the Corethra larva, the results of which were not published, however, until 1911. In this connection he worked out methods for microscopical analyses of the gas contained in the air bladders of the larvae and was able to prove that these organs functioned like the diving tanks of a submarine, their content being regulated until equilibrium with the surrounding water was restored. In 1902 Krogh took part in an expedition to Disko, North Greenland, where he studied the CO2 tension and the oxygen content in the water of springs, streams and the sea. This led to important results about the role of the oceans in the regulation of the CO2 of the atmosphere and also set out the principles of tonometric measurement of dissolved gases which he later applied to physiological problems (1904).  As Bohr’s assistant Krogh became interested in problems connected with the gas exchange of the living organism. At the age of 32 years (1906) he won the Seegen prize of the Austrian Academy of Sciences for a paper on the expiration of free nitrogen from the body. Very careful experiments with chrysalides, eggs and mice showed an extremely slight production of gaseous nitrogen which might be accounted for as being due to excretion of ammonia or, in the case of eggs, as the setting free of physically dissolved nitrogen from the body.  Krogh’s dissertation (1903) contained a study of the gas exchange in the frog. He found that, whereas the skin respiration was relatively constant, great variations occurred with regard to lung respiration. This part of the gas exchange was influenced from the vagi. Krogh interpreted this result as another example of the oxygen secretion that had been assumed by Bohr to take place in the lungs. However, he soon began to doubt the correctness of this conclusion – the observations might be explained by a vasomotor action of the vagi – as well as the whole doctrine of gas secretion in the lungs. Partly in collaboration with his wife, Dr. Marie Krogh, he subjected the whole question of the nature of the gas exchange in the lungs to a new examination. For this purpose he constructed his well-known microtonometer, where the tension equalization with blood takes place against an air bubble of about 0.01 ml. The relative surface therefore being very great, equilibrium is quickly obtained, and, by the micromethods for gas analysis developed by Krogh, the final composition of the air bubble could easily be ascertained. The gas tension of the circulating arterial blood was thus determined and compared to that in the lung alveoli as obtained at the end of expiration. It turned out that the oxygen tension was always higher in the alveolar air than in the arterial blood, so that diffusion alone was sufficient to explain the gas exchange (1910). These fundamental experiments were thus opposed to the views of Bohr and of J. S. Haldane, but they were later confirmed and extended by J. Barcroft in Cambridge and others and are now generally accepted.  The results obtained shed new light on the whole complex of mechanisms that enable the organism to answer the varying «call for oxygen». A number of classical problems such as the binding of gases in the blood, their transport by the blood flow and the exchange of oxygen and CO2 in the tissues attracted Krogh’s attention, and to all of these he has made important contributions.  In collaboration with Bohr and K. A. Hasselbalch the influence of the CO2 tension on the oxyhemoglobin dissociation curve of the blood was demonstrated. This investigation, which is of fundamental importance for the modern conception of the chemical combinations of the respiratory gases in the blood, was made possible by the technique developed by Krogh. It became extended by J. Christiansen, C. G. Douglas and J. S. Haldane’s finding that the oxygen tension also influences the CO2 curve of the blood (1914).  Together with J. Lindhard, Krogh, adopted an idea that had been introduced by A. Bornstein and developed their nitrous oxide method for the determination of the general blood flow, which has been of great importance for the further development in this field. A considerable increase occurred during muscular work. This was attributed to variations in the filling of the heart during diastole. The supply of venous blood must therefore be variable within wide limits and must during rest almost always be inadequate to fill the ventricles. This conclusion was strengthened by Krogh in an analysis of the underlying mechanism 1912), which also led to the conclusion that the portal system acts as a general regulator of the pressure in the central veins and thereby on the output of the heart. Another important result of the determinations of the blood flow was the demonstration of an increased utilization of the oxygen of the blood during muscular work. Since the oxygen pressure of the resting muscles was, as found by several authors, rather low, the higher utilization must be explained by an increase in the diffusion surface. Krogh came to this conclusion after he had made experiments on the diffusion capacity of animal tissues, and these considerations were the reason for his famous studies of the capillaries during rest and work. As is well known, he thus arrived at the conclusion that during muscular work new capillaries which have been closed, are opened, thus enlarging the surface from which the oxygen can diffuse. These investigations resulted in the Nobel Prize in 1920. They were greatly extended by Krogh in the following years, as shown in his book *The Anatomy and Physiology of the Capillaries* (1922) and several further publications. Other comprehensive investigations on heavy muscular work were performed under the auspices of the League of Nations by Krogh and his school (1934), when a number of important problems were dealt with, such as heat regulation, respiratory metabolism, influence of diet on the capacity for work, blood sugar, lactic acid, training and fatigue, kidney function.  In insects, as well as in vertebrates under standard conditions, Krogh demonstrated a regular and constant influence on metabolism of the surrounding temperature which could be expressed by Arrhenius’ formula. He also investigated the effect of certain factors on the development in different animals. His rich experience with regard to metabolism Krogh summarized in the valuable monograph *The Respiratory Exchange in Animals and Man* (1916). Later on (1920) with several collaborators he made another important contribution to this series of problems by establishing the fact that when fat is catabolized for muscular work a loss of 11 % of the heat of combustion takes place, owing to the waste when fats are converted to carbohydrates.  The work on the gas exchange during respiration was not confined to vertebrates; Krogh also took up the analogous question of the mode of function of the tracheal system of insects. Analyses of the air from the tracheal tubes of the common grasshopper showed comparatively low oxygen values while the CO2 output was relatively small – probably it is given out directly through the body surface to a great extent, whereas oxygen is taken up only through the walls of the tracheae. A mechanical ventilation of the tracheae is made difficult by their structure – in many cases no respiratory movements occur – but experiments by Krogh (1920) showed that gas diffusion alone is sufficient to explain the oxygen uptake. In the course of his last unpublished studies on locusts Krogh found that during flight, when there is an enormously increased oxygen uptake in the wing muscles, a special arrangement enables a mechanical ventilation of their tracheae to occur. In his book *The Comparative Physiology of Respiratory Mechanisms* (1940) Krogh has given a fascinating and lucid description of many different ways in which the demand for oxygen is met in the animal kingdom.  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| Biographical | Jules Bordet was born in Soignies, Belgium, on June 13, 1870. He was educated in Brussels where he graduated as Doctor of Medicine in 1892. In 1894 he went to Paris to work at the Pasteur Institute until 1901 when he returned to Belgium to found the Pasteur Institute, Brussels. He has been Director of the Belgian Institute since its inception (honorary since 1940) and Professor of Bacteriology, University of Brussels, since 1907 (honorary since 1935).  Bordet’s early studies showed that antimicrobic sera include two active substances, one existing before immunization, known as alexine, and the other a specific antibody created by vaccination: he developed a method of diagnosing microbes by sera. In 1898, he discovered haemolytic sera and showed that the mechanism of their action on foreign blood is similar to that by which an antimicrobic serum acts on microbes and, furthermore, that the reactions of the sera are colloidal in nature. He has contributed much towards the understanding of the formation of coagulin and also anaphylactic poisons. Together with Gengou (in 1906), he cultivated *B.pertussis* and laid the foundations of the generally accepted opinion that this organism is the bacterial cause of whooping cough. In addition to his being an acknowledged world authority in many branches of bacteriology, Bordet was considered to be a great exponent and worker on immunology. He was the author of *Traité de l’Immunité dans les Maladies Infectieuses* (2nd ed., 1939) (Treatise on immunity in infectious diseases) and a great number of medical publications.  Bordet was a permanent member of the Administrative Council of Brussels University, he was President of the First International Congress of Microbiology (Paris, 1930), and Past President of the Premier Council of Hygiene of Belgium, the Scientific Council of the Pasteur Institute of Paris and the Belgian Academy of Medicine. He was Doctor, *honoris causa*, of the Universities of Cambridge, Paris, Strasbourg, Toulouse, Edinburgh, Nancy, Caen, Montpellier, Cairo, Athens, and Quebec. He was a member of the Belgian Royal Academy, the Royal Society (London), the Royal Society of Edinburgh, the Academy of Medicine (Paris), the National Academy of Sciences (U.S.A.), and many other academies and societies. Bordet gained many awards during his career, including the Grand Cordon de l’Ordre de la Couronne de Belgique (1930), the Grand Cordon de l’Ordre de Léopold (1937), the Grand Croix de la Légion d’Honneur (1938), and public honours of Rumania, Sweden and Luxemburg.  In 1899 Bordet married Marthe Levoz. They had one son, Paul,who succeeded his father as Chief of the Pasteur Institute in Brussels and also as Professor of Bacteriology, and two daughters. Jules Bordet died on April 6, 1961.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
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| ID | 0714 |
| Biographical | Robert Bárány was born on April 22, 1876, in Vienna. His father was the manager of a farm estate and his mother, Maria Hock, was the daughter of a well-known Prague scientist, and it was her intellectucal influence that was most pronounced in the family. Robert was the eldest of six children. When he was quite young he contracted tuberculosis of the bones, which resulted in permanent stiffness of his kneejoint. It is thought that this illness first led him to take an interest in medicine. The disability, however, did not prevent him from playing tennis and walking in the mountains, right through his life. He was always top of the form – in the primary school, the grammar school, and was among the best of his year even at the university.  After completing his medical studies at Vienna University in 1900, Bárány attended the lectures of Professor C. von Noorden in Frankfurt am Main for one year, and then studied at the psychiatric-neurological clinic of Professor Kracpelin in Freiburg i.Br. It was there that his interest in neurological problems was first awakened. On his return to Vienna he became the pupil of Professor Gussenbauer, the surgeon, and finally, in 1903, accepted a post as demonstrator at the Otological Clinic under Professor Politzer. He followed up the theories of Flourens, Purkinje, Mach, Breuer and others, and clarified the physiology and pathology of human vestibular apparatus. He was awarded the Nobel Prize for his work in this field in 1914. The news of this award reached Bárány in a Russian prisoner-of-war camp; he had been attached to the Austrian army as a civilian surgeon and had tended soldiers with head injuries, which fact had enabled him to continue his neurological studies on the correlation of the vestibular apparatus, the cerebellum and the muscular apparatus. Following the personal intervention of Prince Carl of Sweden on behalf of the [Red Cross](https://www.nobelprize.org/nobel_prizes/peace/laureates/1917/index.html), he was released from the prisoner-of-war camp in 1916 and was presented with the Nobel Prize by the King of Sweden at Stockholm.  Bárány returned to Vienna the same year, but was bitterly disappointed by the attitude of his Austrian colleagues, who reproached him for having made only incomplete references in his works to the discoveries of other scientists, on whose theories they said his work was based. These attacks resulted in Bárány leaving Vienna to accept the post of Principal and Professor of an Otological Institute in Uppsala, where he remained for the remainder of his life. Holmgren and a number of famous Swedish otologists published a paper in defence of Bárány.  During the latter part of his life Bárány studied the causes of muscular rheurmatism, and continued working on a book dealing with this subject even after he had suffered a stroke and was partially paralysed. Bárány married Ida Felicitas Berger in 1909. They had two sons; the elder became Professor of Pharmacology at the University of Uppsala, his brother Assistant Professor of Medicine at the [Caroline Institute](http://www.ki.se/), Stockholm; and one daughter, Ingrid, who became a psychiatrist.  He died at Uppsala on April 8, 1936.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
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| Biographical | Charles Richet was born on August 26, 1850, in Paris. He was the son of Alfred Richet, Professor of Clinical Surgery in the Faculty of Medicine, Paris, and his wife Eugenie, *née* Renouard. He studied in Paris, becoming Doctor of Medicine in 1869, Doctor of Sciences in 1878 and Professor of Physiology from 1887 onwards in the Faculty of Medicine, Paris.  For 24 years (1878-1902) he was Editor of the *Revue Scientifique*, and from 1917 he was co-editor of the *Journal de Physiologie et de Pathologie Générale*. He has published papers on physiology, physiological chemistry, experimental pathology, normal and pathological psychology and numerous researches all done in the physiological laboratory of the Faculty of Medicine, Paris, where he tried to study normal and pathological facts together with each other.  In physiology, he worked out the mechanism of the thermoregulation in homoiothermic animals. Before his researches (1885-1895) on polypnoea and shivering due to temperature little was known about the methods by which animals deprived of cutaneous transpiration can guard against overheating and how chilled animals can warm themselves again.  In experimental therapeutics Richet showed that the blood of animals vaccinated against an infection protects against this infection (Nov. 1888). Applying this principle to tuberculosis, he did the first serotherapeutic injection done in man (Dec. 6, 1890).  In 1900, Charles Richet showed that feeding milk and raw meat (zomotherapy) might cure tuberculous dogs.  In 1901 he established that by decreasing the sodium chloride in food, potassium bromide is rendered so effective for the treatment of epilepsy that the therapeutic dose falls from 10 g to 2 g.  In 1913, he was awarded the Nobel Prize for his researches on anaphylaxis. He invented this word to designate the sensitivity developed by an organism after it had been given a parenteral injection of a colloid or protein substance or a toxin (1902). Later he demonstrated the facts of passive anaphylaxis and anaphylaxis *in vitro*. The applications of anaphylaxis to medicine are extremely numerous. Already in 1913, over 4000 memoirs had been published on this question and it plays an important part nowadays in pathology. He showed that in fact parenteral injection of protein substance modifies profoundly and permanently the chemical constitution of the body fluids. Most of Charles Richet’s physiological works scattered in various scientific journals were published in the *Travaux du Laboratoire de la Faculté de Médecine de Paris* (Alcan, Paris, 6 vols. 1890-1911) (Works of the Physiological Laboratory of the Faculty of Medicine, Paris).  Among his other works are: *Suc Gastrique chez l’Homme et chez les Animaux*, 1878 (Gastric juice in man and in animals); *Leçons sur les Muscles et les Nerfs*, 1881 (Lectures on the muscles and nerves); *Leçons sur la Chaleur Animale*, 1884 (Lectures on animal heat); *Essai de Psychologie Générale*, 1884 (Essay on general psychology); *Souvenirs d’un Physiologiste*, 1933 (Memoirs of a physiologist). He was also the editor of *Dictionnaire de Physiologie*, 1895-1912 (Dictionary of Physiology), of which 9 volumes appeared.  Among his recreations were an interest in spiritualism and the writing of a few dramatic works.  In 1877, Charles Richet married Amélie Aubry. They had five sons, Georges, Jacques, Charles (who, like his father, was Professor in the Faculty of Medicine in Paris and was, in his turn, succeeded by his son Gabriel), Albert and Alfred, and two daughters, Louise (Mme Lesné) and Adèle (Mme le Ber).  He died in Paris on December 4, 1935.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
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| ID | 0716 |
| Biographical | Alexis Carrel was born at Lyons, France, on June 28, 1873. He was the son of a business man, also named Alexis Carrel, who died when his son was very young.  Alexis was educated at home by his mother Anne Ricard, and also at St. Joseph School, Lyons.  In 1889 he took the degree of Bachelor of Letters at the University of Lyons; in 1890 the degree of Bachelor of Science and in 1900 his Doctor’s degree at the same University. He then continued his medical work at the Lyons Hospital and also taught Anatomy and Operative Surgery at the University, holding the post of Prosector in the Department of Professor L. Testut. Specializing in Surgery, Carrel began experimental work in this subject in Lyons in 1902, but in 1904 he went to Chicago and in 1905 worked in the Department of Physiology in the University of Chicago under Professor G. N. Stewart. In 1906 he was attached to the Rockefeller Institute for Medical Research, New York, as an Associate Member, becoming a Full Member in 1912. In this Institute he carried out most of the experiments which earned him, in 1912, the Nobel Prize in Physiology or Medicine.  During the 1914-1919 War, Carrel served as a Major in the French Army Medical Corps and at this time he helped to devise the well-known Carrel-Dakin method of treating war wounds, which was widely used.  Carrel’s researches were mainly concerned with experimental surgery and the transplantation of tissues and whole organs. As early as 1902 he published, in the *Lyons Medical*, a technique for the end-to-end anastomosis of blood vessels and in 1910 he demonstrated that blood-vessels could be kept for long periods in cold storage before they were used as transplants in surgery. Earlier, in 1908, he had devised methods for the transplantation of whole organs and later, in 1935, in collaboration with Charles Lindbergh, the airman who was the first to flow across the Atlantic, he devised a machine for supplying a sterile respiratory system to organs removed from the body, Lindbergh having solved the mechanical problems involved. He discussed this aspect of his work and its implications in his book *The Culture of Organs*. Carrel also published the well-known book entitled *Man, the Unknown* and, in collaboration with Georges Debelly, a book on *Treatment of Infected Wounds*.  In collaboration with the French surgeon Theodore Tuffier, who was a pioneer of thoracic surgery, Carrel performed on the heart a successful series of valvotomies, and in collaboration with Burrows he grew sarcoma cells in tissue cultures by the technique of Harrison.  Carrel was honoured by memberships of learned societies in the U.S.A., Spain, Russia, Sweden, The Netherlands, Belgium, France, Vatican City, Germany, Italy and Greece, and by honorary doctorates of the Universities of Belfast, Princeton, California and New York, and Brown and Columbia Universities. He was a Commander in the Legion d’Honneur of France and in the Leopold Order of Belgium, a Grand-Commander in the Swedish Order of the Polar Star, and the recipient of other decorations in orders from Spain, Serbia, Great Britain and the Holy See.  He was married to Anne-Marie-Laure Gourlez de La Motte, the widow of M. de La Meyrie. They had no children.  In 1939, when the Second World War broke out, Carrel went to France as a member of a special mission for the French Ministry of Health, a post which he held for a year. He then became Director of the Carrel Foundation for the Study of Human Problems which was set up by the Vichy Government. While holding this appointment he died in Paris on November 5, 1944.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
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| ID | 0717 |
| Biographical | Allvar Gullstrand, eldest son of Dr. Pehr Alfred Gullstrand, Principal Municipal Medical Officer, and his wife Sofia Mathilda *née* Korsell, was born on June 5, 1862, at Landskrona. He was educated at schools in Landskrona and Jönköping, where he passed his matriculation in 1880; he then went to Uppsala University, which he left in 1885, and spent a year at Vienna, afterwards continuing his medical studies at Stockholm where he graduated in medicine in 1888, presented his doctorate thesis in 1890, and was appointed Lecturer in Ophthalmology in 1891. After holding various appointments as Doctor and Lecturer and serving on the Swedish Medical Board, he was appointed the first Professor of Ophthalmology at Uppsala University in 1894.  He occupied this post until 1913. As from 1914 onwards he held a Personal Professorship in Physical and Physiological Optics at Uppsala University. He was appointed Emeritus Professor in 1927.  He was entirely self-taught in the fields covering his most important work (geometric and physiological optics). The basis of the science he developed was laid in 1890 in his thesis *Bidrag till astigmatismens teori* (Contribution to the theory of astigmatism). The complete proof of this theory is found in the following three works: *Allgemeine Theorie der monochromatischen Aberrationen und ihre nächsten Ergebnisse für die Ophthalmologie* (General theory of monochromatic aberrations and their immediate significance for ophthalmology), 1900, which received awards from the [Swedish Royal Academy of Sciences](http://www.kva.se/) and the Swedish Medical Association; *Die reelle optische Abbildung* (The true optical image), 1906; and *Die optische Abbildung in heterogenen Medien und die Dioptrik der Kristallinse des Menschen* (The optical image in heterogeneous media and the dioptrics of the human crystalline lens), 1908, which was awarded the Centenary Gold Medal of the Swedish Medical Association. The results are combined in the works *Tatsachen und Fiktionen in der Lehre von der optischen Abbildung* (Facts and fictions in the theory of the optical image), 1907; *Handbuch der physiologischen Optik* (Handbook of physiological optics), by H. von Helmholtz, 3rd edition, Vol. I, 1909, and *Einführung in die Methoden der Dioptrik der Augen des Menschen* (Introduction to the methods of the dioptrics of the human eyes), 1911.  Of his other works, the following received awards: *Objektive Differential-diagnostik und photographische Abbildung von Augenmuskellähmungen* (The objective differential diagnosis and photographic illustration of disabilities of the eye muscles), 1892; *Photographisch-ophthalmometrische und klinische Untersuchungen über die Hornhautrefraktion* (Photographic-ophthalmometric and clinical investigations of corneal refractions), 1896; *Die Farbe der Macula centralis retinae* (The pigments of the central macula of the retina), 1905; the first two received awards from the Swedish Medical Association and the latter received the Björkén Prize of the Uppsala Faculty of Medicine.  As the holder of the Research Professorship in Physical and Physiological Optics, Gullstrand devoted himself mainly to calculations and methods for achieving a more suitable form of refracting surfaces in optical instruments, and to investigation of optical system laws of higher order. A result of the former is a record which is kept in the Uppsala University library and which relates to calculations for optical systems, *inter alia* optical systems with appropriate non-spherical surfaces, and the publication *Über asphärische Flächen in optischen Instrumenten* (On aspheric surfaces in optical instruments), 1919. As a result of the latter we may mention the publications *Das allgemeine optische Abbildungssystem* (The general optical image system), 1915 and *Optische Systemgesetze zweiter und dritter Ordnung* (Laws of the optical system of the second and third order), 1924. He gave the last summary of his optical experiments in *Einiges über optische Bilder* (Some aspects of optical images), 1926.  His methods of focal illumination, particularly by means of the slit lamp (1911), have acquired the greatest importance to the practical ophthalmologist. His reflex-free ophthalmoscope (1911) is also a valuable instrument to the ophthalmological diagnostician.  His great administrative ability found expression particularly in the Faculty of Medicine and the Council of Uppsala University and the Swedish Academy of Sciences.  Gullstrand was an honorary Doctor of Philosophy of the Universities of Uppsala, Jena and Dublin, and a member of a number of Swedish and foreign scientific societies. In 1911 he received the Nobel Prize for his work on the dioptrics of the eye. He was member of the Nobel Physics Committee of the Swedish Academy of Sciences (1911-1929), and its Chairman (1922-1929). In 1927 he was awarded the Graefe Medal of the Deutsche Ophthalmologische Gesellschaft.  In 1885 he married Signe Christina Breitholtz. They had one daughter, who died at an early age. Gullstrand died in Stockholm on July 28, 1930.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
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| ID | 0718 |
| Biographical | Ludwig Karl Martin Leonhard Albrecht Kossel was born in Rostock on September 16, 1853. He was the eldest son of the merchant and Prussian consul Albrecht Kossel and his wife Clara, *née* Jeppe. He attended the secondary school in Rostock and went, in the autumn of 1872, to the newly founded University of Strassburg in order to study medicine. He was especially influenced by the lectures and practical teaching of de Bary, Waldeyer, Kundt, [Baeyer](https://www.nobelprize.org/nobel_prizes/chemistry/laureates/1905/index.html) and especially by Hoppe-Seyler.  Part of his studies were carried out in the University of his hometown Rostock where he passed in 1877 the state medical examination and in 1878 the degree of Doctor of Medicine was conferred on him. In the autumn of 1877 he took an assistantship in Hoppe-Seyler’s Institute of Physical Chemistry in Strassburg and in 1881 he qualified as Lecturer of Physiological Chemistry and Hygiene. In 1883 E. du Bois-Reymond called him to become Director of the Chemical Division of the Institute of Physiology in Berlin in place of E. Baumann who had gone to Freiburg and here, in 1887, he became Extraordinary Professor in the Medical Faculty. In April 1895 he moved to Marburg in Hessen as Ordinary Professor of Physiology and Director of the Institute of Physiology there. Here he worked until the spring of 1901. Then he was called to the Chair in Heidelberg formerly held by Kühne and before him by Helmholtz. In 1907 he was appointed «Geheimer Hofrat» (Privy Councillor) and in this year also he presided as Chairman over the Seventh International Congress of Physiology in Heidelberg. In 1908-1909 he was Prorector of this University.  Albrecht Kossel was an honorary doctor of the Universities of Cambridge, Dublin, Ghent, Greifswald, St. Andrews and Edinburgh, and a member of various Academies, among which are the [Royal Swedish Academy of Sciences](http://www.kva.se/en/) and the Royal Society of Sciences of Uppsala.  Kossel’s field of work was physiological chemistry, especially the chemistry of tissues and cells; his activities as a teacher in the University, however, extended to general physiology, which in his time was in most German universities still not separated from physiological chemistry. He began his investigations into the constitution of the cell nucleus at the end of the seventies, and in the nineties he turned more and more to the study of the proteins, the alterations in proteins during transformation into peptone, the effects of a phenetol diet on the urine, the peptonic components of the cells, the simplest proteins, etc. Working on fish-roe he studied the protamines and hexone bases. In 1896 he discovered histidine, then worked out the classical method for the quantitaive separation of the hexone bases. With his distinguished English pupil H. D. Dakin he investigated arginase, the ferment which hydrolyses arginine into urea and ornithine, and later he discovered agmatine in herring roe and devised a method for preparing it.  Kossel was active in securing the foundation of separate chairs of physiology and medical chemistry in German universities so that these subjects would develop. His works were published chiefly in the *Zeitschrift für physiologische Chemie*, which after the deaths of Hoppe-Seyler and E. Baumann came under his direction.  Among his important publications may be mentioned: *Untersuchungen über die Nukleine und ihre Spaltungsprodubte* (Investigations into the nucleins and their cleavage products), 1881; *Die Gewebe des menschlichen Körpers und ihre mikroskopische Untersuchung* (The tissues in the human body and their microscopic investigation), 1889-1891, in two volumes, with Behrens and Schieerdecker; and the *Leitfaden für medizinisch-chemische Kurse* (Textbook for medical-chemical courses), 1888, since reprinted several times. He was also the author of *Die Probleme der Biochemie* (The problems of biochemistry), 1908; *Die Beziehungen der Chemie zur Physiologie* (The relationships between chemistry and physiology), which was a contribution to *Kultur der Gegenwart*, 1913.  Kossel had one daughter and one son, Walther (1888-1956), who became a prominent Professor of Theoretical Physics at Kiel until he moved to the corresponding position at the Danzig Institute of Technology (1932-1945), and in 1947 became Professor at Tübingen University.  Albrecht Kossel died on July 5, 1927.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0718 |
| Interview |  |
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| ID | 0719 |
| Biographical | Theodor Kocher was born on August 25, 1841, at Berne. His father, a Chief-Engineer, was a very keen worker and kept him constantly at work. The influence of a devoted mother and later the loving care of a selfsacrificing wife enabled him to pass without interruption through the continuous strait of secondary school and University, and he obtained his doctorate in 1865. His teachers of surgery were Demme, Lücke, Billroth, and Langenbeck. On the warm recommendation of both the latter he followed Lücke (who had been called to Strassburg) as Ordinary Professor of Surgery and Director of the University Surgical Clinic at Berne in 1872 and remained in this post in spite of several invitations to foreign universities. As Lücke’s assistant and as «Privat-dozent» from 1866 onwards he published experimental work on haemostasis (by torsion of the arteries) in Langenbeck’s *Archiv*, Vol. II, with which Billroth was especially pleased; and by anatomical investigations and studies of pathological anatomy he discovered a new method for the reduction of dislocations of the shoulder, which was soon accepted and used as the simplest and surest method of rectifying not only recent, but also old dislocations.  When Kocher began his surgical activities the transition from the septic to the antiseptic treatment of wounds had been completed and Kocher worked for the latter with all his energies because of its great importance. Then arose a series of works on the antiseptic treatment of wounds with weak chlorine solutions, the Listerian treatment of ovariotomies (1875), the preparation of antiseptic catgut and the simplest method of obtaining healing of wounds without drainage tubes, on conditions governing healing by first intention, and on Lister’s wound dressings.  The surgical clinic in Berne was for a long time the centre of attraction for medical men who favoured the antiseptic treatment of wounds and wished to follow it. Later Kocher was one of the first to go over to pure asepsis about which he had the best opportunities to learn through his collaboration with Tavel, whose bacteriological studies on infective processes he sought to advance. From this work proceeded the second edition of *Vorlesungen über chirurgische Infektionshrankheiten* (Lectures on surgical infectious diseases ) by Kocher and Tavel, Basel, 1892, and Jena, 1900.  Because Kocher had also to give courses of instruction to military doctors, it was necessary to work experimentally on gunshot wounds. Investigation of this subject produced significant contributions to the theory of the explosive effect of missiles, and Kocher with von Schjering produced the most extensive research on and the basis of the modern ideas of the mode of action of small calibre missiles with high initial velocity. These investigations led to numerous small contributions to the journals for Swiss physicians, a lecture to the general session of the International Medical Congress in Rome in April 1874 on the improvement of projectiles from the humane point of view, and two larger works: *Über Schusswunden* (On gunshot wounds), 1880, and *Die Lehre von den Schusswunden durch Kleinkalibergeschosse* (The theory of gunshot wounds due to projectiles of small calibre), 1895.  Among Kocher’s other more important works those on acute osteomyelitis (1878) and the theory of strangulated hernia (an experimental and clinical study, 1877) may be mentioned. In this study, on the basis of a large number of experiments, a new theory of strangulation of hernia was founded called the «dilation theory» which also had great significance for ileus. He published his method for the radical operation for hernia. A larger work was on hernia in infancy in Gerhardt’s Handbook (1880). Apart from hernias, Kocher busied himself very much with the surgery of the abdominal organs. *In Magenresektion* (Resection of the stomach) he described a new procedure: pylorectomy with subsequent gastroduodenostomy. In *Excisio recti*(Excision of the rectum) preparatory excision of the coccyx was introduced, which had been initiated by Kraske, and Kocher took this step further and also removed a piece of the sacrum (1874). Other works were on the radical cure of cancer, the surgical treatment of gastric complaints (1909). In *Choledocho-Duodenostomia interna* (Internal choledocho-duodenostomy) he established the procedure for excision of gall stones from the lowest part of the bile duct. In *Mobilisierung des Duodenum* (Mobilization of the duodenum) he greatly advanced all the operations affecting the duodenum. With Dr. Matti he wrote *Hundert Operationen an den Gallenwegen* (A hundred operations on the bile ducts): this improved earlier surgical treatment of gall stones and simplified them in the form of ideal cholecystotomy. Other larger works dealt with ileus and with diseases of the male sexual organs, injuries of the vertebral column and fractures. Then followed *Zur Kenntnis der traumatischen Epilepsie* (On our knowledge of traumatic epilepsies ) and *Über einige Bedingungen zur Operativen Heilung der Epilepsie* (On some conditions for the operative cure of epilepsy), and papers on injuries and concussion of the brain and trepanning. He devised a new treatment for «pes varus» and published a well-illustrated work on phosphorus necrosis and another on coxa vara.  His *Chirurgische Operationslehre* (Theory on surgical operations) reached six editions and was translated into most modern languages. It described many operations, mostly in abdominal surgery and the surgery of joints. His book *Erkrankungen der Schilddrüse* (Diseases of the thyroid gland ) discussed the etiology, symptology and treatment of goitres. His new ideas on the physiology and pathology of the thyroid gland caused controversy.  He and his pupils also wrote several papers on various aspects of cretinism and various aspects of goitre.  Kocher was an honorary member of numerous academies and medical societies, e.g. the German Surgical Society. He was an Honorary Fellow of the Royal College of Surgeons; Ll.D. Edinburgh University; Honorary Member of the Royal Society of Sciences, Uppsala; Honorary Member of the American Surgical Society; of the New York Academy of Medicine and the College of Physicians, Philadelphia; the Imperial Military Medical Academy, St. Petersburg; the Academy of Medicine, Turin; the Imperial Medical Society of Constantinople; the Royal Medical Society of Vienna; Royal Medico-Surgical Society, London; the London Medical Society; the London Chemical Society; the Medical Society of Finland; and various societies in Milwaukee, Dresden, Leipzig and Erlangen. He was a Corresponding Member of the Surgical Society of Paris and of the Royal Society of Medical and Natural Sciences of Brussels; of the Belgian Academy of Medicine; the German Society of Neurologists and of the Hufeland Society of Berlin; Honorary M.D. of the Free University of Brussels. In 1902 he was President of the German Society of Surgeons in Berlin and President of the First International Surgical Congress, 1905, in Brussels.  In 1909 he was awarded the Nobel Prize for his work on the thyroid gland. Three years later he donated to his University the sum of 200,000 Swiss francs for a Research Institute in Biology.  Kocher married Marie Witchi (1851-1921). They had three sons, the eldest of whom, Albert (1872-1941) became Assistant Professor of Surgery and gave his father considerable help in his work.  Theodor Kocher died at Berne on July 27, 1917.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0719 |
| Interview |  |
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| ID | 0720 |
| Biographical | Ilya Ilyich Mechnikov was born on May 15, 1845\*, in a village near Kharkov in Russia (now Kharkiv, Ukraine). He was the son of an officer of the Imperial Guard, who was a landowner in the Ukraine steppes. His mother, *née* Nevakhowitch, was of Jewish origin.  Mechnikov went to school at Kharkov and was, even when he was a little boy, passionately interested in natural history, on which he used to give lectures to his small brothers and to other children. He was at that time especially interested in botany and geology. When he left school he went to the University of Kharkov to study natural sciences, and worked there so hard that he was able to complete the four year course in two years. Graduating at Kharkov, he went, first to study marine fauna at Heligoland, and then to the University of Giessen, where he worked under Leuckart. Subsequently he went to the University of Göttingen and the Munich Academy, where he worked in von Siebold’s laboratory. While he was at Giessen, he discovered, in 1865, intracellular digestion in one of the flatworms, an observation which was to influence his later discoveries. At Naples he prepared a thesis for his Doctorate on the embryonic development of the cuttle-fish *Sepiola* and the Crustacean *Nelalia*.  In 1867 he returned to Russia, having been appointed docent at the new University of Odessa and from there he went to take up a similar appointment at the University of St. Petersburg. But in 1870 he was appointed Titular Professor of Zoology and Comparative Anatomy at the University of Odessa.  At St. Petersburg he met his first wife, Ludmilla Feodorovitch, who suffered from tuberculosis so severe that she had to be carried to church in a chair for the wedding. For five years Mechnikov did all he could to save her life, but she died on April 20, 1873. Broken by this loss, troubled by weak eyesight and heart troubles and by difficulties in the University, Mechnikov became, at this time, so pessimistic that he tried to take his own life by swallowing a large dose of opium; but, fortunately for himself and for the world, he did not die. It was in Odessa, in fact, that he met his second wife, Olga, whom he married in 1875. In 1880 his second wife had a severe attack of typhoid fever and, although she did not die, Mechnikov, whose health was still poor, again tried to take his own life. This time, however, he decided, in order to save his wife and others embarrassment, to do this by means of the scientific experiment of inoculating himself with relapsing fever to find out whether it was transmissible by the blood. The attack of relapsing fever that followed was severe, but it did not kill him.  In 1882, after his recovery from this disease, Mechnikov resigned his appointment at Odessa because of difficulties in the University during the period of reactionary government which followed the assassination of Alexander II.  He then went to Messina to continue, in a private laboratory he set up there; his work on comparative embryology, and it was here that he discovered the phenomenon of phagocytosis with which his name will always be associated. This discovery was made when Mechnikov observed, in the larvae of starfishes, mobile cells which might, he thought, serve as part of the defences of these organisms and, to test this idea, he introduced into them small thorns from a tangerine tree which had been prepared as a Christmas tree for his children. Next morning he found the thorns surrounded by the mobile cells, and, knowing that, when inflammation occurs in animals which have a blood vascular system, leucocytes escape from their blood vessels, it occurred to him that these leucocytes might take up and digest bacteria that get into the body.  Returning to Odessa, Mechnikov visited Vienna on the way and explained his ideas to Claus, Professor of Zoology there and it was Claus who suggested the term *phagocyte* for the mobile cells which act in this way. Ultimately in 1883, Mechnikov gave, at Odessa, his first paper on phagocytosis. Apart from its fundamental importance in immunology, the discovery had a marked influence on Mechnikov himself. It completely changed his outlook on life; he abandoned his pessimistic philosophy and determined to find further proof of his hypothesis.  Some proof of it he found in the small fresh-water Crustacean *Daphnia*, in which he found that fungal spores which attacked it were themselves attacked by the phagocytes of the crustacean. He then studied anthrax bacilli and found that the more virulent strains of these were not attacked by the phagocytes, while the less virulent strains were.  During this period Mechnikov had been appointed Director of an Institute established in 1886 in Odessa to carry out Pasteur’s vaccine treatment of rabies, but there was much local hostility to this treatment. Mechnikov found that, partly because he was not a medical man, circumstances became so difficult that, in 1888, he left Odessa and went to Paris to ask Pasteur for his advice. Pasteur gave him a laboratory and an appointment in the Pasteur Institute. Here he remained for the rest of his life.  Apart from his work on phagocytosis, Mechnikov had, during his earlier period of scientific activity, published many papers on the embryology of invertebrates. These included work on the embryology of insects, published in 1866, and, in 1886, his studies of the embryology of Medusae. At the Pasteur Institute in Paris Mechnikov was engaged in work associated with the establishment of his theory of cellular immunity, which, like many great advances in science, encountered considerable hostility. He published, during this period, several papers and two volumes on the comparative pathology of inflammation (1892), and his treatise entitled *L’Immunité dans les Maladies Infectieuses* (Immunity in infectious diseases, 1901). In 1908 he was awarded, together with [Paul Ehrlich](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1908/index.html), the Nobel Prize for Physiology or Medicine.  In addition to this work he, together with Roux, proved that syphilis can be transmitted to monkeys. Later he took up the study of the flora of the human intestine and developed a theory that senility is due to poisoning of the body by the products of certain of these bacteria. To prevent the multiplication of these organisms he proposed a diet containing milk fermented by bacilli which produce large amounts of lactic acid and for a time this diet became widely popular.  Mechnikov received many distinctions, among which were the honorary D. Sc. of the University of Cambridge, the Copley Medal of the Royal Society of which he was a Foreign Member, the honorary memberships of the Academy of Medicine in Paris, and the Academies of Sciences and of Medicine in St. Petersburg. In addition, he was a corresponding member of several other societies and a Foreign Member of the Swedish Medical Society.  Photographs taken of him when he was working at the Pasteur Institute show him with long hair and an unkempt beard. It is said of him that at this time he usually wore overshoes in all weathers and carried an umbrella, his pockets being overfull with scientific papers, and that he always wore the same hat, and often, when he was excited, sat on it.  From 1913 onwards Mechnikov began to suffer from heart attacks and, although he rallied for a time and recovered from the distress which the 1914-1918 War caused him, he died on July 15, 1916.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  \* Ilya Mechnikov’s birthday in Old-Style is 3 May. In the original biography, submitted by Ilya Mechnikov to the Nobel Foundation, the born date is 16 May (New-Style). R.I. Belkin, a Russian science historian, have explained that Mechnikov by mistake added 13 days to the Old-Style date, but as he was born in the 19th century, it should have been only 12 days added. (“Commentary” in I.I. Mechnikov, *Academic Collection of Works*, vol. 16. Moscow: Meditsina. p. 434.) |
| Autobiographical |  |
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| Telephone  interview | 0720 |
| Interview |  |
|  |  |
| ID | 0721 |
| Biographical | Paul Ehrlich was born on March 14, 1854 at Strehlen, in Upper Silesia[\*](https://www.nobelprize.org/prizes/medicine/1908/ehrlich/biographical/#footnote), Germany. He was the son of Ismar Ehrlich and his wife Rosa Weigert, whose nephew was the great bacteriologist Karl Weigert.  Ehrlich was educated at the Gymnasium at Breslau and subsequently at the Universities of Breslau, Strassburg, Freiburg-im-Breisgau and Leipzig. In 1878 he obtained his doctorate of medicine by means of a dissertation on the theory and practice of staining animal tissues. This work was one of the results of his great interest in the aniline dyes discovered by W. H. Perkin in 1853.  In 1878 he was appointed assistant to Professor Frerichs at the Berlin Medical Clinic, who gave him every facility to continue his work with these dyes and the staining of tissues with them. Ehrlich showed that all the dyes used could be classified as being basic, acid or neutral and his work on the staining of granules in blood cells laid the foundations of future work on haematology and the staining of tissues.  In 1882 Ehrlich published his method of staining the tubercle bacillus that [Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html) had discovered and this method was the basis of the subsequent modifications introduced by Ziehl and Neelson, which are still used today. From it was also derived the Gram method of staining bacteria so much used by modern bacteriologists.  In 1882 Ehrlich became Titular Professor and in 1887 he qualified, as a result of his thesis *Das Sauerstoffbedürfnis des Organismus* (The need of the organism for oxygen) as a Privatdozent (unpaid lecturer or instructor) in the Faculty of Medicine in the University of Berlin. Later he became an Associate Professor there and Senior House Physician to the Charité Hospital in Berlin.  In 1890 Robert Koch, Director of the newly established Institute for Infectious Diseases, appointed Ehrlich as one of his assistants and Ehrlich then began the immunological studies with which his name will always be associated.  At the end of 1896 an Institute for the control of therapeutic sera was established at Steglitz in Berlin and Ehrlich was appointed its Director. Here he did further important work on immunology, especially on haemolysins. He also showed that the toxin-antitoxin reaction is, as chemical reactions are, accelerated by heat and retarded by cold and that the content of antitoxin in antitoxic sera varied so much for various reasons that it was necessary to establish a standard by which their antitoxin content could be exactly measured. This he accomplished with [von Behring](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1901/index.html)‘s antidiphtheritic serum and thus made it possible to standardize this serum in units related to a fixed and invariable standard. The methods of doing this that Ehrlich then established formed the basis of all future standardization of sera. This work and his other immunological studies led Ehrlich to formulate his famous side-chain theory of immunity.  In 1897 Ehrlich was appointed Public Health Officer at Frankfurt-am-Main and when, in 1899, the Royal Institute of Experimental Therapy was established at Frankfurt, Ehrlich became its Director. He also became Director of the Georg Speyerhaus, which was founded by Frau Franziska Speyer and was built next-door to Ehrlich’s Institute. These appointments marked the beginning of the third phase of Ehrlich’s many and varied researches. He now devoted himself to chemotherapy, basing his work on the idea, which had been implicit in his doctorate thesis written when he was a young man, that the chemical constitution of drugs used must be studied in relation to their mode of action and their affinity for the cells of the organisms against which they were directed. His aim was, as he put it, to find chemical substances which have special affinities for pathogenic organisms, to which they would go, as antitoxins go to the toxins to which they are specifically related, and would be, as Ehrlich expressed it, «magic bullets» which would go straight to the organisms at which they were aimed.  To achieve this, Ehrlich tested, with the help of his assistants, hundreds of chemical substances selected from the even larger number of these that he had collected. He studied, among other subjects, the treatment of trypanosomiasis and other protozoal diseases and produced trypan red, which was, as his Japanese assistant Shiga showed, effective against trypanosomes. He also established, with A. Bertheim, the correct structural formula of atoxyl, the efficiency of which against certain experimental trypanosomiases was known. This work opened a way of obtaining numerous new organic compounds with trivalent arsenic which Ehrlich tested.  At this time, the spirochaete that causes syphilis was discovered by Schaudinn and Hoffmann in Berlin, and Ehrlich decided to seek a drug that would be effective especially against this spirochaete. Among the arsenical drugs already tested for other purposes was one, the 606th of the series tested, which had been set aside in 1907 as being ineffective. But when Ehrlich’s former colleague Kitasato sent a pupil of his, named Hata, to work at Ehrlich’s Institute, Ehrlich, learning that Hata had succeeded in infecting rabbits with syphilis, asked him to test this discarded drug on these rabbits. Hata did so and found that it was very effective.  When hundreds of experiments had repeatedly proved its efficacy against syphilis, Ehrlich announced it under the name «Salvarsan». Subsequently, further work on this subject was done and eventually it turned out that the 914th arsenical substance to which the name «Neosalvarsan» was given, was, although its curative effect was less, more easily manufactured and, being more soluble, became more easily administered. Ehrlich had, like so many other discoverers before him, to battle with much opposition before Salvarsan or Neosalvarsan were accepted for the treatment of human syphilis; but ultimately the practical experience prevailed and Ehrlich became famous as one of the main founders of chemotherapy.  During the later years of his life, Ehrlich was concerned with experimental work on tumours and on his view that sarcoma may develop from carcinoma, also on his theory of athreptic immunity to cancer.  The indefatigable industry shown by Ehrlich throughout his life, his kindness and modesty, his lifelong habit of eating little and smoking incessantly 25 strong cigars a day, a box of which he frequently carried under one arm, his invariable insistence on the repeated proof by many experiments of the results he published, and the veneration and devotion shown to him by all his assistants have been vividly described by his former secretary, Martha Marquardt, whose biography of him has given us a detailed picture of his life in Frankfurt. In Frankfurt the street in which his Institute was situated was named Paul Ehrlichstrasse after him, but later, when the Jewish persecution began, this name was removed because Ehrlich was a Jew. After the Second World War, however, when his birth-place, Strehlen, came under the jurisdiction of the Polish authorities, they renamed it Ehrlichstadt, in honour of its great son.  Ehrlich was an ordinary, foreign, corresponding or honorary member of no less than 81 academies and other learned bodies in Austria, Belgium, Brazil, Denmark, Egypt, Finland, France, Germany, Great Britain, Greece, Hungary, ltaly, The Netherlands, Norway, Roumania, Russia, Serbia, Sweden, Turkey, the U.S.A. and Venezuela. He held honorary doctorates of the Universities of Chicago, Göttingen, Oxford, Athens and Breslau, and was also honoured by Orders in Germany, Russia, Japan, Spain, Roumania, Serbia, Venezuela, Denmark (Commander Cross of the Danebrog Order), and Norway (Commander Cross of the Royal St. Olaf Order).  In 1887 he received the Tiedemann Prize of the Senckenberg Naturforschende Gesellschaft at Frankfurt/Main, in 1906 the Prize of Honour at the XVth International Congress of Medicine at Lisbon, in 1911 the Liebig Medal of the German Chemical Society, and in 1914 the Cameron Prize of Edinburgh. In 1908 he shared with Metchnikoff the highest scientific distinction, the Nobel Prize.  The Prussian Government elected him Privy Medical Counsel in 1897, promoted him to a higher rank of this Counsel in 1907 and, in 1911, raised him to the highest rank, Real Privy Counsel with the title of Excellency.  Ehrlich married, in 1883, Hedwig Pinkus, who was then aged 19. They had two daughters, Stephanie (Mrs. Ernst Schwerin) and Marianne (Mrs. Edmund Landau).  When the First World War broke out in 1914 he was much distressed by it and at Christmas of that year he had a slight stroke. He recovered quickly from this, but his health which had never, apart from a tuberculous infection in early life which had made it necessary for him to spend two years in Egypt, failed him, now began to decline and when, in 1915, he went to Bad Homburg for a holiday, he had, on August 20 of that year, a second stroke which ended his life.  \* Lower Silesia  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
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| ID | 0722 |
| Biographical | Camillo Golgi was born at Corteno near Brescia on July 7, 1843[\*](https://www.nobelprize.org/prizes/medicine/1906/golgi/biographical/#not), the son of a physician. He studied medicine at the University of Pavia under Mantegazza, Bizzozero and Oehl. After graduating in 1865 he continued to work in Pavia at the Hospital of St. Matteo. Golgi himself stated that Bizzozero greatly influenced him and his methods of scientific research; at that time most of his investigations were concerned with the nervous system, i.e. insanity, neurology and the lymphatics of the brain. In 1872 he accepted the post of Chief Medical Officer at the Hospital for the Chronically Sick at Abbiategrasso, and it is believed that in the seclusion of this hospital, in a little kitchen which he had converted into a laboratory, he first started his investigations into the nervous system.  Golgi returned to the University of Pavia as Extraordinary Professor of Histology, went to Siena for a short time, but returned to Pavia and was appointed to the Chair for General Pathology in 1881, in succession to his teacher Bizzozero. He settled down in Pavia for good, and married Donna Lina, a niece of Bizzozero.  Already while working at the Hospital of St. Matteo, Golgi became interested in the investigation of the causes of malaria and he must be credited for having determined the three forms of the parasite and the three types of fever. After prolonged studies he found a way of photographing the most characteristic phases in 1890.  Golgi was a famous teacher, his laboratory was open to anyone anxious to do research. He never actually practised medicine, but directed the Department of General Pathology at St.Matteo Hospital where young doctors were trained. He also founded and directed the Istituto Sieroterapico-Vaccinogeno of the Province of Pavia. Golgi was Rector of Pavia University for a long time and was also made a Senator of the Kingdom of Italy.  He was an old man during the First World War, but assumed the responsibility for a Military Hospital in Pavia, where he created a neuro-pathological and mechano-therapeutical centre for the study and treatment of peripheral nervous lesions and for the rehabilitation of the wounded.  However, the work of greatest importance which Golgi carried out was a revolutionary method of staining individual nerve and cell structures, which is referred to as the «black reaction». This method uses a weak solution of silver nitrate and is particularly valuable in tracing the processes and most delicate ramifications of cells. Golgi himself was extremely modest and reticent about his work and it is not known when exactly he made this invention. All through his life, however, he continued to work on these lines, modifying and improving this technique.  Golgi received the highest honours and awards in recognition of his work. He shared the Nobel Prize for 1906 with [Santiago Ramón y Cajal](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1906/index.html) for their work on the structure of the nervous system. The Historical Museum at the University of Pavia dedicated a hall to Golgi, where more than 80 certificates of honorary degrees, diplomas and awards are exhibited.  Golgi married Donna Lina Aletti, previously mentioned. They had no children of their own, but adopted his niece, now Mrs. Carolina Golgi-Papini in Rome. He died at Pavia, where he had lived all his life, on January 21, 1926.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
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| Biographical | Camillo Golgi was born at Corteno near Brescia on July 7, 1843[\*](https://www.nobelprize.org/prizes/medicine/1906/golgi/biographical/#not), the son of a physician. He studied medicine at the University of Pavia under Mantegazza, Bizzozero and Oehl. After graduating in 1865 he continued to work in Pavia at the Hospital of St. Matteo. Golgi himself stated that Bizzozero greatly influenced him and his methods of scientific research; at that time most of his investigations were concerned with the nervous system, i.e. insanity, neurology and the lymphatics of the brain. In 1872 he accepted the post of Chief Medical Officer at the Hospital for the Chronically Sick at Abbiategrasso, and it is believed that in the seclusion of this hospital, in a little kitchen which he had converted into a laboratory, he first started his investigations into the nervous system.  Golgi returned to the University of Pavia as Extraordinary Professor of Histology, went to Siena for a short time, but returned to Pavia and was appointed to the Chair for General Pathology in 1881, in succession to his teacher Bizzozero. He settled down in Pavia for good, and married Donna Lina, a niece of Bizzozero.  Already while working at the Hospital of St. Matteo, Golgi became interested in the investigation of the causes of malaria and he must be credited for having determined the three forms of the parasite and the three types of fever. After prolonged studies he found a way of photographing the most characteristic phases in 1890.  Golgi was a famous teacher, his laboratory was open to anyone anxious to do research. He never actually practised medicine, but directed the Department of General Pathology at St.Matteo Hospital where young doctors were trained. He also founded and directed the Istituto Sieroterapico-Vaccinogeno of the Province of Pavia. Golgi was Rector of Pavia University for a long time and was also made a Senator of the Kingdom of Italy.  He was an old man during the First World War, but assumed the responsibility for a Military Hospital in Pavia, where he created a neuro-pathological and mechano-therapeutical centre for the study and treatment of peripheral nervous lesions and for the rehabilitation of the wounded.  However, the work of greatest importance which Golgi carried out was a revolutionary method of staining individual nerve and cell structures, which is referred to as the «black reaction». This method uses a weak solution of silver nitrate and is particularly valuable in tracing the processes and most delicate ramifications of cells. Golgi himself was extremely modest and reticent about his work and it is not known when exactly he made this invention. All through his life, however, he continued to work on these lines, modifying and improving this technique.  Golgi received the highest honours and awards in recognition of his work. He shared the Nobel Prize for 1906 with [Santiago Ramón y Cajal](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1906/index.html) for their work on the structure of the nervous system. The Historical Museum at the University of Pavia dedicated a hall to Golgi, where more than 80 certificates of honorary degrees, diplomas and awards are exhibited.  Golgi married Donna Lina Aletti, previously mentioned. They had no children of their own, but adopted his niece, now Mrs. Carolina Golgi-Papini in Rome. He died at Pavia, where he had lived all his life, on January 21, 1926.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
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| Interview |  |
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| ID | 0724 |
| Biographical | Santiago Ramón y Cajal was born on May 1, 1852, at Petilla de Aragón, Spain. As a boy he was apprenticed first to a barber and then to a cobbler. He himself wished to be an artist – his gift for draughtsmanship is evident in his published works. His father, however, who was Professor of Applied Anatomy in the University of Saragossa, persuaded him to study medicine, which he did, chiefly under the direction of his father. (Later, he made drawings for an atlas of anatomy which his father was preparing, but which was never published.)  In 1873 he took his Licentiate in Medicine at Saragossa and served, after a competitive examination, as an army doctor. He took part in an expedition to Cuba in 1874-75, where he contracted malaria and tuberculosis. On his return he became an assistant in the School of Anatomy in the Faculty of Medicine at Saragossa (1875) and then, at his own request, Director of the Saragossa Museum (1879). In 1877 he obtained the degree of Doctor of Medicine at Madrid and in 1883 he was appointed Professor of Descriptive and General Anatomy at Valencia. In 1887 he was appointed Professor of Histology and Pathological Anatomy at Barcelona and in 1892 he was appointed to the same Chair at Madrid. In 1900-1901 he was appointed Director of the «Instituto Nacional de Higiene» and of the «Investigaciones Biológicas».  In 1880 he began to publish scientific works, of which the following are the most important: *Manual de Histología normal y Técnica micrográfica* (Manual of normal histology and micrographic technique), 1889 (2nd ed., 1893). A summary of this manual recast with additions, appeared under the title *Elementos de Histología, etc*. (Elements of histology, etc.), 1897; *Manual de* *Anatomía patológica general* (Manual of general pathological anatomy), 1890 (3rd ed., 1900). In addition may be cited: *Les nouvelles idées sur la fine anatomie des centres nerveux* (New ideas on the fine anatomy of the nerve centres), 1894; *Textura del sistema nervioso del hombre y de los vertebrados* (Textbook on the nervous system of man and the vertebrates), 1897-1899; *Die Retina* *der Wirbelthiere* (The retina of vertebrates), 1894.  Apart from these works Cajal has published more than 100 articles in French and Spanish scientific periodicals, especially on the fine structure of the nervous system and especially of the brain and spinal cord, but including also that of muscles and other tissues, and various subjects in the field of general pathology. These articles are dispersed in numerous Spanish journals and various specialized journals of other countries (especially French ones). Some articles in Spanish by Cajal and his pupils appear in the *Revista Trimestral de Histología normal y patológica* (Quarterly review of normal and pathological histology) (1888 onwards), continuation of them appeared under the title *Trabajos del Laboratorio de Investigaciones biologicas de la Universidad de Madrid* (Communications of the Laboratory for Biological Research, Madrid University).  Cajal’s studies on the structure of the cortex of the brain have been partly grouped together and translated into German by J. Bresler, 1900-1901.  Cajal is also the author of *Reglas y Consejos sobre Investigacion Cientifica* (Rules and advices on scientific investigation), which appeared in six Spanish editions and was translated into German (1933).  Among the distinctions won by Cajal are the following: Member of the Royal Academy of Sciences of Madrid (1895); of the Royal Academy of Medicine of Madrid (1897); of the Spanish Society of Natural History and of the Academy of Sciences of Lisbon (1897); Honorary Member of the Spanish Medical and Surgical Academy and also of several other Spanish societies.  He was also made honorary Doctor of Medicine of the Universities of Cambridge (1894) and Würzburg (1896) and Doctor of Philosophy of the Clark University (Worcester, U.S.A., 1899).  Cajal was a corresponding member of several societies: the Physical-Medical Society of Würzburg (1895); the Medical Society of Berlin (1895); the Society of Medical Sciences of Lisbon (1896); the Vienna Society for Psychiatry and Neurology (1896); the Society of Biology of Paris (1887); the National Medical Academy of Lima (1897); Conimbricensis Instituti Societas (Coimbra, 1898); and Member of Honour of the Italian Psychiatric Society (1896) as well as of the Medical Society of Ghent (Belgium, 1900). In 1906 he was elected an Associate Member of the Academy of Medicine, Paris; in 1916 he became a member of the Swedish Academy of Sciences. Cajàl has been awarded several prizes, for example the Rubio Prize of 1,000 pesetas for his previously mentioned *Elementos de Histología, etc*., the Fauvelle Prize of 1,500 francs of the Society of Biology of Paris (1896); the Moscow Prize of 5,000 francs, established by the Congress of Moscow (1897) to reward medical works which, published during the latter three years, have rendered the greatest services to science and humanity was awarded to Ramon y Cajàl by the International Congress of Medicine in Paris (1900). In 1905, the Royal Academy of Sciences of Berlin awarded him the Helmholtz Medal. He shared the Nobel Prize for 1906 with [Camillo Golgi](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1906/index.html) for their work on the structure of the nervous system.  Cajal was summoned to London to give there, in March 1904, the Croonian Lecture of the Royal Society and to the Clark University (Worcester, Mass., U.S.A.) in 1899 to give there three lectures on the structure of the human brain and on the latest researches on this subject. In 1952 a volume of 651 pages was published «In honour of S. Ramón y Cajal on the centenary of his birth 1852 by members of a research group in neurophysiology» at the Caroline Institute (*Acta Physiol. Scand*., Vol. 29, Suppl. 106).  In 1879 Cajal married Doña Silvería Fañanás García. They had four daughters and three sons.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  For more updated biographical information, see: Ramón y Cajal, Santiago, *Recollections of My Life*. MIT Press, Cambridge, Massachusetts, 1989.  *Santiago Ramón y Cajal died in Madrid on October 18, 1934.* |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0724 |
| Interview |  |
|  |  |
| ID | 0725 |
| Biographical | Robert Koch was born on December 11, 1843, at Clausthal in the Upper Harz Mountains. The son of a mining engineer, he astounded his parents at the age of five by telling them that he had, with the aid of the newspapers, taught himself to read, a feat which foreshadowed the intelligence and methodical persistence which were to be so characteristic of him in later life. He attended the local high school («Gymnasium») and there showed an interest in biology and, like his father, a strong urge to travel.  In 1862 Koch went to the University of Göttingen to study medicine. Here the Professor of Anatomy was Jacob Henle and Koch was, no doubt, influenced by Henle’s view, published in 1840, that infectious diseases were caused by living, parasitic organisms. After taking his M.D. degree in 1866, Koch went to Berlin for six months of chemical study and there came under the influence of Virchow. In 1867 he settled, after a period as Assistant in the General Hospital at Hamburg, in general practice, first at Langenhagen and soon after, in 1869, at Rackwitz, in the Province of Posen. Here he passed his District Medical Officer’s Examination. In 1870 he volunteered for service in the Franco-Prussian war and from 1872 to 1880 he was District Medical Officer for Wollstein. It was here that he carried out the epoch-making researches which placed him at one step in the front rank of scientific workers.  Anthrax was, at that time, prevalent among the farm animals in the Wollstein district and Koch, although he had no scientific equipment and was cut off entirely from libraries and contact with other scientific workers, embarked, in spite of the demands made on him by his busy practice, on a study of this disease. His laboratory was the 4-roomed flat that was his home, and his equipment, apart from the microscope given to him by his wife, he provided for himself. Earlier the anthrax bacillus had been discovered by Pollender, Rayer and Davaine, and Koch set himself to prove scientifically that this bacillus is, in fact, the cause of the disease. He inoculated mice, by means of home-made slivers of wood, with anthrax bacilli taken from the spleens of farm animals that had died of anthrax, and found that these mice were all killed by the bacilli, whereas mice inoculated at the same time with blood from the spleens of healthy animals did not suffer from the disease. This confirmed the work of others who had shown that the disease can be transmitted by means of the blood of animals suffering from anthrax.  But this did not satisfy Koch. He also wanted to know whether anthrax bacilli that had never been in contact with any kind of animal could cause the disease. To solve this problem he obtained pure cultures of the bacilli by growing them on the aqueous humour of the ox’s eye. By studying, drawing and photographing these cultures, Koch recorded the multiplication of the bacilli and noted that, when conditions are unfavourable to them, they produce inside themselves rounded spores which *can* resist adverse conditions, especially lack of oxygen and that, when suitable conditions of life are restored, the spores give rise to bacilli again. Koch grew the bacilli for several generations in these pure cultures and showed that, although they had had no contact with any kind of animal, they could still cause anthrax.  The results of this painstaking work were demonstrated by Koch to Ferdinand Cohn, Professor of Botany at the University of Breslau, who called a meeting of his colleagues to witness this demonstration, among whom was Professor Cohnheim, Professor of Pathological Anatomy. Both Cohn and Cohnheim were deeply impressed by Koch’s work and when Cohn, in 1876, published Koch’s work in the botanical journal of which he was the editor, Koch immediately became famous. He continued, nevertheless, to work at Wollstein for a further four years and during this period he improved his methods of fixing, staining and photographing bacteria and did further important work on the study of diseases caused by bacterial infections of wounds, publishing his results in 1878. In this work he provided, as he had done with anthrax, a practical and scientific basis for the control of these infections.  Koch was still, however, without adequate quarters or conditions for his work and it was not until 1880, when he was appointed a member of the «Reichs-Gesundheitsamt» (Imperial Health Bureau) in Berlin, that he was provided, first with a narrow, inadequate room, and later with a better laboratory, in which he could work with Loeffler, Gaffky and others, as his assistants. Here Koch continued to refine the bacteriological methods he had used in Wollstein. He invented new methods – «Reinkulturen» – of cultivating pure cultures of bacteria on solid media such as potato, and on agar kept in the special kind of flat dish invented by his colleague Petri, which is still in common use. He also developed new methods of staining bacteria which made them more easily visible and helped to identify them. The result of all this work was the introduction of methods by which pathogenic bacteria could be simply and easily obtained in pure culture, free from other organisms and by which they could be detected and identified. Koch also laid down the conditions, known as Koch’s postulates, which must be satisfied before it can be accepted that particular bacteria cause particular diseases.  Some two years after his arrival in Berlin Koch discovered the tubercle bacillus and also a method of growing it in pure culture. In 1882 he published his classical work on this bacillus. He was still busy with work on tuberculosis when he was sent, in 1883, to Egypt as Leader of the German Cholera Commission, to investigate an outbreak of cholera in that country. Here he discovered the vibrio that causes cholera and brought back pure cultures of it to Germany. He also studied cholera in India.  On the basis of his knowledge of the biology and mode of distribution of the cholera vibrio, Koch formulated rules for the control of epidemics of cholera which were approved by the Great Powers in Dresden in 1893 and formed the basis of the methods of control which are still used today. His work on cholera, for which a Prize of 100,000 German Marks was awarded to him, also had an important influence on plans for the conservation of water supplies.  In 1885 Koch was appointed Professor of Hygiene in the University of Berlin and Director of the newly established Institute of Hygiene in the University there. In 1890 he was appointed Surgeon General (Generalarzt) Class I and Freeman of the City of Berlin. In 1891 he became an Honorary Professor of the Medical Faculty of Berlin and Director of the new Institute for Infectious Diseases, where he was fortunate to have among his colleagues, such men as [Ehrlich](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1908/index.html), [von Behring](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1901/index.html) and Kitasato, who themselves made great discoveries.  During this period Koch returned to his work on tuberculosis. He sought to arrest the disease by means of a preparation, which he called tuberculin, made from cultures of tubercle bacilli. He made two preparations of this kind called the old and the new tuberculin respectively, and his first communication on the old tuberculin aroused considerable controversy. Unfortunately, the healing power that Koch claimed for this preparation was greatly exaggerated and, because hopes raised by it were not fulfilled, opinion went against it and against Koch. The new tuberculin was announced by Koch in 1896 and the curative value of this also was disappointing; but it led, nevertheless, to the discovery of substances of diagnostic value. While this work on tuberculin was going on, his colleagues at the Institute for Infectious Diseases, von Behring, Ehrlich and Kitasato, carried out and published their epoch-making work on the immunology of diphtheria (see the biographies of [Ehrlich](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1908/ehrlich-bio.html) and [von Behring](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1901/behring-bio.html)).  In 1896 Koch went to South Africa to study the origin of rinderpest and although he did not identify the cause of this disease, he succeeded in limiting the outbreak of it by injection into healthy farm-stock of bile taken from the gall bladders of infected animals. Then followed work in India and Africa on malaria, blackwater fever, surra of cattle and horses and plague, and the publication of his observations on these diseases in 1898. Soon after his return to Germany he was sent to Italy and the tropics where he confirmed the work of [Sir Ronald Ross](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1902/index.html) in malaria and did useful work on the aetiology of the different forms of malaria and their control with quinine.  It was during these later years of his life that Koch came to the conclusion that the bacilli that caused human and bovine tuberculosis are not identical and his statement of this view at the International Medical Congress on Tuberculosis in London in 1901 caused much controversy and opposition; but it is now known that Koch’s view was the right one. His work on typhus led to the idea, then a new one, that this disease is transmitted much more often from man to man than from drinking water and this led to new control measures.  In December, 1904, Koch was sent to German East Africa to study East Coast fever of cattle and he made important observations, not only on this disease, but also on pathogenic species of *Babesia* and *Trypanosoma* and on tickborne spirochaetosis, continuing his work on these organisms when he returned home.  Koch was the recipient of many prizes and medals, honorary doctorates of the Universities of Heidelberg and Bologna, honorary citizenships of Berlin, Wollstein and his native Clausthal, and honorary memberships of learned societies and academies in Berlin, Vienna, Posen, Perugia, Naples and New York. He was awarded the German Order of the Crown, the Grand Cross of the German Order of the Red Eagle (the first time this high distinction was awarded a medical man), and Orders from Russia and Turkey. Long after his death, he was posthumously honoured by memorials and in other ways in several countries.  In 1905 he was awarded the Nobel Prize for Physiology or Medicine. In 1906, he returned to Central Africa to work on the control of human trypanosomiasis, and there he reported that atoxyl is as effective against this disease as quinine is against malaria. Thereafter Koch continued his experimental work on bacteriology and serology.  In 1866 Koch married Emmy Fraats. She bore him his only child, Gertrud (b. 1865), who became the wife of Dr. E. Pfuhl. In 1893 Koch married Hedwig Freiberg.  Dr. Koch died on May 27, 1910, in Baden-Baden. |
| Autobiographical |  |
| Podcast |  |
| Telephone  interview | 0725 |
| Interview |  |
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| ID | 0726 |
| Biographical | Ivan Petrovich Pavlov was born on September 14, 1849 at Ryazan, where his father, Peter Dmitrievich Pavlov, was a village priest. He was educated first at the church school in Ryazan and then at the theological seminary there.  Inspired by the progressive ideas which D. I. Pisarev, the most eminent of the Russian literary critics of the 1860’s and I. M. Sechenov, the father of Russian physiology, were spreading, Pavlov abandoned his religious career and decided to devote his life to science. In 1870 he enrolled in the physics and mathematics faculty to take the course in natural science.  Pavlov became passionately absorbed with physiology, which in fact was to remain of such fundamental importance to him throughout his life. It was during this first course that he produced, in collaboration with another student, Afanasyev, his first learned treatise, a work on the physiology of the pancreatic nerves. This work was widely acclaimed and he was awarded a gold medal for it.  In 1875 Pavlov completed his course with an outstanding record and received the degree of Candidate of Natural Sciences. However, impelled by his overwhelming interest in physiology, he decided to continue his studies and proceeded to the Academy of Medical Surgery to take the third course there. He completed this in 1879 and was again awarded a gold medal. After a competitive examination, Pavlov won a fellowship at the Academy, and this together with his position as Director of the Physiological Laboratory at the clinic of the famous Russian clinician, S. P. Botkin, enabled him to continue his research work. In 1883 he presented his doctor’s thesis on the subject of «The centrifugal nerves of the heart». In this work he developed his idea of nervism, using as example the intensifying nerve of the heart which he had discovered, and furthermore laid down the basic principles on the trophic function of the nervous system. In this as well as in other works, resulting mainly from his research in the laboratory at the Botkin clinic, Pavlov showed that there existed a basic pattern in the reflex regulation of the activity of the circulatory organs.  In 1890 Pavlov was invited to organize and direct the Department of Physiology at the Institute of Experimental Medicine. Under his direction, which continued over a period of 45 years to the end of his life, this Institute became one of the most important centres of physiological research.  In 1890 Pavlov was appointed Professor of Pharmacology at the Military Medical Academy and five years later he was appointed to the then vacant Chair of Physiology, which he held till 1925.  It was at the Institute of Experimental Medicine in the years 1891-1900 that Pavlov did the bulk of his research on the physiology of digestion. It was here that he developed the surgical method of the «chronic» experiment with extensive use of fistulas, which enabled the functions of various organs to be observed continuously under relatively normal conditions. This discovery opened a new era in the development of physiology, for until then the principal method used had been that of «acute» vivisection, and the function of an organism had only been arrived at by a process of analysis. This meant that research into the functioning of any organ necessitated disruption of the normal interrelation between the organ and its environment. Such a method was inadequate as a means of determining how the functions of an organ were regulated or of discovering the laws governing the organism as a whole under normal conditions – problems which had hampered the development of all medical science. With his method of research, Pavlov opened the way for new advances in theoretical and practical medicine. With extreme clarity he showed that the nervous system played the dominant part in regulating the digestive process, and this discovery is in fact the basis of modern physiology of digestion. Pavlov made known the results of his research in this field, which is of great importance in practical medicine, in lectures which he delivered in 1895 and published under the title *Lektsii o rabote glavnykh pishchevaritelnyteh zhelez* (Lectures on the function of the principal digestive glands) (1897).  Pavlov’s research into the physiology of digestion led him logically to create a science of conditioned reflexes. In his study of the reflex regulation of the activity of the digestive glands, Pavlov paid special attention to the phenomenon of «psychic secretion», which is caused by food stimuli at a distance from the animal. By employing the method – developed by his colleague D. D. Glinskii in 1895 – of establishing fistulas in the ducts of the salivary glands, Pavlov was able to carry out experiments on the nature of these glands. A series of these experiments caused Pavlov to reject the subjective interpretation of «psychic» salivary secretion and, on the basis of Sechenov’s hypothesis that psychic activity was of a reflex nature, to conclude that even here a reflex – though not a permanent but a temporary or conditioned one – was involved.  This discovery of the function of conditioned reflexes made it possible to study all psychic activity objectively, instead of resorting to subjective methods as had hitherto been necessary; it was now possible to investigate by experimental means the most complex interrelations between an organism and its external environment.  In 1903, at the 14th International Medical Congress in Madrid, Pavlov read a paper on «The Experimental Psychology and Psychopathology of Animals». In this paper the definition of conditioned and other reflexes was given and it was shown that a conditioned reflex should be regarded as an elementary psychological phenomenon, which at the same time is a physiological one. It followed from this that the conditioned reflex was a clue to the mechanism of the most highly developed forms of reaction in animals and humans to their environment and it made an objective study of their psychic activity possible.  Subsequently, in a systematic programme of research, Pavlov transformed Sechenov’s theoretical attempt to discover the reflex mechanisms of psychic activity into an experimentally proven theory of conditioned reflexes.  As guiding principles of materialistic teaching on the laws governing the activity of living organisms, Pavlov deduced three principles for the theory of reflexes: the principle of determinism, the principle of analysis and synthesis, and the principle of structure.  The development of these principles by Pavlov and his school helped greatly towards the building-up of a scientific theory of medicine and towards the discovery of laws governing the functioning of the organism as a whole.  Experiments carried out by Pavlov and his pupils showed that conditioned reflexes originate in the cerebral cortex, which acts as the «prime distributor and organizer of all activity of the organism» and which is responsible for the very delicate equilibrium of an animal with its environment. In 1905 it was established that any external agent could, by coinciding in time with an ordinary reflex, become the conditioned signal for the formation of a new conditioned reflex. In connection with the discovery of this general postulate Pavlov proceeded to investigate «artificial conditioned reflexes». Research in Pavlov’s laboratories over a number of years revealed for the first time the basic laws governing the functioning of the cortex of the great hemispheres. Many physiologists were drawn to the problem of developing Pavlov’s basic laws governing the activity of the cerebrum. As a result of all this research there emerged an integrated Pavlovian theory on higher nervous activity.  Even in the early stages of his research Pavlov received world acclaim and recognition. In 1901 he was elected a corresponding member of the Russian Academy of Sciences, in 1904 he was awarded a Nobel Prize, and in 1907 he was elected Academician of the Russian Academy of Sciences; in 1912 he was given an honorary doctorate at Cambridge University and in the following years honorary membership of various scientific societies abroad. Finally, upon the recommendation of the Medical Academy of Paris, he was awarded the Order of the Legion of Honour (1915).  After the October Revolution, a special government decree, signed by Lenin on January 24, 1921, noted «the outstanding scientific services of Academician I.P.Pavlov, which are of enormous significance to the working class of the whole world».  The Communist Party and the Soviet Government saw to it that Pavlov and his collaborators were given unlimited scope for scientific research. The Soviet Union became a prominent centre for the study of physiology, and the fact that the 15th International Physiological Congress of August 9-17, 1935, was held in Leningrad and Moscow clearly shows that it was acknowledged as such.  Pavlov directed all his indefatigable energy towards scientific reforms. He devoted much effort to transforming the physiological institutions headed by him into world centres of scientific knowledge, and it is generally acknowledged that he succeeded in this endeavour.  Pavlov nurtured a great school of physiologists, which produced many distinguished pupils. He left the richest scientific legacy – a brilliant group of pupils, who would continue developing the ideas of their master, and a host of followers all over the world.  In 1881, Pavlov married Seraphima (Sara) Vasilievna Karchevskaya, a teacher, the daughter of a doctor in the Black Sea fleet. She first had a miscarriage, said to be due to her having to run after her very fast-walking husband. Subsequently they had a son, Wirchik, who died very suddenly as a child; three sons, Vladimir, Victor and Vsevolod, one of whom was a well-known physicist and professor of physics at Leningrad in 1925, and a daughter, Vera.  Dr. Pavlov died in Leningrad on February 27, 1936.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
| Autobiographical |  |
| Podcast |  |
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| Interview |  |
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| ID | 0727 |
| Biographical | Niels Ryberg Finsen was born on December 15, 1860, at Thorshavn in the Faroe Islands. His father, Hannes Steingrim Finsen, belonged to an Icelandic family with traditions reaching back to the 10th century, and occupied prominent (from 1871 the highest) positions in the administration of the Faroe Islands. The mother, Johanne Formann, was born in Falster, Denmark. The boy received his early education in schools at Thorshavn and then at Herlufsholm in Denmark. Here the Rector declared that «Niels was a very nice boy, but his gifts were small and he was quite devoid of energy». This may have been due to fagging for older pupils, for when the boy was moved to a school at Reykjavik, Iceland, in 1876, he succeeded much better in spite of the fact that he did not initially know the language.  In 1882 Finsen went to Copenhagen to study medicine, taking his final examination in 1890. The same year he also became prosector of anatomy at the University of Copenhagen, a post he left in 1893 in order to be able to devote more time to his scientific work. He still went on with private tutoring of medical students, thus gaining a very moderate income for his living.  Already from 1883 and probably several years earlier he suffered from an illness which turned out to be Pick’s disease and is characterized by progressive thickening of the connective tissue of certain membranes in the liver, the heart and the spleen. This results in impairment of the functions of these organs. As time went on, symptoms of heart trouble developed in addition to the general weakness and ascites, so that Finsen became more and more of an invalid. His last years had to be spent in a wheel-chair and his ascites had to be tapped no less than 18 times – often as much as 6 litres of fluid were withdrawn. That he in spite of this was able to make his remarkable contributions to medicine tells of a strong will and great energy.  He has himself given the following short description of his work.  «My disease has played a very great role for my whole development… The disease was responsible for my starting investigations on light: I suffered from anaemia and tiredness, and since I lived in a house facing the north, I began to believe that I might be helped if I received more sun. I therefore spent as much time as possible in its rays. As an enthusiastic medical man I was of course interested to know *what benefit* the sun really gave. I considered it from the physiological point of view but got no answer. I drew the conclusion that I was right and the physiology wrong. From this time (about 1888) I collected all possible observations about animals seeking the sun, and my conviction that the sun had a useful and important effect on the organism (especially the blood?) became stronger and stronger. What this useful effect really was, I could not find; I have been working for this goal ever since but have not been able to find exactly what I have been seeking, though we have gone somewhat forward.  My intention was even then (about 15 years ago) to use the beneficial effects of the sun in the form of sun bathing or artificial light baths; but I understood that it would be inappropriate to bring it into practical use if the theory was not built upon scientific investigations and definite facts.  During my work towards this goal I encountered several effects of light. I then devised the treatment of small-pox in red light (1893) and further the treatment of lupus (1895). Both these things are therefore in a sense side-issues, but they completely occupied my time for several years and have partly drawn me away from my main goal.  During the last few years, I have, however, become convinced that it does not help to wait until I find the answer I am looking for in the laboratory, but that it is justified to work *also* with clinical experiments. Thus both approaches can be carried out simultaneously in the effort to reach the final goal.»  In beautiful but simple experiments Finsen demonstrated that the most refractive rays from the sun («the chemical rays») or from an electric arc may have a stimulating effect on the tissues. If the irradiation is too strong, however, it may give rise to tissue damage, but this may to some extent be prevented by pigmentation of the skin as in the negro or in those much exposed to the sun. In small-pox Finsen thought that the multiple scars might be avoided if the patient was protected from the chemical rays. The experiments with such patients were successful. On the other hand chemical rays free from heat rays might be used to obtain a useful effect either by concentration on particular area – and this led to the treatment of *lupus vulgaris* or other skin diseases – or employed as general sun-baths, which on Finsen’s suggestion was tried in cases of tuberculosis. The results were promising but as a rule the northern climate was not well suited for such therapy. As is well known, this kind of treatment has been found to be excellent in places where the sun is rich in chemical rays, e.g. in the Alps where the absorption of these rays by the atmosphere is rather small. The treatment of surgical tuberculosis in this way by O. Bernhard and A. Rollier at high elevations in Switzerland has been specially successful.  Finsen himself proved very convincingly that the concentrated chemical rays may exercise very beneficial effects in the disfiguring disease *lupus vulgaris*. This is due to a bactericidal as well as a general stimulating effect on the tissues. He has developed the technique by numerous practical methods, and the Finsen Institute was erected in Copenhagen as early as 1896, being enlarged some years later due to the generosity of two Danish donors, Mr. Hageman and Mr. Jörgensen, and the Danish Government. It has served as the model for numerous similar institutes in different parts of the world, and together they have greatly reduced the number of cases of lupus.  Finsen’s work contained a definite and important recent discovery and was therefore well qualified for a Nobel Prize. Moreover he was still a young man. Of course it was known that his health was not good, but it was obviously thought that the Prize might be of considerable importance. This was soon found to be the case. When Finsen, on October 17, 1903, received the letter with the announcement of the decision, his first words were: «Well, thus it has now been established that the thing is Danish». When the usual Nobel festivities took place at Stockholm on December 10, 1903, he himself was sitting at his home in his wheel-chair receiving congratulations from his personnel and from numerous friends. He then made it known that he would donate 50,000 crowns of the Prize to the Institute and another 60,000 crowns to a sanatorium for heart and liver diseases which had also been founded by him. One immediate consequence was that each of his two main donors gave 50,000 crowns to the Finsen Institute. Thus in spite of Finsen’s failing health his ideas were spread still further and his creation – the Institute – was helped.  Among the many publications by Finsen *Om Lysets Indvirkninger paa Huden* (On the effects of light on the skin) appeared in 1893 and the classical treatise Om Anvendelse i Medicinen af koncentrerede kemiske Lysstraaler (The use of concentrated chemical light rays in medicine) in 1896. This and other papers were published in German in 1899, and *La Photothérapie* appeared in French the same year. The results of many of his researches are contained in the communications published by his Institute. Finsen tried to counteract the symptoms of his illness in various ways, and during his last years he kept to a diet poor in salt. This led to his last publication, a thorough study of *En Ophobning af Salt i Organismen* (An accumulation of salt in the organism) in 1904.  Finsen received the title of Professor in 1898, and in 1899 he became Knight of the Order of Dannebrog, to which a few years later the Silver Cross was added. He was member or honorary member of numerous societies in Scandinavia, in Iceland, Russia, Germany etc. He received a Danish gold medal for merit, and in 1904 the Cameron Prize was given him from the University of Edinburgh.  In 1892 Finsen married Ingeborg Balslev (b. 1868), daughter of the bishop Balslev at Ribe. They had four children, of which the eldest boy died the day after he was born. The second son, Halldor (b. 1896 ) became a physician. One daughter, Gudrun (b. 1900) married Professor S. Lomholt, who was for many years head of the Department of Skin Diseases of the Finsen Institute and is the author of a charming biography of his father-in-law. The youngest daughter, Valgerda (b. 1903 ), also married.  Dr. Finsen died on September 24, 1904.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above. |
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| Biographical | Ronald Ross was born on May 13, 1857, as the son of Sir C.C.G. Ross, a General in the English army. He commenced the study of medicine at St. Bartholomew’s Hospital in London in 1875; entered the Indian Medical Service in 1881. He commenced the study of malaria in 1892. In 1894 he determined to make an experimental investigation in India of the hypothesis of Laveran and Manson that mosquitoes are connected with the propagation of the disease. After two and a half years’ failure, Ross succeeded in demonstrating the life-cycle of the parasites of malaria in mosquitoes, thus establishing the hypothesis of Laveran and Manson. In 1899 he joined the Liverpool School of Tropical Medicine under the direction of Sir Alfred Jones. He was immediately sent to West Africa to continue his investigations, and there he found the species of mosquitoes which convey the deadly African fever. Since then the School has been unremitting in its efforts to improve health, and especially to reduce the malaria in West Africa. Ross’ researches have been confirmed and assisted by many distinguished authorities, especially by [Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html), Daniels, Bignami, Celli, Christophers, Stephens, Annett, Austen, Ruge, Ziemann, and many others.  In 1901 Ross was elected a Fellow of the Royal College of Surgeons of England and also a Fellow of the Royal Society, of which he became Vice-President from 1911 to 1913. In 1902 he was appointed a Companion of the Most Honourable Order of Bath by His Majesty the King of Great Britain. In 1911 he was elevated to the rank of Knight Commander of the same Order. In Belgium, he was made an Officer in the Order of Leopold II.  In 1902 a movement was set on foot to commemorate the valuable services rendered to the School of Tropical Medicine by its originator and Chairman, Sir Alfred Jones, by founding a Chair of Tropical Medicine in University College to be connected with the School. The movement was met with enthusiastic support, and an amount of money was quickly collected sufficient to found «Sir Alfred Jones’ Chair of Tropical Medicine». Ross was appointed to the Professorship in 1902 and retained the Chair until 1912, when he left Liverpool, and was appointed Physician for Tropical Diseases at Kings College Hospital, London, a post which he held together with the Chair of Tropical Sanitation in Liverpool. He remained in these posts until 1917, when he was appointed Consultant in Malariology to the War Office, his service in this capacity, and in special connection with epidemic malaria then occurring on combatant troops, being recognized by his elevation to the rank of Knight Commander, St. Michael and St. George, in 1918. He was later appointed Consultant in Malaria to the Ministry of Pensions. In 1926 he assumed the post of Director in Chief of the Ross Institute and Hospital of Tropical Diseases and Hygiene, which had been created by admirers of his work, and he remained in this position until his death. He was also a President of the Society of Tropical Medicine. His Memoirs (London, 1923) were «inscribed to the people of Sweden and the memory of Alfred Nobel».  During this active career, Ross’ interest lay mainly in the initiation of measures for the prevention of malaria in different countries of the world. He carried out surveys and initiated schemes in many places, including West Africa, the Suez Canal zone, Greece, Mauritius, Cyprus, and in the areas affected by the 1914-1918 war. He also initiated organizations, which have proved to be well established, for the prevention of malaria within the planting industries of India and Ceylon. He made many contributions to the epidemiology of malaria and to methods of its survey and assessment, but perhaps his greatest was the development of mathematical models for the study of its epidemiology, initiated in his report on Mauritius in 1908, elaborated in his *Prevention of Malaria* in 1911 and further elaborated in a more generalized form in scientific papers published by the Royal Society in 1915 and 1916. These papers represented a profound mathematical interest which was not confined to epidemiology, but led him to make material contributions to both pure and applied mathematics. Those related to «pathometry» are best known and, 40 years later, constitute the basis of much of the epidemiological understanding of insect-borne diseases.  Through these works Ross continued his great contribution in the form of the discovery of the transmission of malaria by the mosquito, but he also found time and mental energy for many other pursuits, being poet, playwright, writer and painter. Particularly, his poetic works gained him wide acclamation which was independent of his medical and mathematical standing.  He received many honours in addition to the Nobel Prize, and was given Honorary Membership of learned societies of most countries of Europe, and of many other continents. He got an honorary M.D. degree in Stockholm in 1910 at the centenary celebration of the Caroline Institute. Whilst his vivacity and single-minded search for truth caused friction with some people, he enjoyed a vast circle of friends in Europe, Asia and America who respected him for his personality as well as for his genius.  Ross married Rosa Bessie Bloxam in 1889. They had two sons, Ronald and Charles, and two daughters, Dorothy and Sylvia. His wife died in 1931, Ross survived her until a year later, when he died after a long illness, at the Ross Institute, London, on September 16, 1932.  From [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html)*, Physiology or Medicine 1901-1921*, Elsevier Publishing Company, Amsterdam, 1967  This autobiography/biography was written at the time of the award and first published in the book series [*Les Prix Nobel*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lesprix.html). It was later edited and republished in [*Nobel Lectures*](https://www.nobelprize.org/nobel_organizations/nobelfoundation/publications/lectures/index.html). To cite this document, always state the source as shown above.  For more updated biographical information, see: Ross, Ronald, *Memoirs*. John Murray, London, 1923. |
| Autobiographical |  |
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| ID | 0729 |
| Biographical | Emil Adolf Behring was born on March 15, 1854 at Hansdorf, Deutsch-Eylau as the eldest son of the second marriage of a schoolmaster with a total of 13 children. Since the family could not afford to keep Emil at a University, he entered, in 1874, the well-known Army Medical College at Berlin. This made his studies financially practicable but also carried the obligation to stay in military service for several years after he had taken his medical degree (1878) and passed his State Examination (1880). He was then sent to Wohlau and Posen in Poland. Besides much practical work he found in Posen time to study (at the Chemical Department of the Experimental Station) problems connected with septic diseases. In the years 1881-1883 he carried out important investigations on the action of iodoform, stating that it does not kill microbes but may neutralize the poisons given off by them, thus being antitoxic. His first publications on these questions appeared in 1882. The governing body concerned with military health, which was especially interested in the prevention and combating of epidemics, being aware of the ability of Behring, sent him to the pharmacologist C. Binz at Bonn for further training in experimental methods. In 1888 they ordered him back to Berlin, where he worked-undoubtedly in full agreement with his own wishes – as an assistant at the Institute of Hygiene under Robert Koch. He remained there for several years after 1889, and followed Koch when the latter moved to the Institute for Infectious Diseases. This appointment brought him into close association, not only with Koch, but also with P. Ehrlich, who joined, in 1890, the brilliant team of workers Koch had gathered round him. In 1894 Behring became Professor of Hygiene at Halle, and the following year he moved to the corresponding chair at Marburg.  Behring’s most important researches were intimately bound up with the epoch-making work of Pasteur, [Koch](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1905/index.html), [Ehrlich](https://www.nobelprize.org/nobel_prizes/medicine/laureates/1908/index.html), Löffler, Roux, Yersin and others, which led the foundation of our modern knowledge of the immunology of bacterial diseases; but he is, himself, chiefly remembered for his work on diphtheria and on tuberculosis. During the years 1888-1890 E. Roux and A. Yersin, working at the Pasteur Institute in Paris, had shown that filtrates of diphtheria cultures which contained no bacilli, contained a substance which they called a *toxin*, that produced, when injected into animals, all the symptoms of diphtheria. In 1890, L. Brieger and C. Fraenkel prepared, from cultures of diphtheria bacilli, a toxic substance, which they called *toxalbumin*, which when injected in suitable doses into guinea-pigs, immunized these animals to diphtheria.  Starting from his observations on the action of iodoform, Behring tried to find whether a disinfection of the living organism might be obtained if animals were injected with material that had been treated with various disinfectants. Above all the experiments were performed with diphtheria and with tetanus bacilli. They led to the well-known development of a new kind of therapy for these two diseases. In 1890 Behring and S. Kitasato published their discovery that graduated doses of sterilised brothcultures of diphtheria or of tetanus bacilli caused the animals to produce, in their blood, substances which could neutralize the toxins which these bacilli produced *(antitoxins)*. They also showed that the antitoxins thus produced by one animal could immunize another animal and that it could cure an animal actually showing symptoms of diphtheria. This great discovery was soon confirmed and successfully used by other workers.  Earlier in 1898, Behring and F. Wernicke had found that immunity to diphtheria could be produced by the injection into animals of diphtheria toxin neutralized by diphtheria antitoxin, and in 1907 Theobald Smith had suggested that such toxin-antitoxin mixtures might be used to immunize man against this disease. It was Behring, however, who announced, in 1913, his production of a mixture of this kind, and subsequent work which modified and refined the mixture originally produced by Behring resulted in the modern methods of immunization which have largely banished diphtheria from the scourges of mankind. Behring himself saw in his production of this toxin-antitoxin mixture the possibility of the final eradication of diphtheria; and he regarded this part of his efforts as the crowning success of his life’s work.  From 1901 onwards Behring’s health prevented him from giving regular lectures and he devoted himself chiefly to the study of tuberculosis. To facilitate his work a commercial firm in which he had a financial interest, built for him well-equipped laboratories at Marburg and in 1914 he himself founded, also in Marburg, the Behringwerke for the manufacture of sera and vaccines and for experimental work on these. His association with the production of sera and vaccines made him financially prosperous and he owned a large estate at Marburg, which was well stocked with cattle which he used for experimental purposes.  The great majority of Behring’s numerous publications have been made easily available in the editions of his *Gesammelte Abhandlungen* (Collected Papers) in 1893 and 1915.  Numerous distinctions were conferred upon Behring. Already in 1893 the title of Professor was conferred upon him, and two years later he became «Geheimer Medizinalrat» and officer of the French Legion of Honour. In the ensuing years followed honorary membership of Societies in Italy, Turkey and France; in 1901, the year of his Nobel Prize, he was raised to the nobility, and in 1903 he was elected to the Privy Council with the title of Excellency. Later followed further honorary memberships in Hungary and Russia, as well as orders and medals from Germany, Turkey and Roumania. He also became an honorary freeman (Ehrenbürger) of Marburg.  In 1896 Behring married the 20 years old Else Spinola, daughter of the Director of the Charité at Berlin. They had six sons. Behring died at Marburg on March 31, 1917. |
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