PONTIFICIA ACADEMIA
SCIENTIARVM

YEARBOOK
2004

VATICAN CITY

THE PONTIFICAL ACADEMY OF SCIENCES

Yearbook 2004

Vatican City

'*Truth, freedom and responsibility are connected in the experience of the scientist*. In setting out on his path of research, he understands that he must tread not only with the impartiality required by the objectivity of his method but also with the intellectual honesty, the responsibility, and I would say with a kind of "reverence", which befit the human spirit in its drawing near to truth. For the scientist, to understand in an ever better way the particular reality of man in relation to the biological-physical processes of nature, to discover always new aspects of the cosmos, to know more about the location and the distribution of resources, the social and environmental dynamics, and the logic of progress and development, becomes translated into a duty *to serve more fully the whole of mankind*, to which he belongs. For this reason, the ethical and moral responsibilities connected to scientific research can be perceived as a requirement within science, because it is a fully human activity, but not as control, or worse, as an imposition which comes from outside. The man of science knows perfectly, from the point of view of his knowledge, that truth cannot be subject to negotiation, cannot be obscured or abandoned to free conventions or agreements between groups of power, societies, or States. Therefore, because of the ideal of service to truth, he feels a special responsibility in relation to the advancement of mankind, not understood in generic or ideal terms, but as the advancement of the whole man and of everything that is authentically human'.

Address of the Holy Father John Paul II
on the Occasion of the Jubilee Plenary Session
of the Pontifical Academy of Sciences, 13 November 2000.

Joannes Paulus PP. II

CASINA PIO IV – VATICAN GARDENS
Headquarters of the Pontifical Academy of Sciences

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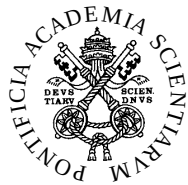

VATICAN CITY 2004

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FOREWORD

It is a great honour for me, as Chancellor of the Pontifical Academy of Sciences, to present this new Yearbook of our Academy to the Supreme Pontiff, the Catholic Church and other Churches, and the world of science and learning. This volume offers a photograph, a brief biography, a summary of scientific research, and a short list of publications of each Academician, as well as a variety of informative statistics. As can be seen from a perusal of the pages of this Yearbook, the Academy is fully loyal to the ends set out in its statutes, namely to achieve a representation within its ranks of the various branches of science and of the great regions of the world. The inter-disciplinary and international dialogue that this reality allows on the topical and pressing subjects of contemporary science may be adjudged a most valuable and perhaps unique source of fertile advance. The activity of the Pontifical Academy of Sciences, for this reason, seeks to constitute a significant contribution to the progress of man at both a scientific and ethical level. We have to recognise that during the last century man achieved greater progress, if not in relation to knowledge about himself certainly in relation to knowledge about the macrocosm and the microcosm, than was the case throughout the whole of the rest of the history of mankind. The happy insight of Pope Clement VII, who in founding the Academy of the Lynxes in 1603 – continued by Pope Pius XI with his refoundation of the Academy in the form of the Pontifical Academy of Sciences in 1936 – sought to establish a scientific 'Senate' within the Holy See, seems today more than ever of contemporary relevance during this epoch of ours which has been defined by many as the epoch of science.

Of course, all the activities of the Academy would not be possible without the vital help of the Holy Father who has always followed its initiatives and deliberations with great care and interest, providing both keen moral support, as well as important funding and the magnificent buildings of the Academy (recently restored). A profound debt of gratitude must therefore be expressed to His Holiness John Paul II for his benevolence and guidance. I would also like to extend my thanks to the President, Prof. Nicola Cabbibo, the members of the Council, and all the Academicians, who, through their participation, make possible the life of the Academy.

Marcelo Sánchez Sorondo,
Bishop-Chancellor of the Pontifical Academy of Sciences

PAS OBJECTIVES

– Promoting the progress of the mathematical, physical and natural sciences, and the study of related epistemological questions and issues
– Recognising excellence in science
– Stimulating an interdisciplinary approach to scientific knowledge
– Encouraging international interaction
– Furthering participation in the benefits of science and technology by the greatest number of people and peoples
– Promoting education and the public's understanding of science
– Ensuring that science works to advance of the human and moral dimension of man
– Achieving a role for science which involves the promotion of justice, development, solidarity, peace, and the resolution of conflict
– Fostering interaction between faith and reason and encouraging dialogue between science and spiritual, cultural, philosophical and religious values
– Providing authoritative advice on scientific and technological matters
– Cooperating with the members of other Academies in a friendly spirit to promote such objectives.

HISTORICAL PROFILE

The Academy was founded in Rome on 17 August 1603 by Federico Cesi, Giovanni Heck, Francesco Stelluti and Anastasio de Filiis with the name 'Linceorum Academia'. After various vicissitudes it was refounded in 1847 by Pius IX with the name 'Pontificia Accademia dei Nuovi Lincei'. It was then enlarged in 1887 by Leo XIII; provided with its new headquarters of Casina Pio IV in the Vatican Gardens in 1922; and refounded again with new statutes by the Motu Proprio *In Multis Solaciis* of 28 October 1936 of Pius XI, who gave it the new name of 'Pontificia Academia Scientiarum'.

The Pontifical Academy of Sciences directly depends on the Supreme Pontiff and is made up of eighty 'Pontifical Academicians' who are such by sovereign appointment. They are proposed by the Academic Body and chosen without any form of discrimination from the most eminent scientists and scholars of the mathematical and experimental sciences of every country of the world.

The Pontifical Academy of Sciences is at the present time unique in its kind because it is the only Academy of Sciences which is supranational in character and belongs to a category that is unique in the world.

Its purpose is to honour pure science wherever it may be found, ensure its freedom, and favour its research, which are the indispensable bases for the progress of science.

The eighty 'Pontifical Academicians' are joined by the Academicians 'Perdurante Munere' who are such because of their office, and by the 'Honorary Academicians' who are such because of the services they have rendered to the Academy.

By his Apostolic 'Breve' of 25 November 1940 Pius XII granted to the 'Pontifical Academicians' the title of 'Excellency'.

By his Apostolic 'Breve' of 3 March 1961 John XXIII extended the title of 'Excellency' to the Honorary Academicians, and in addition in 1961 established the 'Pius XI Medal' to be awarded to young scientists for their notable contributions to duly recognised scientific research (Art. 4 of the Statutes).

THE PRESIDENT, CHANCELLOR AND COUNCIL OF THE ACADEMY

President of the Academy
Prof. Nicola CABIBBO, appointed 30 March 1993
(presently in his third term)

Chancellor
H.E. Msgr. Marcelo SÁNCHEZ SORONDO, appointed 5 October 1998

Members of the Council
Prof. Werner ARBER
Prof. Günter BLOBEL
Prof. Nicola CABIBBO
Rev. Prof. George V. COYNE, S.J.
Prof. Paul J. CRUTZEN
Prof. Paul GERMAIN
Prof. Vladimir I. KEILIS-BOROK
Prof. Nicole M. LE DOUARIN
H.E. Msgr. Prof. Marcelo SÁNCHEZ SORONDO

THE PRESIDENTS, CHANCELLORS AND MEMBERS OF THE COUNCIL 1936-2004

Presidents

Rev. Agostino GEMELLI, O.F.M. (28 October 1936 – 15 July 1959)
Msgr. Georges LEMAÎTRE (19 March 1960 – 20 June 1966)
Rev. Daniel J.K. O'CONNELL, S.J. (15 January 1968 – 15 January 1972)
Prof. Carlos CHAGAS (9 November 1972 – 30 October 1988)
Prof. Giovanni Battista MARINI-BETTÒLO (31 October 1988 – 29 March 1993)
Prof. Nicola CABIBBO (30 March 1993–)

Chancellors and Directors

Prof. Dr. Pietro SALVIUCCI Chancellor (28 October 1936 – 31 December 1973)
Rev. Carlo Enrico di ROVASENDA, O.P., Vice-Director (16 November 1972); Director (3 April 1974 – 31 December 1986)
Msgr. Eng. Renato DARDOZZI, Vice-Director (5 July 1985); Director of the Chancellery (1 January 1987); Chancellor (30 January 1995 – 30 June 1997)
H.E. Msgr. Giuseppe PITTAU, S.J., Chancellor (1 July 1997 – 4 October 1998)
H.E. Msgr. Marcelo SÁNCHEZ SORONDO Chancellor (5 October 1998–)

Members of the Council of the Academy

ARMELLINI G. 1936-1940; 1944-1948
LEPRI G. 1936-1941; 1944-1948
ALBAREDA A.M. 1936-1962
BIANCHI E. 1936-1940
BOTTAZZI F. 1936-1941
AMALDI U. 1941-1944
GIORDANI F. 1941-1961
LOMBARDI L. 1941-1954
SEVERI F. 1944-1961

QUAGLIARIELLO G. 1944-1957
BOLDRINI M. 1958-1969
BONINO G.B. 1958-1980
CROCCO G.A. 1958-1965
PISTOLESI E. 1958-1968
O'CONNELL D.J. 1962-1982
BRÜCK H.A. 1964-1986
LEPRINCE-RINGUET L. 1964-1968; 1980-1988
DE BROGLIE L. 1969-1980
MARINI-BETTÒLO G.B. 1969-1996
TUPPY H. 1974-1988
PUPPI G. 1980-1988; 1993-1999
COYNE G.V. 1986-
CHAGAS C. 1988-1992
BLANC-LAPIERRE A. 1989-1992
ŁOJASIEWICZ S. 1989-1992
DALLAPORTA N. 1991-1998
DE GIORGI E. 1991-1996
LEJEUNE J. 1993-1994
PULLMAN B. 1994-1996
DARDOZZI R. 1995-1997
KEILIS-BOROK V.I. 1995-
RUNCORN S.K. 1995
ARBER W. 1996-
ESCHENMOSER A. 1996-2000
PITTAU G. 1997-1998
SÁNCHEZ SORONDO M. 1998-
CAFFARELLI L.A. 1999-2002
GERMAIN P. 1999-
CRUTZEN P.J. 2001-
LE DOUARIN N.M. 2001-
BLOBEL G. 2003-

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Werner Arber

Date and place of birth: 3 June 1929, Gränichen, Switzerland
Wife and children: Antonia; Silvia and Caroline
Appointment to the Academy: 12 May 1981
Scientific discipline: Microbiology
Academic title: Professor at the University of Basel

Most important awards, prizes and academies Nobel Prize in Physiology or Medicine (1978). Academies: European Molecular Biology Organization (1964); European Academy of Arts, Sciences and Humanities (1981); Foreign Associate of the National Academy of Sciences, USA (1984); Foreign Honorary Member of the American Academy of Arts and Sciences (1984); Academia Europaea (1989); Fellow of the American Academy of Microbiology (1996); Associate Fellow of the Third World Academy of Sciences (TWAS) (1997); President of the International Council of Scientific Unions (ICSU) (1996-1999).

Summary of scientific research W. Arber's main scientific interests are the mechanisms which promote and which limit the spontaneous variation of genetic information in micro-organisms. In his doctoral dissertation he explained that rare, spontaneous derivatives of the bacterial virus λ have a part of the viral DNA substituted by a segment from the chromosome of the host bacteria. The concept of these hybrid transducing viruses later served others as a model for the design of cloning vectors in recombinant DNA technology. Beginning in 1960, W. Arber explored the molecular basis of host-controlled modification of bacterial viruses. This led to the discovery that this phenomenon acts at the DNA level. Specific enzymes, now known as restriction endonucleases, serve in many bacterial strains to recognise foreign DNA upon its entry and they subsequently inactivate this DNA by cleavage. An associated DNA methylase protects the cellular DNA from restriction cleavage. Restriction and modification systems thus represent barriers limiting the exchange of genetic

material between different micro-organisms, thereby improving genetic stability. Soon after their isolation, restriction enzymes proved to be extremely useful tools for molecular genetic studies, since they provide specific fragmentation of the long DNA filaments, a prerequisite for detailed structural and functional analysis. W. Arber has also intensively studied enzyme-directed processes in the structural rearrangement of genetic material, in particular transposition and site-specific recombination. These processes lead to the recombination of non-homologous DNA and thus can bring about new gene functions by fusion of previously independent DNA segments. They represent part of the mechanisms responsible for spontaneous mutagenesis and they are important agents in both vertical and horizontal evolution. On the basis of his long-term experience and taking into account knowledge accumulated over the past fifty years on molecular mechanisms of mutagenesis and of different kinds of recombination of genetic information, particularly in micro-organisms, W. Arber has postulated a theory of molecular evolution, according to which the products of evolution genes carried in the genome are involved either in the generation or in the limitation of genetic variation, without, however, implying a specific direction to biological evolution. Rather, the course of biological evolution results from the casual action of the products of evolution genes on DNA, from the conformational flexibility of the structures of biologically active molecules, from the largely stochastic nature of any interaction affecting genetic stability, and from chance environmental influences, whereby the steadily exerted natural selection limits diversity according to the temporal fitness of the organisms involved. In brief, a multitude of specific molecular mechanisms contribute to overall spontaneous genetic variation. These specific mechanisms can be classified into three major natural strategies of genetic variation, namely, small local changes in the nucleotide sequences, intragenomic rearrangement of DNA segments, and acquisition of a segment of foreign DNA by horizontal gene transfer. These strategies differ in the quality of their contributions to genetic variation and thus to biological evolution. The postulate that the products of specific evolution genes together with intrinsic properties of matter are at the origin of genetic variation which drives biological evolution has interesting philosophical implications. Nature cares actively for biological evolution. The juxtaposition of evolution genes and of the more classical genes acting to the benefit of individual lives implies an intrinsic duality of the genome. These aspects have been discussed by W. Arber in some of his recent publications, as well as the relevance of the acquired knowledge on spontaneous genetic variation for the evaluation of conjectural risks of genetic engineering.

Main publications Arber, W., Kellenberger, G. and Weigle, J.J., 'The defectiveness of lambda transducing phage' in *Papers on bacterial genetics* selected by E.A. Adelberg, Little, Brown and Co., Boston-Toronto, pp. 224-229 (1960); Arber, W. and Dussoix, D., 'Host specificity of DNA produced by Escherichia coli. 1. Host controlled modification of bacteriophage lambda', *J. Mol. Biol.*, 5, pp. 18-36 (1962); Dussoix, D. and Arber, W., 'Host specificity of DNA produced by Escherichia coli. 2. Control over acceptance of DNA from infecting phage lambda', *J. Mol. Biol.*, 5, pp. 37-49 (1962); Arber, W. and Linn, S., 'DNA modification and restriction', *Ann. Rev. Biochem.*, 38, pp. 467-500 (1969); Smith, J.D., Arber, W. and Kuehnlein, U., 'Host specificity of DNA produced by Escherichia coli. 14. The role of nucleotide methylation in in vivo B-specific modification', *J. Mol. Biol.*, 63, pp. 1-8 (1972); Arber, W., Iida, S., Juette, H., Caspers, P., Meyer, J. and Haenni, C., 'Rearrangements of genetic material in Escherichia coli as observed on the bacteriophage Pl plasmid', *Cold Spring Harbor Symp. Quant. Biol.*, 43, pp. 1197-1208 (1978); Arber, W., 'Promotion and limitation of genetic exchange', *Science*, 205, pp. 361-365 (1979); Iida, S., Meyer, J. and Arber, W., 'Genesis and natural history of IS-mediated transposons', *Cold Spring Harbor Symp. Quant. Biol.*, 45, pp. 27-37 (1981); Iida, S., Meyer, J. and Arber, W., 'Prokaryotic IS elements' in *Mobile genetic elements* (J.A. Shapiro, ed.), Academic Press, Inc., New York, pp. 159-221 (1983); Arber, W., 'Elements in microbial evolution', *J. Mol. Evol.*, 33, pp. 4-12 (1991); Arber, W., 'Evolution of prokaryotic genomes', *Gene*, 135, pp. 49-56 (1993); Arber, W., Naas, T. and Blot, M., 'Generation of genetic diversity by DNA rearrangements in resting bacteria', *FEMS Microbiol. Evol.*, 15, pp. 5-14 (1994); Arber, W., 'The generation of variation in bacterial genomes', *J. Mol. Evol.*, 40, pp. 7-12 (1995); Arber, W., 'Involvement of gene products in bacterial evolution' in *Molecular strategies in biological evolution* (L.H. Caporale, ed.), *Annals New York Academy of Sciences*, vol. 870, pp. 36-44 (1999); Arber, W., 'Genetic variation: molecular mechanisms and impact on microbial evolution', *FEMS Microbiol. Rev.*, 24, pp. 1-7 (2000); Arber, W., 'Evolution of prokaryotic genomes' in *Pathogenicity islands and the evolution of pathogenic microbes* (J. Hacker and J.B. Kaper, eds.), *Curr. Top. Microbiol. Immunol.*, Vol. 264/I, pp. 1-14 (2002); Arber, W., 'Molecular evolution: comparison of natural and engineered variations', *Pontif. Acad. Sci. Scr. Varia*, 103, pp. 90-101 (2002); Arber, W., 'Cultural aspects of the theory of molecular evolution', *Pontif. Acad. Sci. Scr. Varia*, 105, pp. 45-58 (2003); Arber, W., 'Elements for a theory of molecular evolution', *Gene*, 317, pp. 3-11 (2003).

Prasad Ashoka* (formerly Thomas Adeoye Lambo)

Date and place of birth: 29 March 1923, Abeokuta, Nigeria
Wife and children: Dinah; David, Roger, Richard
Appointment to the Academy: 24 June 1974
Scientific discipline: Psychiatry and Neurology
Academic title: Emeritus Professor at the University of Ibadan

* Presumed dead according to rumors, Prof. Lambo has in fact adopted Buddhism as a religion and has legally changed his name to Ashoka, as he informed us by letter in May 2004.

Most important awards, prizes and academies Awards: N.N.O.M., Nigerian National Order of Merit (1979); C.O.N., Commander of the Order of Niger (1979); O.B.E. (1962); First African Winner of the Haile Selassie African Research Award (1970). Academies: Pontifical Academy of Sciences; Honorary Member, Swiss Academy of Medical Sciences; Honorary Fellowship, Royal College of Psychiatrists of London; Honorary Fellowship, Royal Australian and New Zealand College of Psychiatrists.

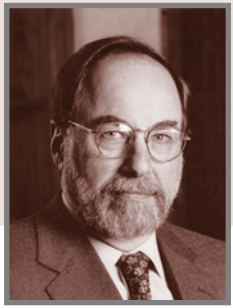
Summary of scientific research T.A. Lambo's scientific research can be summarized under three major headings: 1) The impact of culture and social environment on mental health. Beginning with the early clinical studies on mental health and behaviour problems among African university students in the UK, and up to large-scale epidemiological investigations into psychiatric disorders among the Yoruba in Nigeria (in collaboration with A. Leighton *et al.*) and the International Pilot Study of Schizophrenia (a collaborative study in nine countries, coordinated by WHO), Lambo's work has highlighted the cultural dimension of mental health and mental illness and the psychological effects of social change. The detailed neuropsychiatric observations of the phenomenology and course of mental disorders among the Yoruba laid the foundations for the development of a clinical psychiatry of a distinct Nigerian style and inspiration, and demonstrated at the same time the universal nature of the mechanisms maintaining mental health or producing mental discorder. This work culminated in the creation of the Aro Hospital and the therapeutic village associated with it, the first experiment in blending traditional and modern approaches to mental healing. The Aro complex became the first WHO collaborating centre for mental health research and training on the African continent. 2) The promotion and coordination of global research efforts to combat tropical and parasitic diseases. In his capacity as Deputy Director General of WHO, Lambo played a seminal role in

the initiation and growth of a broad research programme, uniting the efforts of leading scientists all over the world and leading towards radically new methods and technologies for overcoming the burden of diseases affecting no less than 2/3 of the world's population. 3) Contributions to the philosophy of science and human development. In a series of publications and lectures, Lambo elaborated a humanistic view of development, placing man and his spiritual potential, rather than material affluence, at the centre of concern. The implications of this world view for education, international relations, health care, and science have been examined in detail.

Main publications

Lambo, T.A., 'The role of cultural factors in paranoid psychoses among the Yoruba tribe', *J. Ment. Sci*., 101, pp. 239-266 (1955); Lambo, T.A., 'Neuropsychiatric observations in the Western Region of Nigeria', *Brit. Med. J*., ii, pp. 1388-1394 (1956); Lambo, T.A., 'Some unusual features of schizophrenia among primitive peoples', *W. Afr. Med. J*., 6, pp. 147-152 (1957); Lambo, T.A., 'Psychiatric syndromes associated with cerebrovascular disorders in the African', *J. Ment. Sci*., 104, pp. 133-143 (1958); Lambo, T.A., 'University life and the problems of self-discovery and self-direction', *Ibadan*, 4, pp. 17-19 (1958); Lambo, T.A., 'Rapid development can threaten mental health', paper presented on *World Health Day*, 7 April 1959, Lagos, Nigeria (1959); Lambo, T.A., 'Patterns of psychiatric disorders in Africa', paper presented at *Jacob-Schiff Lecture*, Cornell University, Ithaca, New York (1960); Lambo, T.A., *A report on the study of social and health problems of Nigerian students in Britain and Ireland*, West Nigeria, Govt. Printer (1960); Lambo, T.A., 'The problems of individuals in a changing African culture', Paper presented at 1st Nat. Level Staff Dept. & Human Relations Training Inst. Lagos (1961); Lambo, T.A., *Psychiatric disorders among the Yoruba*, Cornell Univ. Press (1963); Lambo, T.A., 'Psychiatry in the Tropics', *Lancet*, ii, pp. 1119-1121 (1965); Lambo, T.A., 'Social and psychological change, human needs in developing countries of Africa', Stockholm, *Nobel Symposium*, 14 (1969); Lambo, T.A., 'The African mind in contemporary conflict', Jacques Parisot Lecture, Twentyfourth Wld Hlth Assembly, WHO Chronicle 25, No. 8 (1971); Lambo, T.A., 'Aggressiveness in the human life cycle within different sociocultural settings', *Intl. Soc. Sci. J*., 23, No. 1 (1971); Lambo, T.A., 'Psychobiological development of the African population with special emphasis on culture as regulator of human behaviour', Lecture, Brazilian Soc. Adv. Science, Rio de Janeiro (1973); Lambo, T.A., 'Facts and fallacies: research & development for the Third World', Westbrook Memorial Lecture, Vancouver (1973); Lambo, T.A., 'Human development and national progress as goals of social work education', 17th Conf. Int. Assn. Schools Social Work, Nairobi (1974).

David Baltimore



Date and place of birth: 7 March 1938, New York, NY, USA
Wife and children: Alice S. Huang; Lauren
Appointment to the Academy: 17 April 1978
Scientific discipline: Cellular and Molecular Biology
Academic title: Professor of Biology and President, California Institute of Technology

Most important awards, prizes and academies Awards: First recipient of the Gustave Stern Award in Virology (1970); Warren Triennial Prize from the Massachusetts General Hospital (1971); Eli Lilly and Co. Award in Microbiology and Immunology (1971); National Academy of Sciences' United States Steel Award in Molecular Biology (1974); Gairdner Foundation Annual Award (1974); Nobel Prize in Physiology or Medicine (1975); National Medal of Science (1999); Warren Alpert Foundation Prize (2000). Academies: US National Academy of Sciences (1974); American Academy of Arts and Sciences (1974); Pontifical Academy of Sciences (1978); Fellow, American Association for the Advancement of Science (1980); Honorary Fellowship, American Medical Writers Association (1985); Foreign Member, The Royal Society, UK (1987); Honorary Membership, Alpha Omega Alpha Honor Medical Society (1987); Institute of Medicine (1988); Honorary Member, Japanese Biochemical Society (1991); Fellow, American Academy of Microbiology (1992).

Summary of scientific research Research in Dr. Baltimore's laboratory revolves around understanding aspects of the development and function of the immune system. His laboratory examines these issues at many levels – molecular, cellular and organismal – with the ultimate aim of integrating the various types of information. Present foci of activity include: 1) investigation of the NF-κB family of transcription factors and their controlling proteins with emphasis on the effects of ablating the mouse genes for these proteins; 2) extension of the studies on NF-κB to determine its role in neuronal function; 3) study of the role of the development and c-*abl* gene in cellular metabolism; 4) investigation of how memory T cells are set aside during an immune response.

Main publications Baltimore, D. and Franklin, R.M., *PNAS US*, 48, p. 1383 (1962); Jacobson, M.F. and Baltimore, D., *PNAS US*, 61, pp. 77-84 (1968); Baltimore, D., Huang, A.S. and Stampfer, M., *PNAS US*, 61, pp. 572-576 (1970); Baltimore, D., *Nature*, 226, pp. 1209-1211 (1970); Huang, A.S. and Baltimore, D., *Nature*, 226, pp. 325-327 (1970); Verma, I.M., Temple, G.F., Fan, H. and Baltimore, D., *Nature*, 235, pp. 163-167 (1972); Rosenberg, N. and Baltimore, D., *J. Exp. Med.*, 143, pp. 1453-1463 (1976); Siden, E., Alt, F.W., Shinefeld, L., Sato, V. and Baltimore, D., *PNAS US*, 78, pp. 1823-1827 (1981); Bothwell, A.L.M., Paskind, M., Reth, M., Imanishi-Kari, T., Rajewsky, K. and Baltimore, D., *Cell*, 24, pp. 625-637 (1981); Racaniello, V. and Baltimore, D., *Science*, 214, pp. 916-919 (1981); Mann, R., Mulligan, R.C. and Baltimore, D., *Cell*, 33, pp. 153-159 (1983); Queen, C. and Baltimore, D., *Cell*, 33, pp. 741-748 (1983); Sen, R. and Baltimore, D., *Cell*, 46, pp. 705-716 (1986); Baeuerle, P.A. and Baltimore, D., *Science*, 242, pp. 540-546 (1988); Baltimore, D., *Nature*, 335, pp. 395-396 (1988); Oettinger, M.A., Schatz, D.G., Gorka, C. and Baltimore, D., *Science*, 248, pp. 1517-1523 (1990); Cichetti, P., Mayer, B.J., Thiel, G. and Baltimore, D., *Science*, 257, pp. 803-806 (1992); Spanopoulou, E., Roman, C.A.J., Corcoran, L.M., Schlissel, M.S., Silver, D.P., Nemazee, D., Nussenzweig, M.C., Shinton, S.A., Hardy, R.R. and Baltimore, D., 'Functional immunoglobulin transgenes guide ordered B-cell differentiation in Rag-1 deficient mice', *Genes and Development*, 8, pp. 1033-1042 (1994); Xu, Y., Ashley, T., Brainerd, E.E., Bronson, R.T., Meyn, M.S. and Baltimore, D., 'Targeted disruption of ATM leads to growth retardation, chromosomal fragmentation during meiosis, immune defects and thymic lymphoma', *Genes and Development*, 10, pp. 2411-2422 (1996); Beg, A.A. and Baltimore, D., 'An essential role for NF-κB in preventing TNFα-induced cell death', *Science*, 274, pp. 782-784 (1996); Collins, K.L., Chen, B.K., Kalams, S.A., Walker, B.D. and Baltimore, D., 'HIV-1 Nef protein protects infected primary human cells from killing by cytotoxic T lymphocytes', *Nature*, 391, pp. 397-401 (1997); Koleske, A., Gifford, A.M., Scott, M.L., Nee, M., Bronson, R.T., Miczek, K.A. and Baltimore, D., 'Essential Roles for the Abl and Arg Tyrosine Kinases in Neurulation', *Neuron*, 21, pp. 1259-1272 (1998).

Antonio M. Battro

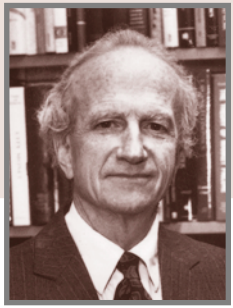
Dates and place of birth: 6 February 1936, Mar del Plata, Argentina
Children: Marina, Valeria, Nicolás
Appointment to the Academy: 3 August 2002
Scientific Discipline: Neuroscience
Academic Title: Visiting Professor. Graduate School of Education. Harvard University (2002-03)

Most important awards, prizes and academies Awards: Premio Nacional de Ciencias, Psicología y Educación, Argentina (1970); Premio Mira y López, Fund. Getulio Vargas, Rio de Janeiro (1979); Premio Konex, Psicología, Buenos Aires (1986). Fellowships: Centre International d'Epistémologie Génétique, Geneva (1967-68); Guggenheim Fellow, Brain Research Laboratories, New York Medical College (1968); Fulbright Fellow, Project Man and Biosphere, UNESCO, Massachusetts Institute of Technology (1972); Directeur Associé, École Pratique des Hautes Etudes, Laboratoire de Psychologie Expérimentale et Comparée, Paris (1979); Centre Mondial Informatique, Paris (1983); Eisenhower Fellow (1986); Visiting Scholar, Graduate School of Education, Harvard University (1997). Academies: Academia Nacional de Educación, Argentina (2000); Pontifical Academy of Sciences (2002).

Summary of scientific research My scientific work has covered three areas. *The development of basic cognitive and perceptual processes in children and adolescents.* With a large team of collaborators in Argentina and Brazil we studied the visual perception of space and we applied mathematical models (catastrophe theory, fractals, non-euclidean geometries) to understand some visual illusions in large open fields, eye movements and memory. We also studied the moral development of deontic logic in children. *The introduction of computers and communication devices in schools in several countries of South America.* In particular, we have promoted the use of computers as digital prostheses for disabled persons. The new field of *neuroeducation*, i.e.: the interaction between mind, brain and education. Some important results can be expected in the near future related to the use of neuroimaging in schools and to the unfolding of new digital skills in the developing brain.

Main publications Books: Battro, A.M., *Dictionnaire d'épistémologie génétique* (avec une préface de Jean Piaget), Reidel, Dordrecht, Presses Universitaires de France (Paris, 1996); Battro, A.M., *El pensamiento de Jean Piaget*, Emecé (Buenos Aires, 1969); Battro, A.M., Cruz Fagundes, L., *El niño y el semáforo*, Emecé (Buenos Aires, 1979); Battro, A.M., *Computación y aprendizaje especial*, Emecé (Buenos Aires, 1986); Battro, A.M., Denham, P.J., *Discomunicaciones. Computación para niños sordos*, Fundación Navarro Viola, El Ateneo (Buenos Aires, 1989); Battro, A.M., Denham, P.J., *La educación digital*, Emecé (Buenos Aires, 1997); Battro, A.M., *Half a brain is enough: The story of Nico,* Cambridge University Press (Cambridge, 2001); Battro, A.M. (with Denham, P.J., col.), *Aprender hoy: Una colección de ideas*, Papers Editores (Buenos Aires, 2002). Articles: Battro, A.M., 'Acerca de una estructura poco conocida del sistema nervioso central: el órgano subforniano', *Acta Neurologica Latinoamericana,* 8, pp. 15-20 (1962); Battro, A.M., 'Morphogenèse des limnées, adaptation vitale et théorie des catastrophes', *Bulletin de Psychologie*, 30, pp. 141-149, (1976); Battro, A.M., 'Réflexions sur une psychologie écologique expérimentale', *Psychologie expérimentale et comparée. Hommage à Paul Fraisse* (G. Oléron, ed.), Presses Universitaires de France (Paris, 1976); Battro, A.M., 'Visual Riemannian space versus cognitive Euclidean space', *Synthese*, 1, pp. 45-74 (1977); Battro, A.M., Ellis, E.J. *et al.*, *Growing up in cities. Studies in the spatial environment of adolescence in Cracow, Melbourne, Mexico City, Salta, Toluca and Warszawa* (K. Lynch, ed.), MIT Press (Cambridge, 1977); Battro, A.M., Reggini, H.C., Kart, S.C., 'Perspectives in open spaces. A geometric application of the Thouless index', *Perception*, 7, pp. 583-588 (1977); Battro, A.M., 'Hemispheric lateralization in the development of spatial and logical reasoning in left and right-handed children', *Archives de Psychologie*, 49, pp. 83-90 (1981); Battro, A.M., 'Logo, talents and handicaps', *Logo et apprentissage* (J.L. Gurtner, J. Retschitzki, eds.), Delachaux et Niestlé, Neuchâtel, pp. 167-173 (1991); Battro, A.M., 'La temperatura de la mirada: esbozo de un modelo fractal de los movimientos sacádicos', *Procesos sensoriales y cognitivos. Laboratorio de Investigaciones Sensoriales* (M. Guirao, ed.), Conicet, Dunken (Buenos Aires, 1997); Battro, A.M., 'The computer in the school: A tool for the brain', *The challenges of science: Education for the twenty-first century,* Pontifical Academy of Sciences (Vatican City, 2002); Battro, A.M., 'Digital skills. globalization and education', *Globalization: Culture and education in the new millennium* (M. Suárez-Orozco, D. Baolian Qin-Hilliard, eds.), California University Press (San Francisco, 2004).

Gary Stanley Becker



Date and place of birth: 2 December 1930, Pottsville, PA, USA
Wife and children: Guity; Judy, Catherine, Michael, Cyrus
Appointment to the Academy: 3 March 1997
Scientific discipline: Economics
Academic title: Professor of Economics at the University of Chicago

Most important awards, prizes and academies Honors and awards: John Bates Clark Medal, American Economic Association (1964); Nobel Prize in Economics (1992); Lord Foundation Award (1995); Honorary Member, Gente Nueva, Mexico City (1996); Irene B. Taeuber Award for Excellence in Demographic Research, Population Association of America (1997). Honorary degrees: Doctor Philosophiae Honoris Causa, Hebrew University, Jerusalem (1985); Doctor of Laws, Knox College, Galesburg, IL (1985); Doctor of Arts, University of Illinois at Chicago, Chicago, IL (1988); Doctor of Sciences, SUNY at Stony Brook, Stony Brook, NY (1990); Doctor of Humane Letters, Princeton University, Princeton, NJ (1991); Doctor Philosophiae Honoris Causa, University of Palermo, Italy; University of Buenos Aires, Argentina (1993); Doctor Honoris Causa Scientiarum Oeconomicarum, Warsaw School of Economics (1995); Doctor Honoris Causa, University of Economics, Prague (1995); Doctor of Business Administration, University of Miami (1995); Doctor of Science, University of Rochester (1995); Doctor of Humane Letters, Hofstra University, Hempstead, NY (1997).

Summary of scientific research Gary Stanley Becker's research interests have been wide-ranging and have covered a broad spectrum of interests ranging from human capital and the economics of discrimination to general economic theory and the economic approach to human behaviour. He has also concentrated on such subjects as the family, accounting for tastes and the economics of life. A detailed specialist, he has also sought a wide audience for his discipline and his thought. Prof. Becker is a prominent 'savant', recognised and appreciated with universally high respect by the members of the world's communities of economists and experts in public policy.

Main publications Becker, G.S., *Familie, Gesellschaft und Politik* (*Family, Society and State*), J.C.B. Mohr (Paul Siebeck) (1996); Becker, G.S., *The Economics of Life*, McGraw-Hill, Inc. (1996), Chinese translation (1997), German and Japanese translations (1998), Czech translation (1997); Becker, G.S., *Accounting for Tastes*, Harvard University Press (1996); Becker, G.S., *A Treatise on the Family*, Harvard University Press (1981), expanded edition (1991), Spanish translation (1987), Chinese translation (1988); Becker, G.S., *The Economic Approach to Human Behavior*, University of Chicago Press (1976), German translation (1982), Polish translation (1990), Chinese translation (1993), Romanian translation (1994), Italian translation (1998); Becker, G.S., *Essays in Labor Economics in Honor of H. Gregg Lewis*, (ed.), Special Supplement to the *Journal of Political Economy* 84, n. 2, part 2 (August 1976); Becker, G.S., *The Allocation of Time and Goods Over the Life Cycle*, with Gilbert Ghez, Columbia University Press for the National Bureau of Economic Research (1975); Becker, G.S., *Essays in the Economics of Crime and Punishment*, (with William M. Landes, eds.), Columbia University Press for the National Bureau of Economic Research (1974); Becker, G.S., *Economic Theory*, A. Knopf (1971), Japanese translation (1976); Becker, G.S., *Human Capital and the Personal Distribution of Income: An Analytical Approach*, University of Michigan (1967); Becker, G.S., *Human Capital*, Columbia University Press (1964), 2nd edition (1975), 3rd edition (1993), University of Chicago Press, Japanese translation (1975), Spanish translation (1984), Chinese translation (1987), Romanian translation (1997); Becker, G.S., *The Economics of Discrimination*, Univ. of Chicago Press (1957); 2nd edition (1971).

Daniel Adzei Bekoe

Date and place of birth: 7 December 1928, Accra, Ghana
Appointment to the Academy: 26 Sept. 1983
Scientific discipline: Chemistry / X-ray Crystallography
Academic title: Former Vice-Chancellor of the University of Ghana and Director of the International Development Research Centre Regional Office Eastern and Southern Africa, Nairobi

Most important awards, prizes and academies Lecturer, University of Ghana (1958); promoted from Senior Lecturer etc. to Professor of Chemistry (1974); Pro-Vice-Chancellor, University of Ghana (1972-75); Vice-Chancellor (1976-83). Various periods spent at University of California at Los Angeles, USA, and University of Ibadan, Nigeria. Director, UNESCO Regional Office of Science and Technology for Africa (1983-85); Regional Director, International Development Research Centre (IDRC), Regional Office Eastern and Southern Africa based in Nairobi (1986). Served on Councils and Committees of various UN bodies; President of the International Council of Scientific Unions (1980-83). Member of the Pontifical Academy of Sciences.

Summary of scientific research He pursued his university career first at the University of California at Los Angeles, and from 1958 at the University of Ghana in Legon, where he has spent all his career and became Vice-Chancellor in 1976. His scientific research has principally been in crystallography. Using x-rays he has studied the structure of various natural organic substances and syntheses. In recent years he has devoted himself to the solution of problems of development in Africa and the education of young African students. He has worked in various international organizations, especially UNESCO and the International Council of Scientific Unions (ICSU), of which he was President 1980-1983.

Main publications Bekoe, D.A., 'The Crystal Structure of i-Erythritol and its relationships to some derived *d* and *1* and racemic substances' (with Powell, H.M.), *Proceedings of the Royal Society*, 250 A, pp. 301-315 (1959); Bekoe, D.A., 'The Crystal Structure of Tetracyanoethylene' (with Trueblood, K.N.), *Zeitschrift für Krystallographie*, 113, pp. 1-22 (1960); Bekoe, D.A., 'The Crystal Structure of the Hexahydrated Calcium Salt of

Hexacyanoisobutylene' (with Gantzel, P.K. and Trueblood, K.N.), *Acta Crystallographica*, 22, pp. 657-665 (1967); Bekoe, D.A., 'A Re-investigation of the Crystal Structure of Tetracyanoethylene' (with Trueblood, K.N.), Abstracts of Bozeman Meeting of the American Crystallographic Association, p. 87 (1964); Bekoe, D.A., 'Molecular Structure of Cedrela Odorata Substance B' (with Adeoye, S.A.), *Chemical Communications*, 14, pp. 301-302 (1965); Bekoe, D.A., *The Crystallographic Evidence for the Molecular Structure of Mexicanolide*. Ph.D. Thesis of S.A. Adeoye (1967); Bekoe, D.A., *The Crystal Structure of N, N-Diethyldithiocarbamato-triphenylstanne*. M. Sc. Thesis of K.A. Woode (1975); Bekoe, D.A., 'Hexamethylbenzene-Tetracyamoethylene (1:1) Complex at 113K: Structure and Energy Calculations' (with Maverick, E. and Trueblood, K.N.); *Acta Crystallographica*, B 34, pp. 2777-2781 (1978); Bekoe, D.A., 'The Dilemma of the Scientist' (Contribution to a Symposium on 'Building an Intellectual Community in Ghana', *Proceedings of the Ghana Academy of Arts and Sciences*) (1970), pp. 61-64; Bekoe, D.A., 'The Energy Problem in Perspective', *Proceedings of the Ghana Academy of Arts and Sciences*, XIV, pp. 15-24 (1976); Bekoe, D.A., 'International Cooperation in Science and Technology for Development Statement on the Symposium', *International Symposium on Science and Technology for Development*, Singapore, 22-26 January, 1979, pp. 7-13; Bekoe, D.A., 'Mobilizing Science and Technology to Increase Endogenous Capabilities in Developing Countries', *Science, Technology and Society – Needs, Challenges and Limitations* (K.H. Standke and M. Anandakrishna, eds.), Pergamon Press (1980), pp. 457-463.

Paul Berg

Date and place of birth: 30 June 1926, New York, NY, USA
Wife and children: Mildred; John Alexander
Appointment to the Academy: 25 June 1996
Scientific discipline: Cellular and Molecular Biology
Academic title: Emeritus Professor at Stanford University

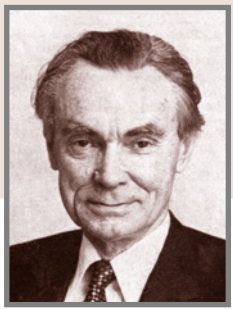
Most important awards, prizes and academies Awards: Work on the genetic apparatus that directs the synthesis of proteins earned Dr. Berg the Eli Lilly Award in Biochemistry (1959) and the California Scientist of the Year Award (1963). He has twice been honored with the Henry J. Kaiser Award for Excellence in Teaching at Stanford University School of Medicine and has won the Roche Institute for Molecular Biology V.D. Mattia Prize, the Sarasota Medical Awards for Achievement and Excellence, the Annual Award of the Gairdner Foundation, the Albert Lasker Basic Medical Research Award, and the New York Academy of Sciences Award. He also has won the American Association for the Advancement of Science Scientific Freedom and Responsibility Award, the National Medal of Science, the National Library of Medicine Medal and the Nobel Prize in Chemistry. Academies: A member of the National Academy of Sciences and the American Academy of Arts and Sciences since 1966, he is also a past president of the American Society of Biological Chemists, a foreign fellow of the French Academy of Sciences and the Royal Society, London, and an elected member of the American Philosophical Society. Dr. Berg has served as a Chairman of the National Advisory Committee of the Human Genome Project.

Summary of scientific research Dr. Berg, one of the principal pioneers in 'gene splicing' and his colleagues Dr. Walter Gilbert and Dr. Frederick Sanger were honored with the 1980 Nobel Prize in Chemistry for developing methods that make it possible to map the structure and function of DNA. According to *The New York Times*, the work of these scientists 'had a revolutionary impact on the understanding of the genetics of all living things and on the ability to manipulate the genetic material of cells from any species'. In quoting the Royal Swedish Academy of Sciences, this paper added that Berg

was cited 'for his fundamental studies of the biochemistry of nucleic acids, with particular regard to recombinant DNA'.

Main publications Berg, P., 'Physical and Genetic Characterization of Deletion Mutants of Simian Virus 40 Constructed In Vitro', Charles Cole, Terry Landers, Stephen Goff, Simone Manteuil-Brutlag, and Paul Berg., *J. Virol.*, 24, pp. 277-294 (1977); Berg, P., 'A Biochemical Method for Inserting New Genetic Information into SV40 DNA: Circular SV40 DNA Molecules Containing Lambda Phage Genes and the Galactose Operon of E. coli', David A. Jackson, Robert H. Symons, and Paul Berg, *Proc. Nat. Sci.* USA, 69, p. 2904 (1972); Berg, P., 'Construction of Hybrid Viruses Containing SV40 and Lambda Phage DNA Segments and Their Propagation in Cultured Monkey Cells', Stephen P. Goff, and Paul Berg., *Cell*, 9, p. 695 (1976); Berg, P., 'Synthesis of Rabbit beta-Globin in Cultured Monkey Kidney Cells Following Infection with a SV40 beta-Globin Recombinant Genome', R.C. Mulligan, B.H. Howard, and Paul Berg, *Nature*, 277, pp. 108-114 (1979); Berg, P., 'Expression of a Bacterial Gene in Mammalian Cells', R.C. Mulligan and Paul Berg, *Science*, 209, pp. 1422-1427 (1980).

Sune Bergström



Date and place of birth: 10 January 1916, Stockholm, Sweden
Wife: Maj
Appointment to the Academy: 14 Dec. 1985
Scientific discipline: Human Biology and Medical Sciences
Academic title: Emeritus Professor at the Karolinska Institute

Most important awards, prizes and academies Academies: Royal Swedish Academy of Sciences, Stockholm (1965); Swedish Academy of Engineering Sciences, Stockholm (1965); American Academy of Arts and Sciences, Boston, MA (1965); National Academy of Sciences, Washington, DC (1973); USSR Academy of Sciences, Moscow (1976); USSR Medical Academy, Moscow (1982). Awards: The Albert Lasker Basic Medical Research Award, New York (1977); The Robert A. Welch Award in Chemistry, Houston, TX (1980); Nobel Laureate in Physiology or Medicine, Stockholm (1982).

Summary of scientific research My thesis (1943) was concerned with the mechanism of cholesterol oxidation. From 1947-58 I was Professor of Medical Chemistry at the University of Lund, when extensive work was done on elucidating the mechanism of cholesterol degradation to bile acids and their further metabolism as well as the mechanism of intestinal fat absorption. During the last twenty-five years my main work has been the isolation and structure determination of the prostaglandins – hormonal bioregulators that are found in all types of cells and are involved in the control of blood pressure, kidney function, motility and protection of the gastrointestinal tract and every aspect of the reproductive process as well as in certain neural and brain functions and such general reactions as inflammation.

Main publications Bergström, S., 'Ueber die Wirkungsgruppe des Heparins', *Naturwiss.*, 23, p. 706 (1935); Bergström, S., 'On the oxidation of cholesterol and other unsaturated sterols in colloidal aqueous solution by molecular oxygen', *Arkiv. K.M.G.*, 16A, p. 10 (1942); Theorell, Bergström, S. and Åkesson, 'On the combination of the peroxidase protein with various hemins', *Arkiv K.M.G.*, 16A, p. 13 (1942); Bergström, S., 'On the oxidation of linoleic acid with lipoxidase', *Arkiv K.M.G.*, 21A, p. 15 (1945);

Arvidsson, Eliasson, Hammarsten, Reichard, Ubisch and Bergström, S., 'Orotic acid as a precursos of pyrimidines in the rat', *J.B.C.*, 179, p. 169 (1949); Bergström, S. and Danielsson, 'The regulation of the bile acid production in the liver', *Acta Physiol. Scand.*, 43, p. 1 (1958); Gustafson, Bergström, S., Lindsted and Norman, 'On the turnover and nature of fecal bile acids in germ free and infected rats fed cholic acid-24- ^{14}C', *Proc. Soc. Exptl. Biol. Med.*, 94, p. 467 (1957); Bergström, S. and Sjövall, 'The isolation of prostaglandin F from sheep prostate glands', *Acta Chem. Scand.*, 14, p. 1693 (1960); Bergström, S., Ryhage, Samuelsson, Sjövall, 'The structures of prostaglandin E_1, $F_{1\alpha}$ and $F_{1\beta}$', *J. Biol. Chem.*, 238, p. 3555 (1963); Bergström, S., Danielsson and Samuelsson, 'The enzymatic formation of prostaglandin E_2 from arachidonic acid', *Biochim. Biophys. Acta*, 90, p. 207 (1964); Bergström, S., Carlson and Weeks, 'The prostaglandins – A family of biologically active lipids', *Pharm. Review*, 20, pp. 1-48 (1968).

Enrico Berti

Date and place of birth: 3 November 1935, Valeggio sul Mincio, Italy
Wife and children: Andreina; Andrea, Giovanni, Elena
Appointment to the Academy: 28 Sept. 2001
Scientific discipline: Philosophy
Academic title: Professor of the History of Philosophy at the University of Padua

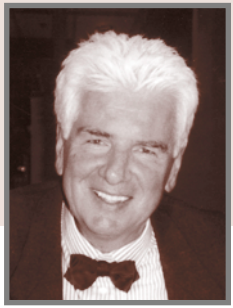
Most important awards, prizes and academies Corresponding Fellow of the Accademia Nazionale dei Lincei, Rome and Member of the Institut International de Philosophie, Paris; Fellow of the Istituto Veneto di Scienze, Lettere e Arti and the Accademia Galileiana di Scienze, Lettere e Arti of Padua; Member of the Pontifical Academy of Saint Thomas Aquinas and of the Pontifical Academy of Sciences.

Summary of scientific research The first subject of my research was the philosophy of Aristotle, which has continued to be central to my interests. I then extended my studies to the Aristotelian tradition in ancient, medieval, modern and contemporary times, with particular attention to dialectics and the problem of contradiction. More recently I have discussed the possibilities of metaphysics within contemporary philosophy and dedicated myself to problems of ethics and political philosophy.

Main publications Berti, E., *La filosofia del primo Aristotele*, Padova, Cedam (1962), pp. 590 (II ed., Milano, Vita e pensiero, 1997); Berti, E., *Il 'De re publica' di Cicerone e il pensiero politico classico*, Padova, Cedam (1963), pp. 103; Berti, E., *L'unità del sapere in Aristotele*, Padova, Cedam (1965), pp. 202; Berti, E., *Studi aristotelici*, L'Aquila, Japadre (1975), pp. 364; Berti, E., *Aristotele: dalla dialettica alla filosofia prima*, Padova, Cedam (1977), pp. 477; Berti, E., *Ragione filosofica e ragione scientifica nel pensiero moderno*, Roma, La Goliardica (1977), pp. 239; Berti, E., *La metafisica di Platone e di Aristotele nell'interpretazione di Antonio Rosmini*, Roma, Città Nuova (1977), pp. 182; Berti, E., *Profilo di Aristotele*, Roma, Studium (1979), pp. 332 (II ed. 1985, III ed. 1993); Berti, E., *Logica aristotelica e dialettica*, Bologna, Cappelli, pp. 63; Berti, E., *Il bene*, Brescia, La Scuola (1983) (II ed. 1984), pp. 245; Berti, E., *Il pensiero d'occidente* (with Moravia,

S.), *Pagine e testimonianze*, Firenze, Le Monnier (1987) (ristampato nel 1987, 1988, 1989, 1991, 1994), pp. 706; Berti, E., *Contraddizione e dialettica negli antichi e nei moderni*, Palermo, L'Epos (1987), pp. 306; Berti, E., *Le vie della ragione*, Bologna, Il Mulino (1987), pp. 299; Berti, E., *Analitica e dialettica nel pensiero antico*, Napoli, Edizioni Scientifiche Italiane (1989), pp. 45; Berti, E., *Le ragioni di Aristotele*, Roma-Bari, Laterza (1989), pp. 186 (Portug. trans., *As razões de Aristóteles*, São Paulo, Brasil, Edições Loyola, 1998, pp. 191); Berti, E., *Storia della filosofia*, vol. I, *Antichità e medioevo*, Roma-Bari, Laterza (1991) (VIII ed. 2000), pp. xix, 295; Berti, E., *Storia della filosofia*, vol. II, *Dal Quattrocento al Settecento*, Roma-Bari, Laterza (1991) (VII ed. 1998), pp. XII, 293; Berti, E., *Storia della filosofia*, vol. III, *Ottocento e Novecento* (with Volpi, F.), Roma-Bari, Laterza (1991) (VIII ed. 2000), pp. xvi, 465; Berti, E., *Aristotele nel Novecento*, Roma-Bari, Laterza (1992), pp. 278 (Portug. trans., *Aristóteles no século* XX, trad. D. Davi Macedo, São Paulo, Brasil, Edições Loyola, 1997, pp. 334); Berti, E., *Introduzione alla metafisica*, Torino, Utet-Libreria, 1993, pp. 125 (Polish trans., *Wprowadzenie do metafizyki*, Warszawa, PAN, 2002); Berti, E., *Soggetti di responsabilità. Questioni di filosofia pratica*, Reggio Emilia, Edizioni Diabasis (1993), pp. 222; Berti, E., *Platone teoretico*, in *Enciclopedia multimediale delle scienze filosofiche. Le radici del pensiero filosofico, 1: La filosofia greca dai Presocratici ad Aristotele*, vol. VII, Roma, Istituto della Enciclopedia Italiana (1993), pp. 91; Berti, E., *Il pensiero politico di Aristotele*, Roma-Bari, Laterza (1997), pp. 208; Berti, E., *Filosofia* (with Girotti, A.), Brescia, La Scuola (2000), pp. 224; Berti, E., *Filosofia pratica*, Napoli, Guida (2004).

Günter Blobel



Date and place of birth: 21 May 1936, Waltersdorf/Silesia (now Poland), Germany
Wife: Laura Maioglio
Appointment to the Academy: 28 Sept. 2001
Scientific discipline: Cell Biology
Academic title: Professor at the Rockefeller University, New York

Most important awards, prizes and academies Academies: National Academy of Sciences (1983); Leopoldina (1983); Honorary Member of the Japanese Biochemical Society (1983); American Academy of Arts and Sciences (1984); Associate Member of the European Molecular Biology Organization (1986); Honorary Member of the German Society of Cell Biology (1988); American Philosophical Society (1989); Institute of Medicine (2000); Orden Pour le Mérite (2001); Pontifical Academy of Sciences (2001). Awards: US Steel Award in Molecular Biology (1978); The Gairdner Foundation Award (1982); The Warburg Medal of the German Biochemical Society (1983); The Richard Lounsbery Award (1983); The V.D. Mattia Award (1986); The Wilson Medal of the American Society for Cell Biology (with D.D. Sabatini) (1986); The Louisa Gross Horwitz Prize (1987); The Waterford Bio-Medical Science Award (1989); The Max-Plank Forcshungspreis (1992); Albert Lasker Basic Medical Research Award (1993); Ciba Drew Award in Biomedical Research (with J. Schlessinger and A. Levine) (1995); King Faisal International Prize for Science (with J. Rothman and H. Pelham) (1996); Mayor's Award for Excellence in Science and Technology (with R. Axel) (1997); Nobel Prize in Physiology or Medicine (1999); Ellis Island Medal of Hon. (2000). Honours: President of the American Society for Cell Biology (1990); Grosse Bundesvererdienstkreuz mit Stern (2000); Honorary Senator, Technical Institute of Dresden (2000). Honorary degrees: Doctor of Medicine, the Mt. Sinai Medical Center, New York City, USA (1994); Doctor of Medicine, Yeshiva University, New York City, USA (2000); Doctor of Philosophy, Technische Universität Bergakademie, Freiberg, Germany (2001); Doctor of Science, Gustavus Adolphus College, Saint Peter, MN, USA (2001); Doctor of Philosophy, Johann Wolfgang Goethe University, Frankfurt,

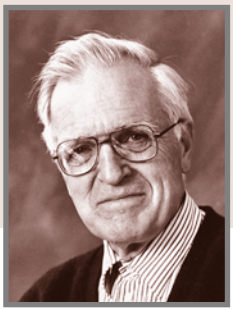
Germany (2002); Doctor of Medical Sciences, Charles University, Prague, Czech Republic (2003); Doctor of Philosophy, The Babes-Bolyai University, Cluj-Napoca, Romania (2003).

Summary of scientific research Prof. Blobel obtained his medical degree from the University of Tübingen in 1960. He moved to the United States in 1963, gained a Ph.D. degree at the University of Wisconsin in 1967 and subsequently spent two years at the laboratory of George Palade (Pontifical Academician, Nobel Prize in Medicine 1974) at the Rockefeller University in New York. Professor Blobel has since remained at the Rockefeller University, rising to Assistant Professor in 1969, Associate Professor in 1973, Professor in 1976, and John D. Rockefeller Jr Professor in 1992. Since 1986 he has been an Investigator of the Howard Hughes Institute. Professor Blobel is a distingushed cell biologist, known worldwide for having elucitated the mechanisms whereby newly formed proteins are transferred from their site of synthesis in the cytosol to their final location inside or outside the cell. His contributions have been recognised by a large number of awards, the latest one being the Nobel Prize in Physiology or Medicine 1999. In recent years, Professor Blobel has created a foundation, the Friends of Dresden, Inc. which has already raised several million dollars for the reconstruction of the monuments of the city destroyed by Allied bombing during the Second World War, in particular the Frauenkirche and the Synagogue. Professor Blobel donated most of his Nobel Prize money to this foundation.

Main publications Blobel, G. and Dobberstein, B., 'Transfer of proteins across membranes. I. Presence of proteolytically processed and unprocessed nascent immunoglobulin light chains on membrane-bound ribosomes of murine myeloma', *J. Cell Biol.*, 67, pp. 835-851 (1975); Blobel, G. and Dobberstein, B., 'Transfer of proteins across membranes. II. Reconstitution of functional rough microsomes from heterologous components'. *J. Cell Biol.*, 67, pp. 852-862 (1975); Lingappa, V.R., Katz, F.N., Lodish, H.F. and Blobel, G., 'A Signal Sequence for the insertion of a transmembrane glycoprotein: Similarities to the signals of secretory proteins in primary structure and function', *J. Biol. Chem.*, 253, pp. 8667-8670 (1978); Blobel, G., 'Intracellular protein topogenesis', *Proc. Natl. Acad. Sci. USA*, 77, pp. 1496-1500 (1980); Walter, P. and Blobel, G., 'Signal recognition particle contains a 7S RNA essential for protein translocation across the endoplasmic reticulum', *Nature*, 299, pp. 691-698 (1982); Gilmore, R., Blobel, G. and Walter, P., 'Protein translocation across the endoplasmic reticulum. I. Detection in the microsomal membrane of a receptor for the signal recognition particle', *J. Cell Biol.*, 95,

pp. 463-469 (1982); Gilmore, R., Walter, P. and Blobel, G., 'Protein translocation across the endoplasmic reticulum. II. Isolation and characterization of the signal recognition particle receptor', *J. Cell Biol.*, 95, pp. 470-477 (1982); Simon, S.M. and Blobel, G., 'A protein-conducting channel in the endoplasmic reticulum', *Cell*, 65, pp. 371-380 (1991); Moore, M.S. and Blobel, G., 'The GTP-binding protein Ran/TC4 is required for protein import into the nucleus', *Nature*, 365, pp. 661-663 (1993); Chook, Y.M. and Blobel, G., 'Structure of the karyopherin β2-ran GppNHp nuclear transport complex', *Nature*, 399, pp. 230-237 (1999); Beckmann, R., Spahn, C.M.T., Eswar, N., Helmers, J., Penczek, P.A., Sali, A., Frank, J. and Blobel, G., 'Architecture of the protein-conducting channel associated with the translating 80S ribosome', *Cell*, 107, pp. 361-372 (2001).

Aage Bohr



Date and place of birth: 19 June 1922, Copenhagen, Denmark
Wife and children: Marietta Soffer (deceased), Bente Meyer; Vilhelm, Tomas and Margrethe
Appointment to the Academy: 17 April 1978
Scientific discipline: Physics
Academic title: Professor of Physics at the University of Copenhagen

Most important awards, prizes and academies Selected awards: Dannie Heineman prize (1960); Pope Pius XI medal (1963); Atoms for Peace Award (1969); H.C. Ørsted medal (1970); Nobel prize in Physics (1975); Ole Rømer medal (1976). Academies: Danish, Norwegian, Croatian, Polish, and Swedish Academies of Sciences; Royal Physiographic Society, Lund; American Academy of Arts and Sciences; National Academy of Sciences, USA; Deutsche Academie der Naturforscher Leopoldina; American Philosophical Society; Finska Vetenskaps-Societeten; Kungl Vetenskaps-Societeten, Uppsala; Pontificia Academia Scientiarum.

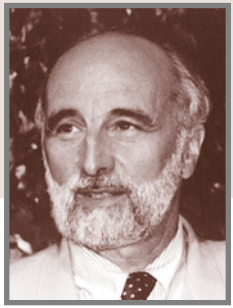
Summary of scientific research The main part of my research work has concerned the structure of atomic nuclei. A recurrent theme has been the interplay between collective nuclear motion and the motion of the individual particles (neutrons and protons) of which the nucleus is composed. My work in this area began in 1949 and soon afterwards I was joined by Ben R. Mottelson in a close cooperation that has continued over the years. Among the topics that have occupied us are: 1) The occurrence of rotational spectra as a striking consequence of nuclear deformation. The role of symmetry in the description of rotational spectra; 2) The role of correlations between pairs of nucleons that lead to a superfluid phase of nuclear matter; 3) The analysis of the spectrum of quantal channels for the fissioning nucleus passing over the saddle point; 4) The great variety of collective modes, involving the spatial density of nucleons and the spin, isospin, and pairing variables; 5) The development of a unified description of nuclear dynamics based on the coupling between particle and vibrational variables; 6) The effect of angular momentum on nuclear properties and the study of nuclear states with very high spin. In more recent years my research activity has focussed on the basis for quantum mechanics, in a

joint effort with Ole Ulfbeck. The project has centered on the origin of indeterminacy and the related nature of the fortuitous basic events (clicks in counters), which the probabilistic theory deals with. By a sharpened distinction between what happens on the spacetime scene (experiences) and what concerns the symbolic formalism, quantum mechanics is seen as having a fully abstract foundation, based on the representation of spacetime symmetry. The notion of a particle, as an intermediary between source and detector is, thereby, eliminated, as a remnant from classical physics, and the basic events are seen to come by themselves, without a cause (genuine fortuitousness). Lately, in a joint project with Ben R. Mottelson and Ole Ulfbeck, it has been found that genuine fortuitousness, as described above, provides the principle behind quantum mechanics. From this principle, which asserts that the basic event, a click in a counter, comes without any cause, the formalism of quantum mechanics emerges, no longer dealing with things (atoms, particles or fields) to be measured, but as the theory of distributions of uncaused clicks that form patterns laid down by spacetime symmetry. The subject, thereby, reveals itself with unexpected simplicity and beauty. The departure from usual quantum mechanics is strikingly borne out by the absence of Planck's constant from the theory. The elimination of indeterminate particles as cause for the clicks, which the principle of genuine fortuitousness implies, is analogous to the elimination of the ether implied by the principle of relativity.

Main publications Bohr, A., 'The Coupling of Nuclear Surface Oscillations to the Motion of Individual Nucleons', *Dan. Mat. Fys. Medd.*, 26 (14), (1952); Bohr, A., 'Collective and Individual-Particle Aspects of Nuclear Structure' (with Mottelson, B.), *Dan. Mat. Fys. Medd.*, 27 (16), (1953); Bohr, A., 'On the Theory of Nuclear Fission', *Proceedings Intern. Conference on Peaceful Uses of Atomic Energy* (Geneva, 1955), Vol. 2, pp. 151, UN (New York, 1956); Bohr, A., 'Study of Nuclear Structure by Electromagnetic Excitation with Accelerated Ions' (with Huus, T., Mottelson, B. and Winther, A.), *Rev. Mod. Phys.*, 28, 432 (1956); Bohr, A., 'Possible Analogy between the Excitation Spectra of Nuclei and those of the Superconducting Metallic State' (with Mottelson, B. and Pines, D.), *Phys. Rev.*, 110, p. 936 (1958); Bohr, A., 'Quantization and Stability of Currents in Superconductors' (with Mottelson, B.), *Phys. Rev.*, 125, p. 495 (1962); Bohr, A., *Elementary Modes of Nuclear Excitations and their Coupling*. Comptes Rendus du CIPN (Paris, 1964), *Centre National de la Recherche Scientifique*, pp. 437; Bohr, A., 'Pair Correlations and Double Transfer Reactions', *Nuclear Structure*, IAEA (Vienna, 1968), p. 179; Bohr, A., 'Perspectives in the Study of Nuclei with High

Angular Momentum' (with Mottelson, B.), suppl. *Journal Phys. Soc. of Japan*, 44, p. 157 (1978); Bohr, A., *Nuclear Structure*, Vol. I: Single-Particle Motion, 1969; Vol. II: *Nuclear Deformations*, 1975, (with Mottelson, B.), W.A. Benjamin Inc., New York; Bohr, A., 'Primary Manifestation of Symmetry. Origin of Quantal Indeterminacy' (with Ulfbeck, O.), *Rev. Mod. Phys.*, 67, p. 1 (1995); Bohr, A., 'Genuine Fortuitousness. Where Did That Click Come From?' (with Ulfbeck, O.), *Foundations for Physics*, 31, p. 757 (2001); Bohr, A., 'The Principle Underlying Quantum Mechanics' (with Mottelson, B. and Ulfbeck, O.), *Foundations for Physics*, in print (2004).

Thierry Boon-Falleur



Date and place of birth: 3 December 1944, Kessel-Lo, Belgium
Wife and children: Christine Huguier; Laurence, Marie
Appointment to the Academy: 6 Feb. 2002
Scientific discipline: Biology
Academic title: Professor, Université Catholique de Louvain

Most important awards, prizes and academies Awards: Prix Rik et Nel Wouters pour la recherche sur le cancer (1986); Prix De Vooght d'Immunologie (1986); Cancer Research Institute, Award for Research in Immunology (1987); Dr Joseph Steiner Cancer prize (1990); Prix Francqui (1990); Prix Louis Jeantet (1994); Rabbi Shai Shacknai Memorial Prize in Immunology and Cancer Research (1994); Prix Sandoz d'Immunologie (1995); Prix Léopold Griffuel (1999). Academies: Belgian Immunological Society; Société Belge de Biologie Cellulaire; Membre Titulaire, Académie Royale de Médecine de Belgique (1994); Associate Member, Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique (1996). Scientific Committees: Fonds National de la Recherche Scientifique; Caisse Générale d'Epargne et de Retraite; Committee of Cancer Experts of the European Community (1985-1993); Scientific Council of the Institut Curie, Paris; Fédération belge contre le Cancer. Editorial Boards: The European Journal of Immunology; Immunity; Cancer Cell; International Journal of Cancer.

Summary of scientific research Cancer immunotherapy is based on the notion that it is possible to artificially improve the immune response to tumor antigens to make it reach its full potential. Unlike responses directed against viral antigens, anti-tumoral responses may not have been perfected throughout evolution, because escaping cancer probably conferred little or no selective advantage. Our interest in tumor immunology started with a fortuitous observation made with a mouse tumor which was strictly non-immunogenic. Mice from which this tumor was removed by surgery did not show any protection against a challenge with the same tumor cells. We observed that by treating the tumor cells in vitro with a mutagen we obtained tumor cell mutants that were rejected in the mice by a T lymphocyte mediated process.

Remarkably the mice that had rejected these "tum-" mutants showed a degree of protection against a challenge with the original non-immunogenic tumor cells. This led to two conclusions. First, all mouse tumors bear tumor-specific antigens recognized by T cells even though many of them are non-immunogenic. Second, it is possible to create conditions that favor the T lymphocyte responses against the tumor antigens. On the basis of these findings we launched an effort to identify the antigens recognized on mouse tumors by T cells. A first step was to obtain in vitro cytolytic T lymphocytes (CTL) that specifically lysed the tumor cells. Antigenic transfectants could be detected on the basis of their ability to stimulate the proliferation of the relevant CTL clone and the genes coding for the antigens could be retrieved from these transfectants by using appropriate cosmid technology. Later the genes coding for these antigens were identified. Our results demonstrated that there are two major genetic processes that produce tumor-specific antigens. The first is the acquisition of mutations by the cancer cell, which generate peptides because of an amino-acid change. Mutated peptides either become capable of binding to major histocompatibility complex molecules or contain a new epitope. The second is the expression by the tumor of a gene which is not expressed in the normal cells of the adult. Around 1985 we began to examine whether the results obtained in mice could be extended to man. We focused our efforts on melanoma. Stimulation of T lymphocytes with autologous melanoma cells produced cytolytic T cells that appeared to lyse the tumor cells specifically. This led to the identification of the first gene coding for a human tumor-specific antigen recognized by T cells. This previously unknown gene was named *MAGE* and it was soon found to be expressed in many tumors and not in normal cells with the exception of male germline cells. Antigens encoded by cancer-germline genes ought to be very suitable as therapeutic vaccines for cancer-patients as they are strictly tumor-specific and present on a large proportion of tumors. Gene mutation was also found to be a major source of human tumor-specific antigens. Finally, we observed that CTL of melanoma patients can respond to antigens encoded by melanocytic differentiation genes, such as tyrosinase and Melan-A. Our first clinical trial involved the vaccination of metastatic melanoma patients with an antigenic peptide which is encoded by *MAGE-3* and presented by HLA-A1. Seven patients out of 26 showed evidence of tumor regression. No toxicity was observed. Similar results were observed after vaccination with the *MAGE-3* protein or with an ALVAC recombinant virus coding for *MAGE* sequences. We have therefore developed highly sensitive approaches for the detection of CTL responses com-

bined with an analysis of the T cell receptor diversity of the responding CTL. These approaches are beginning to show a correlation between CTL responses and tumor regressions. We will use these approaches to try to understand why only a minority of cancer patients respond to therapeutic vaccination.

The most relevant publications Van Pel, A., Boon, T., 'Protection against a non-immunogenic mouse leukemia by an immunogenic variant obtained by mutagenesis', *Proc. Natl. Acad. Sci. USA*, 79, pp. 4718-4722 (1982); De Plaen, E., Lurquin, C., Van Pel, A., Mariamé, B., Szikora, J-P., Wölfel, T., Sibille, C., Chomez, P. and Boon, T., 'Immunogenic (tum-) variants of mouse tumor P815: Cloning of the gene of tum- antigen P91A and identification of the tum- mutation', *Proc. Natl. Acad. Sci. USA*, 85, pp. 2274-2278 (1988); Lurquin, C., Van Pel, A., Mariamé, B., De Plaen, E., Szikora, J-P., Janssens, C., Reddehase, M.J., Lejeune, J. and Boon, T., 'Structure of the gene coding for tum- transplantation antigen P91A. A peptide encoded by the mutated exon is recognized with Ld by cytolytic T cells', *Cell*, 58, pp. 293-303 (1989); van der Bruggen, P., Traversari, C., Chomez, P., Lurquin, C., De Plaen, E., Van den Eynde, B., Knuth, A. and Boon, T., 'A gene encoding an antigen recognized by cytolytic T lymphocytes on a human melanoma', *Science*, 254, pp. 1643-1647 (1991); Traversari, C., van der Bruggen, P., Luescher, I., Lurquin, C., Chomez, P., Van Pel, A., De Plaen, E., Amar-Costesec, A. and Boon, T., 'A nonapeptide encoded by human gene MAGE-1 is recognized on HLA-A1 by cytolytic T lymphocytes directed against tumor antigen MZ2-E', *Journal of Experimental Medicine*, 176, pp. 1453-1457 (1992); Gaugler, B., Van den Eynde, B., van der Bruggen, P., Romero, P., Gaforio, J.J., De Plaen, E., Lethé, B., Brasseur, F. and Boon, T., 'Human gene MAGE-3 codes for an antigen recognized on a melanoma by autologous cytolytic T lymphocytes', *Journal of Experimental Medicine*, 179, pp. 921-930 (1994); Coulie, P., Lehmann, F., Lethé, B., Herman, J., Lurquin, C., Andrawiss, M. and Boon, T., 'A mutated intron sequence codes for an antigenic peptide recognized by cytolytic T lymphocytes on a human melanoma', *Proceedings of the National Academy of Sciences USA*, 92, pp. 7976-7980 (1995); Mandruzzato, S., Brasseur, F., Andry, G., Boon, T. and van der Bruggen, P., 'A CASP-8 mutation recognized by cytolytic T lymphocytes on a human head and neck carcinoma', *Journal of Experimental Medicine*, 186, pp. 785-793 (1997); Ikeda, H., Lethé, B., Lehmann, F., Van Baren, N., Baurain, J.-F., De Smet, C., Chambost, H., Vitale, M., Moretta, A., Boon, T. and Coulie, P.G., 'Characterization of an antigen that is recognized on a melanoma showing partial HLA loss by CTL expressing an NK inhibitory

receptor', *Immunity*, 6, pp. 199-208 (1997); Marchand, M., Van Baren, N., Weynants, P., Brichard, V., Dréno, B., Tessier, M-H., Rankin, E., Parmiani, G., Arienti, F., Humblet, Y., Bourland, A., Vanwijck, R., Liénard, D., Beauduin, M., Dietrich, P-Y., Russo, V., Kerger, J., Masucci, G., Jäger, E., De Greve, J., Atzpodien, J., Brasseur, F., Coulie, P.G., van der Bruggen, P., and Boon, T., 'Tumor regressions observed in patients with metastatic melanoma treated with an antigenic peptide encoded by gene MAGE-3 and presented by HLA-A1', *International Journal of Cancer*, 80, pp. 219-230 (1999); Morel, S., Lévy, F., Burlet-Schiltz, O., Brasseur, F., Probst-Kepper, M., Peitrequin, A-L., Monsarrat, B., Van Velthoven, R., Cerottini, J-C., Boon, T., Gairin, J.E. and Van den Eynde, B., 'Processing of some antigens by the standard proteasome but not by the immunoproteasome results in poor presentation by dendritic cells', *Immunity*, 12, pp. 107-117 (2000); Coulie, P.G., Karanikas, V., Colau, D., Lurquin, C., Landry, C., Marchand, M., Dorval, T., Brichard, V., and Boon, T., 'A monoclonal cytolytic T-lymphocyte response observed in a melanoma patient vaccinated with a tumor-specific antigenic peptide encoded by gene MAGE-3', *Proceedings of the National Academy of Sciences USA*, 98, pp. 10290-10295 (2001).

Nicola Cabibbo

Date and place of birth: 10 April 1935, Rome, Italy
Wife and children: Paola Iandolo; Andrea
Appointment to the Academy: 9 June 1986, President since 1993
Scientific discipline: Physics
Academic title: Professor of Theoretical Physics at the University of Rome 'La Sapienza' and President of the P.A.S.

Most important awards, prizes and academies Awards: Premio Alcide De Gasperi per le Scienze (1968); J.J. Sakurai Prize for Theoretical Particle Physics of the American Physical Society (1989); High Energy and Particle Physics Prize of the European Physical Society (1991). Academies: Socio Nazionale dell'Accademia Nazionale dei Lincei, Rome; Socio Nazionale dell'Accademia delle Scienze, Turin; Foreign Member of the National Academy of Sciences, USA; Foreign Member of the American Academy for Arts and Sciences; Member of the Pontifical Academy of Sciences. Loeb Lecturer, Harvard University (1965).

Summary of scientific research Nicola Cabibbo is a theoretical physicist who has worked on different aspects of elementary particles and their interactions. He has made important contributions to the theory of weak interactions, in particular through the discovery of the phenomenon of quark and current mixing. This discovery established the existence of a new class of physical constants, whose first example is the Cabibbo angle which determines the mixing of strange quarks with non-strange quarks. At the same time this discovery clarified the behaviour of weak interactions for different quark species, thus creating the basis for the development of unified theories of weak and electromagnetic interactions. N. Cabibbo carried on (in collaboration with R. Gatto) the first theoretical studies on the use of electron positron colliding beam machines, demonstrating their great promise for revealing new aspects of elementary particle structure. An important contribution to the theory of strong interaction has been the demonstration that the extended nature of hadrons as quark composites implies the existence of a new phase of hadronic matter (obtained at high temperature or high density) where quarks are deconfined. An experimental signature for the existence

of this phase is given by the exponential nature of the hadron spectrum.
In recent years the scientific activity of N. Cabibbo has been centered on the use of large computers for the numerical simulation of quark interactions. He established the methods for applying numerical simulation to the study of weak interaction of quarks. In the same period he became interested in computer architecture and is now engaged in building a Supercomputer (APE) particularly adapted to the problems of numerical simulation.

Main publications Cabibbo, N., Gatto, R., 'Electron-Positron Colliding Beam Experiments', *Physical Review*, 124, p. 1577 (1961); Cabibbo, N., 'Measurement of the Linear Polarization of g Rays by the Elastic Photoproduction of p 0 on He 4', *Physical Review*, 124, p. 1577 (1961); Cabibbo, N. and Gatto, R., 'Proton-Antiproton Annihilation into Electrons, Muons and Vector Bosons', *Il Nuovo Cimento*, 24, pp. 170-180 (1962); Cabibbo, N., 'Unitary Symmetry and Leptonic Decays', *Phys. Rev. Lett.*, 10, pp. 531-533 (1963); Cabibbo, N. and Maksymowicz, A., 'Determination of the Form Factors in $K\mu_3$ Decays', *Phys. Lett.*, 9, pp. 352-353 (1964); Cabibbo, N., 'Unitary Symmetry and Nonleptonic Decays', *Phys. Rev. Lett.*, 12, pp. 62-63 (1964); Cabibbo, N. and Radicati, L.A., 'Sum Rule for the Isovector Magnetic Moment of the Nucleon', *Phys. Lett.*, 19, pp. 697-699 (1966); Cabibbo, N., Parisi, G. and Testa, M., 'Hadron Production in $e^+ e^-$ Collisions', *Lettere al Nuovo Cimento*, 4, pp. 35-39 (1970); Altarelli, G., Cabibbo, N. and Maiani, L., 'The Drell-Hearn Sum Rule and the lepton Magnetic Moment in the Weinberg Model of Weak and Electromagnetic Interactions', *Phys. Lett.*, 40B, pp. 415-419 (1972); Bahcall, J.N., Cabibbo, N. and Yahil, A., 'Are Neutrinos Stable Particles?', *Phys. Rev. Lett.*, 28, pp. 316-318 (1972); Cabibbo, N. and Parisi, G., 'Exponential Hadronic Spectrum and Quark Liberation', *Phys. Lett.*, 59B, pp. 67-69 (1975); Cabibbo, N., 'Bag Models', *Proceedings of the International Neutrino Conference*, Aachen (1976); Cabibbo, N., 'Time Reversal Violation in Neutrino Oscillation', *Phys. Lett.*, 72B, pp. 333-335 (1978); Cabibbo, N., 'The Impact of Gauge Theory on Elementary Particle Physics', *Proceedings of the Thirteenth 'Gauge Theories Leptons' Rencontre de Moriond*, Vol. II, (J. Tran Thanh Van, ed.) (1978); Cabibbo, N., 'Parton Distributions and their Q2 Dependence', *The Whys of Subnuclear Physics*, Plenum Publishing Corporation (1979); Cabibbo, N. and Maiani, L., 'The Vanishing of Order-G Mechanical Effects of Cosmic Massive Neutrinos on Bulk Matter', *Phys. Lett.*, 114B, pp. 115-117 (1982); Cabibbo, N. and Marinari, F., 'New Method for Updating SU(N) Matrices in Computer Simulations of Gauge Theories', *Phys.*

Lett., 119B, p. 387 (1982); Cabibbo, N., 'Gauge Theories and Monopoles' (A Modest Introduction) *Techniques and Concepts of High Energy Physics* (Thomas Ferbel, ed.), NATO ASI Series, Series B: *Physics*, vol. *99* (47) Plenum Press (1983), New York, *Proceedings of the Second NATO Advanced Study Institute*, Lake George (July 1982); Allega, M., Cabibbo, N., 'Acoustic Detection of Superheavy Monopoles in Gravitational Antennas', *Lett. Nuovo Cimento*, 38, pp. 263-269 (1983); Cabibbo, N., Martinelli, G. and Petronzio, R., 'Weak Interactions on the Lattice', *Nuclear Physics*, 244B, pp. 381-391 (1984); Cabibbo, N., 'Quark Mixing', Proceedings of the X Capri Symposium, *30 Years of Elementary Particle Theory* (May 1992).

Luis Angel Caffarelli

Date and place of birth: 8 December 1948, Buenos Aires, Argentina
Wife and children: Irene M. Gamba; Alejandro, Nicolas, Mauro
Appointment to the Academy: 2 August 1994
Scientific discipline: Mathematics
Academic title: Professor at the University of Texas at Austin

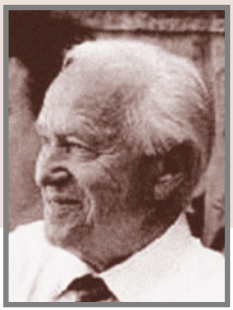
Most important awards, prizes, and academies Professional societies: American Mathematical Society; American Academy of Arts and Sciences (1986); National Academy of Sciences (1991); Pontifical Academy of Sciences; Unión Matemática Argentina; Foreign Member, Academia Nacional de Ciencias, Buenos Aires and Córdoba; Foreign Member, Accademia Nazionale delle Scienze; Foreign Member, Accademia Nazionale dei Lincei. Honours and awards: Plenary Lecturer at ICM Beijing (2002); Fermi Lectures, Scuola Normale di Pisa (1998); Colloquium Lecturer – A.M.S. (1993); Pius XI Gold Medal (1988); Invited Lecturer, Math into the XXI Century Series, A.M.S. Centennial Celebration Guggenheim Fellowship (1985); Bocher Prize (1984); Co-awarded Stampacchi Prize (1982); Premio Konex Platino-Brillante (2003); Doctor Honoris Causa Universidad Autónoma de Madrid, École Normale Superieur, and Universidad de la Plata; Honorary Professor Universidad de Buenos Aires and Universidad de Mar del Plata.

Summary of scientific research Luis Caffarelli works in non linear analysis, mainly on non linear partial differential equations arising from geometry and mechanics, He has conducted extensive research into free boundary and singular perturbation problems. Caffarelli has worked on free boundary problems that arise naturally when a constitutive relation or a conserved quantity (a temperature, a pressure, a density) changes discontinuously its behavior across some value of the variables under consideration. Typical examples are solid-liquid interphases, burnt-unburnt mixtures in flame propagation, and flow in porous media. Understanding of the geometry and stability of the solution and its interphase is important in selecting and evaluating simulation methods, as well as understanding the models themselves. Another area of research is fully non linear equations and optimal

transportation. Fully non linear equations arise in optimization and optimal control. They have also been recently studied in relation to optimal transportation and optimal antenna design. Other areas of interest are incompressible flows, harmonic maps, and minimal surface theory and more recently, on non linear random homogenization.

Main publications Caffarelli, L.A., 'Non linear elliptic theory and the Monge-Ampere equation', *Proceedings of the International Congress of Mathematicians*, Vol. I, pp. 179-187, Higher Ed. Press (Beijing, 2002); Caffarelli, L.A., Jerison, D., Kenig, C.E., 'Some new monotonicity theorems with applications to free boundary problems', *Ann. of Math.*, (2) 155 (2002), no. 2, pp. 369-404 (Reviewer: Ján Lovivsek); Caffarelli, L.A., Roquejoffre, J.-M., 'A nonlinear oblique derivative boundary value problem for the heat equation: analogy with the porous medium equation', *Ann. Inst. H. Poincaré Anal. Non Linéaire*, 19 (2002), no. 1, pp. 41-80 (Reviewer: Jesús Hernández); Caffarelli, L.A., Feldman, M., McCann, R.J., 'Constructing optimal maps for Monge's transport problem as a limit of strictly convex costs', *J. Amer. Math. Soc.*, 15 (2002), no. 1, pp. 1-26 (electronic), (Reviewer: J.E. Brothers); Caffarelli, L.A., Viaclovsky, J.A., 'On the regularity of solutions to Monge-Ampère equations on Hessian manifolds', *Comm. Partial Differential Equations*, 26 (2001), no. 11-12, pp. 2339-2351 (Reviewer: John Urbas); Athanasopoulos, I., Caffarelli, L.A., Salsa, S., 'The free boundary in an inverse conductivity problem', *J. Reine Angew. Math.*, 534 (2001), pp. 1-31 (Reviewer: Hong Ming Yin); Caffarelli, L. A., 'The obstacle problem. Lezioni Fermiane', [Fermi Lectures] *Accademia Nazionale dei Lincei*, Rome, *Scuola Normale Superiore*, Pisa, 1998, pp. ii+54, pp. 49-02; Athanasopoulos, I., Caffarelli, L.A., Salsa, S., 'Caloric functions in Lipschitz domains and the regularity of solutions to phase transition problems.', *Ann. of Math.*, (2), 143 (1996), no. 3, pp. 413-434 (Reviewer: Elena Comparini); Caffarelli, Luis A., 'A priori estimates and the geometry of the Monge Ampère equation', *Nonlinear partial differential equations in differential geometry (Park City, UT, 1992),* 5–63, IAS/Park City Math. Ser., 2, *Amer. Math. Soc., Providence, RI* (1996), (Reviewer: John Urbas); Caffarelli, L.A., Cabré, X., 'Fully nonlinear elliptic equations', *American Mathematical Society Colloquium Publications*, 43, *American Mathematical Society, Providence, RI* (1995), pp. vi+104 (Reviewer: P. Lindqvist); Caffarelli, L.A., Gidas, B., Spruck, J., 'Asymptotic symmetry and local behavior of semilinear elliptic equations with critical Sobolev growth', *Comm. Pure Appl. Math.*, 42 (1989), no. 3, pp. 271-297 (Reviewer: Robert McOwen).

Luigi Luca Cavalli-Sforza



Date and place of birth: 25 January 1922, Genoa, Italy
Wife and children: Albamaria Ramazzotti; Matteo, Francesco, Luca Tommaso, Violetta
Appointment to the Academy: 2 August 1994
Scientific discipline: Biology (Genetics of Human Populations)
Academic title: Emeritus Professor at Stanford University

Most important awards, prizes and academies Awards: Catalonia Prize; Fyssen Prize, Paris; Balzan Prize; Accademia dei Lincei Prize. Academies: Member and former President of the American Society of Human Genetics; former President of the Biometric Society; Hon. Foreign Member of the American Academy of Arts and Sciences and the US National Academy of Sciences; Foreign Member of the Royal Society and of Académie de Science, Institut de France; Accademia Nazionale dei Lincei. Honorary degrees: Columbia University, NY; Cambridge University, UK; University of Calabria; University of Bologna; University of Cagliari; University of Rome; University of Sassari.

Summary of scientific research His research concentrated on bacterial genetics during the period 1942-1954 and has focused on human population genetics and evolution since 1951.

Main publications Cavalli-Sforza, L., *The Genetics of Human Populations*, Freeman (New York, 1971) and Dover Publications (New York, 1999); Cavalli-Sforza, L., *Cultural Transmission and Evolution*, Princeton Univ. Press (1981); Cavalli-Sforza, L., *The Neolithic Transition and Population Genetics of Europe*, Princeton UP (1984); Cavalli-Sforza, L., *African Pygmies*, Acad. Press (1986); Cavalli-Sforza, L., *History and Geography of Human Genes*, Princeton UP (June-July 1994); Italian edition published by Adelphi; Cavalli-Sforza, L., *Chi Siamo*, Mondadori (1993), English edition, *The Great Human Diasporas*; Cavalli-Sforza, L., *Genes, Peoples and Languages*, Ferrar Strauss and Giroux (1999), Penguin Press (2000), Italian edition published by Adelphi; Cavalli-Sforza, L., *The Meaning of Nature*, *Scripta Varia* 95, Vatican City (2000), pp. 195-209.

Te-Tzu Chang

Date and place of birth: 3 April 1927, Shanghai, China
Wife and children: Szu-Mei Hwa; Dean, Jih-Wen
Appointment to the Academy: 17 March 1997
Scientific discipline: Agriculture (Crop Science)
Academic title: Researcher, Institute of Botany, Academia Sinica, Taiwan

Most important awards, prizes and academies Awards: John Scott Award and Medal (for the invention of IR8 dwarf rice); International Service in Agronomy Award; Frank Meyer Award and Medal on Plant Germplasm and International Service in Crop Science Award of the CSSA; Rank Prize in Food and Nutrition, London; Tyler Prize for Environmental Achievement. Academies: Agricultural Association of China, Taiwan; American Society of Agronomy; Crop Science Society of America; Institute of Biology, UK; Society for the Advancement of Breeding Research in Asia and Oceania; Crop Science Society, Philippines; Foreign Associate of the National Academy of Sciences, USA; Fellow of the National Academy of Agricultural Sciences, India; Third World Academy of Sciences, Trieste, Italy; Academia Sinica; Hon. Foreign Member, American Academy of Arts and Sciences.

Summary of scientific research Dr. Chang has directed his attention to crop improvement and genetic resources conservation. He played a pivotal role in the 'Green Revolution' in rice by introducing and incorporating the *sd-1* semidwarfing gene from Taiwan which confers high productivity on tropical rices, and has supported continuing advances by supplying useful germplasm. He has also rescued numerous threatened land races and wild rices through collaborative field collecting and persuading Asian and African nations to deposit their national rice collections for safekeeping in the IRRI Germplasm Center with the guarantee of repatriation, and has helped China, the USA, India and Taiwan in designing modern seed preservation banks. In addition, he has trained more than a thousand young rice workers from developing nations in rice production, breeding, and germplasm conservation.

Main publications Chang, T.-T., 'Genetics and Evolution of the Green Revolution', *UNESCO-CSIC Symp. On Biology and Ethics*, CSIC (Madrid,

1979), pp. 187-209; Chang, T.-T. and Li, C.C. 'Genetics and Breeding', in *Rice: Production and Utilization*, AVI (Westport, 1980), pp. 87-146; Chang, T.-T., 'Sustaining and Expanding the Green Revolution in Rice', *South-East Asia's Environmental Future: The Search for Sustainability*, UN University Press (Tokyo, 1993), pp. 291-220; Chang, T.-T. *et al.*, 'The Conservation and Use of Rice Genetic Resources', *Adv. Agron.*, 35, pp. 37-91 (1982); Chang, T.-T., 'Conservation of Rice Genetic Resources: Luxury or Necessity?', *Science*, 224, pp. 251-256 (1984); Chang, T.-T. *et al.* 'Management and Utilization of Plant Germplasm Collections', *Beltsville Smypos. on Agric. Research 13*, Kluwer (1989), pp. 127-159; Chang, T.-T., *Expansion of the U.S. National Seed Storage Laboratory*, National Academy Press (1988); Chang, T.-T., 'The Case for Large Collections', *The Use of Plant Genetic Resources*, Cambridge Univ. Press (1989), pp. 123-156; Chang, T.-T., 'The Human Factor', *Plant Genetic Resources Conservation: Perspectives for the 2000s*, TARI, Taichung (Taiwan, 1994), pp. 123-4; Chang, T.-T., 'The Origins and Early Cultures of the Cereal Grains and Food Legumes', *The Origins of Chinese Civilization* (California, 1983), pp. 65 ff.; Chang, T.-T., 'The Impact of Rice on Human Civilization and Population Expansion', *Interdisciplinary Science Review*, 12, pp. 63-69 (1987); Chang, T.-T., 'Plant Genetic Resources: Key to Future Food Production', *Iowa State J. Research*, 59, pp. 325-496 (1985); Chang, T.-T., *Managing Global Genetic Resources: Agricultural Crop Issues and Policies*, National Academy Press (1993); Chang, T.-T., 'Rice', *The Cambridge World History of Food*, Cambridge Univ. Press (2000), Vol. I, pp. 132-149; Chang, T.-T. *et al.* (eds.), *Food Needs of the Developing World in the Early Twenty-First Century*, The Pontifical Academy of Sciences (1999), p. 475.

Claude Cohen-Tannoudji

Date and place of birth: 1 April 1933, Constantine, Algeria
Wife and children: Jacqueline; Joëlle, Michel
Appointment to the Academy: 17 May 1999
Scientific discipline: Physics
Academic title: Professor at the Collège de France

Most important awards, prizes and academies Nobel Prize in Physics (1997). Academies: Académie des Sciences, Paris; National Academy of Sciences, USA; American Academy of Arts and Sciences; Accademia Nazionale dei Lincei, Italy; Académie Royale des Sciences, des Lettres et des Beaux-Arts, Belgium; Russian Academy of Sciences.

Summary of scientific research The scientific problems investigated by Claude Cohen-Tannoudji deal with radiation-matter interactions. With his collaborators he has written five books on quantum mechanics, quantum electrodynamics and quantum optics, and about 200 theoretical and experimental papers on various problems of atomic physics and quantum optics.

During his Ph.D. done under the supervision of Alfred Kastler and Jean Brossel, he predicted that atomic energy levels should be displaced by light and he observed the corresponding light shifts. A few years later, he showed that very narrow level crossing resonances can be observed in atomic ground states and he detected in this way very weak magnetic fields (in the nanogauss range). With his students, S. Haroche, J. Dupont-Roc, S. Reynaud and J. Dalibard, he developed the dressed atom approach for describing atom-photon interactions. This approach has been very useful, not only in understanding in a synthetic way various physical effects in the RF and optical domains (Autler-Townes effect, fluorescence triplet, photon antibunching, intermittent fluorescence, dipole forces …), but also in discovering new physical effects (cancellation of an atomic g-factor by a RF field, time correlations between frequency filtered photons, Sisyphus effect …). He developed simple physical pictures for radiative corrections such as the Lamb shift and the spin anomaly g-2. During the last fifteen years, he has made with his collaborators, A. Aspect, J. Dalibard and Ch. Salomon, several contributions to the

field of manipulation of atoms by light, such as the Sisyphus cooling mechanism where a moving atom is running up potential hills more frequently than down, or the use of velocity selective dark states for cooling atoms at one, two and three dimensions, below the limit corresponding to the recoil kinetic energy of an atom emitting or absorbing a single photon. Other recent contributions have investigated gravitational cavities for neutral atoms where cold atoms bounce (up to 10 times) off a mirror formed by an evanescent wave, and the quantization of atomic motion and the localization of atoms in periodic optical potential wells. Very recently, his group has observed Bose-Einstein condensation of helium atoms in a metastable state. He was co-laureate of the 1997 Nobel Prize in Physics for the development of methods to cool and trap atoms with laser light.

Main publications Books: Cohen-Tannoudji, C., Diu, B., Laloë, F., *Quantum Mechanics*, Tomes I and II, Wiley (New York, 1997); Cohen-Tannoudji, C., Dupont-Roc, J., Grynberg, G., *Photons and Atoms*, *Introduction to Quantum Electrodynamics*, Wiley (New York, 1989); Cohen-Tannoudji, C., Dupont-Roc, J., Grynberg, G., *Atom-Photon Interactions: Basic Processes and Applications*, Wiley (New York, 1992); Cohen-Tannoudji, *Atoms in Electromagnetic Fields*, World Scientific (Singapore, 1994); Bardou F., Bouchaud, J.-P., Aspect, A., Cohen-Tannoudji, C., *Lévy Statistics and Laser Cooling, How Rare Events Bring Atoms to Rest* (Cambridge, 2001). Articles: Cohen-Tannoudji, C., 'Théorie quantique du cycle de pompage optique. Vérification exprimentale des nouveaux effets prévus' (Ph.D. Paris), *Ann. Phys. Paris*, 7, pp. 423-469 (1962); Cohen-Tannoudji, C., Dupont-Roc, J., 'Experimental study of Zeeman light shifts in weak magnetic fields', *Phys. Rev.*, A5, p. 968 (1972); Dupont-Roc, J., Haroche, S., Cohen-Tannoudji, C., 'Detection of very weak magnetic fields (10-9 Gauss) by Rb-87 zero-field level crossing resonances', *Phys.*, *Letters*, A28, p. 638 (1969); Dalibard, J., Cohen-Tannoudji, C., 'Dressed-atom approach to atomic motion in laser light: the dipole force revisited', *J.O.S.A.*, B2, p. 1707 (1985); Aspect, A., Dalibard, J., Heidmann, A., Salomon, C., Cohen-Tannoudji, C., 'Cooling atoms with stimulated emission', *Phys. Rev. Lett.*, 57, p. 1688 (1986); Dalibard, J., Cohen-Tannoudji, C., 'Laser cooling below the Doppler limit by polarization gradients: simple theoretical models', *J.O.S.A.*, B6, p. 2023 (1989); Aspect, A., Arimondo, E., Kaiser, R., Vansteenkiste, N., Cohen-Tannoudji, C., 'Laser cooling below the one-photon recoil energy by velocity-selective coherent population trapping', *Phys. Rev. Lett.*, 61, p. 826 (1988); Verkerk, P., Lounis, B., Salomon, C., Cohen-Tannoudji, C., Courtois,

J.-Y., Grynberg, G., 'Dynamics and spatial order of cold cesium atoms in a periodic optical potential', *Phys. Rev. Lett.*, 68, p. 3861 (1992); Aminoff, C.G., Steane, A.M., Bouyer, P., Desbiolles, P., Dalibard, J., Cohen-Tannoudji, C., 'Cesium atoms bouncing in a stable gravitational cavity', *Phys. Rev. Lett.*, 71, p. 3083 (1993); Bardou, F., Bouchaud, J.-P., Emile, O., Aspect, A., Cohen-Tannoudji, C., 'Sub-recoil laser cooling and Lévy flights', *Phys. Rev. Lett.*, 72, p. 203 (1994); Kulin, S., Saubamea, B., Peik, E., Lawall, J., Hijmans, T.W., Leduc, M., Cohen-Tannoudji, C., 'Coherent Manipulation of Atomic Wave Packets by Adiabatic Transfer', *Phys. Rev. Lett.*, 78, p. 4185 (1997); Saubama, B., Hijmans, T.W., Kulin, S., Rasel, E., Peik, E., Leduc, M., Cohen-Tannoudji, C., 'Direct Measurement of The Spatial Correlation Function of Ultracold Atoms', *Phys. Rev. Lett.*, 79, p. 3146 (1997); Pereira, F., Leonard, J., Wang, J., Barrelet, C., Perales, F., Rasel E., Unnikrishnan, C., Leduc, M., Cohen-Tannoudji, C., 'Bose-Einstein Condensation of Metastable Helium', *Phys. Rev. Lett.*, 86, p. 3459 (2001).

Bernardo Maria Colombo

Date and place of birth: 24 February 1919, Olginate, Lecco, Italy
Wife and children: Paolina Mariani; Giovanni, Carlo, Paolo
Appointment to the Academy: 18 Sept. 1992
Scientific discipline: Demography
Academic title: Emeritus Professor at the University of Padua

Most important awards, prizes and academies Gold medal for merit in education, culture and arts. Academies: Società Italiana di Statistica; International Union for the Scientific Study of Population; International Statistical Institute; International Association for Official Statistics; Socio effettivo, Accademia Patavina di Scienze, Lettere ed Arti; Socio effettivo, Istituto Veneto di Scienze, Lettere ed Arti; Pontifical Academy of Sciences.

Summary of scientific research Starting from a basic preparation in statistics, Prof. Colombo, during a long career, has pursued several lines of research. After early work on the theory of hypothesis testing and original contributions to the techniques of sequential analysis, he moved to an interest in demographic problems. In this field he has been involved both in the methodology of measurements of fertility and nuptiality, and in factual analysis, with particular reference to the startling phenomenon of the recovery of the birth rate in several countries during the last world war and to the incidence of illegal abortion in Italy. To this kind of research work he has joined continuous attention to fundamental aspects of demographic policies in order to find reasonable lines of intervention which respect basic human rights and lead to acceptable solutions through a balance between free individual decisions and collective needs and targets. Strongly engaged in consulting work for civil authorities, his main contribution has been suggestions about the organization of the school system and the methodology of production of good official statistics. He has also carried out biometrical research, starting with a thorough study on the primary and secondary sex ratio in man. His most recent and engaging work, with responsibility for the coordination of large undertakings at the international and national levels, centers on a subject – the biometry of the menstrual cycle and especially of fecundability – which is at the heart of the

interaction of the biological and behavioural components of reproduction, that is to say the history of individuals as well as of human populations.

Main publications Colombo, B., *La recente inversione nella tendenza della natalità*, CEDAM, Padova (1951); Colombo, B., 'Sulla misura della fertilità matrimoniale e sulla determinazione della sua dinamica', *Riv. Intern. di Scienze Soc.*, 61, pp. 40-58 (1953); Colombo, B., 'Intorno all'estrapolazione della dinamica della nuzialità', *Statistica*, 14, pp. 747-775 (1954); Colombo, B., 'On the sex ratio in man', *Cold Spring Harbor Symposia on Quantitative Biology*, 22, pp. 193-202 (1957); Colombo, B., 'Appunti di metodologia sequenziale', *Mem. Acc. Patav. di Sc., Lett. ed Arti*, 71, pp. 113-140 (1959); Colombo, B., *Prospettive per la scuola dopo l'obbligo*, Il Mulino, Bologna (1971); Colombo, B., *La diffusione degli aborti illegali in Italia*, Vita e Pensiero, Milano (1977); Colombo, B., 'Droits de l'homme, idéologies et politiques démographiques', *Actes – Congrés International de la Population – Mexico 1977*, Union Intern. pour l'Et. Scient. de la Pop., Liège, pp. 541-590 (1978); Colombo, B., 'Le statistiche demografiche', ISTAT, *Annali di Stat.*, Serie IX, 1, pp. 19-53 (1981); Colombo, B., 'Riflessioni sullo sfruttamento intensivo dei risultati censuari', *Statistica*, 42, 4, pp. 455-476 (1982); Colombo, B., 'La qualità dei dati statistici', *Atti del convegno di Trieste*, Vol. I, Soc. Ital. di Stat., pp. 25-65 (1983); Colombo, B., 'Politiche demografiche e politiche sociali: possibilità e opportunità d'intervento', *Secondo rapporto sulla situazione demografica italiana*, Ist. di Ric. sulla Popol., CNR, Roma, pp. 327-347 (1988); Colombo, B., 'Biometrical research on some parameters of the menstrual cycle', *Intern. Jl. of Gynec. and Obst.,* Suppl. 1, pp. 13-18 (1989); Fortuna, I. and Colombo, B., 'La regolarità degli eventi rari in Demografia', *Atti e Memorie dell'Accademia Patavina di Scienze, Lettere ed Arti*, Parte III, Classe di Scienze Matematiche e Naturali, 103, pp. 65-83 (1992); Colombo, B., *Resources and Population: Natural, Institutional and Demagraphic Dimensions of Development* (a cura di Bernardo Colombo, Paul Demeny e Max Perutz), Clarendon Press, Oxford (1996); Colombo, B. and Scarpa, B., 'Calendar Methods of Fertility Regulation: a rule of thumb', *Statistica*, 56, 1, pp. 3-14 (1996); Colombo, B., 'Evaluation of fertility predictors and comparison of different rules', *Genus*, 54, 3-4, pp. 153-167 (1998); Colombo, B. and Masarotto, G., *Daily Fecundability: First Results from a New Data Base*, http://www.demographic-research.org/Volumes/Vol3/5/ (2000); Dunson, D.B., Baird, D.D. and Colombo, B., 'Changes with age in the level and duration of fertility in the menstrual cycle', *Human Reproduction*, 17, 5, pp. 1399-1403 (2002); Dunson, D.B. and Colombo, B., 'Bayesian Modelling of Markers of Day – Specific Fertility', *Jl. of the Amer. Stat. Ass.*, 98, 461, pp. 28-37 (2003).

Suzanne Cory

Date and place of birth: 11 March 1942, Melbourne, Australia
Wife and children: Jerry Adams; Keren, Karly
Appointment to the Academy: 27 January 2004
Scientific discipline: Molecular Biology
Academic title: Professor

Most important awards, prizes and academies Awards: David Syme Prize, University of Melbourne (1982); Avon Australia 'Spirit of Achievement' Award (1992); Lemberg Medal, Australian Society for Biochemistry & Molecular Biology (1995); Burnet Medal, Australian Academy of Science (1997); Australia Prize (shared) (1998); Charles S. Mott Prize (shared), General Motors Cancer Research Foundation (1998); L'Oreal – UNESCO Women in Science Award (2001); Royal Medal, Royal Society (2002); Centenary of Federation Medal, Australia (2003). Academies: Fellow, Australian Academy of Sciences (1986); Fellow, Royal Society (1992); Honorary Member of American Association for Immunology (1993-); Fellow, Royal Society of Victoria (1996); Foreign Member of the US National Academy of Science (1997); Asia-Pacific International Molecular Biology Network (1998); Foreign Honorary Member, American Academy of Arts and Sciences (2001); Associate Foreign Member of the French Academy of Sciences (2002); Australian Academy of Science; Royal Society; Australian Society for Biochemistry and Molecular Biology; American Association for Cancer Research; American Association for Immunology; Royal Society of Victoria; US National Academy of Sciences; American Academy of Arts & Sciences; French Academy of Sciences. Honours: Overseas Science Research Scholarship from the Royal Commission for the Exhibition 1851 (1966-68); Rothmans Fellowship (1969-71); Queen Elizabeth II Fellowship (1972-74); Roche Fellowship (1974-76); International Research Scholar, Howard Hughes Medical Institute (1992-97); Appointment as Companion in the Order of Australia (1999); Cavalcade of Australian Scientists (13 selected over past century); Centenary of Federation Victorian Honour Roll of Women (2001); ISI Australian Citation Laureate (2001). Honorary degrees: Degree of Doctor of Science (Honoris Causa) The

University of Sydney (2000); Degree of Doctor of Science (Honoris Causa) The University of Oxford (2004). Research Professor of Molecular Oncology, University of Melbourne (1993-96).

Summary of scientific research Suzanne Cory's research has had a major impact on the understanding of immunology and the development of cancer. After pioneering Ph.D. studies determining the sequence of methionine transfer RNA, using the sequencing methods that had just been developed by Fred Sanger, her post-doctoral studies at the University of Geneva focused on sequence analysis of R17 phage RNA a model messenger RNA. Cory and Adams returned to Melbourne in 1971 to The Walter and Eliza Hall Institute. During the first few years, they discovered 5' caps on mammalian messenger RNAs, helped to introduce gene cloning technology in Australia, and addressed a central puzzle regarding the immune response: how does the body make the myriad antibodies needed to fight diverse infectious agents? Their laboratory helped uncover the astonishing solution: antibody genes are encoded as bits and pieces which can combine in a myriad ways, thereby creating much greater diversity with which to fight infection. In 1981, their attention turned to the nature of the genetic accidents that cause cancer. Their laboratory showed that damage to chromosomes can activate cancer-promoting genes. They tracked down the mutation which activates the oncogene *myc* and leads to Burkitt's lymphoma, a malignancy of antibody-producing cells. In collaboration with Alan Harris, they then engineered novel lines of lymphoma-prone mice, to study the early stages of disease and test for synergistic mutations. The current focus of their research is how cells decide whether to live or die. This program was launched in 1988 by the seminal finding of David Vaux in their laboratory that *bcl-2,* the gene responsible for follicular lymphoma, promotes cell survival. This discovery opened an entirely new way of thinking about cancer development, since all other oncogenes (cancer-causing genes) had been found to promote cell proliferation. The *bcl-2* gene proved to have numerous relatives, and some actually promote cell death (apoptosis) rather than cell survival. Today, a major program at the Hall Institute, led by Adams, Cory, Harris, Strasser, Huang, Vaux, Gerondakis and Colman is directed to understanding how apoptosis is controlled, influences normal development and contributes to cancer and other diseases. This knowledge will lead to the development of more effective therapeutics far cancer and degenerative diseases.

Main publications Adams, J.M. and Cory, S., 'Modified nucleosides and bizarre 5'-termini in mouse myeloma rnRNA', *Nature*, 255, pp. 28-33 (1975); Cory, S. and Adams, J.M., 'Deletions are associated with somatic

rearrangement of immunoglobulin heavy chain genes', *Cell*, 19, pp. 37-51 (1980); Adams, J.M., Gerondakis, *S.,* Webb, E., Corcoran, L.M. and Cory, S., 'Cellular *myc* oncogene is altered by chromosome translocation to an immunoglobulin locus in murine plasmacytomas and rearranged similarly in Burkitt lymphomas of man', *Proc. Natl. Acad. Sci. USA*, 80, pp. 1982-1986 (1983); Corcoran, L.M., Adams, J.M., Dunn, A.R. and Cory, S., 'Murine T lymphomas in which the cellular *myc* oncogene has been activated by retroviral insertion', *Cell*, 37, pp. 113-122 (1984); Adams, J.M., Harris, A.W., Pinkert, C.A., Corcoran, L.M., Alexander, W.S., Cory, S., Palmiter, R.D. and Brinster, R.L., 'The *c-myc* oncogene driven by immunoglobulin enhancers induces lymphoid malignancy in transgenic mice', *Nature*, 318, pp. 533-538 (1985); Vaux, D., Cory, S. and Adams, J.M., '*Bcl-2* gene promotes haematopoietic cell survival and co-operates with *c-myc* to immortalize pre-B cells', *Nature*, 335, pp. 440-442 (1988); Johnson, G.R., Gonda, T.J., Metcalf, D., Hariharan, J.K. and Cory, S., 'A lethal myeloproliferative syndrome in mice transplanted with bone marrow cells infected with a retrovirus expressing granulocyte-macrophage colony stimulating factor', *EMBO J.*, 8, pp. 441-448 (1989); Strasser, A., Harris, A.W., Bath, M.L. and Cory, S., 'Novel primitive lymphoid tumours induced in transgenic mice by cooperation between *myc* and *bcl-2*', *Nature*, 348, pp. 331-333 (1990); Rosenbaum, H., Harris, A.W., Bath, M.L., McNeall, J., Webb, E., Adams, J.M. and Cory, S., 'An Eμ-v-*abl* transgene elicits plasmacytomas in concert with an activated *myc* gene', *EMBO J.*, 9, pp. 897-905 (1990); Elefanty, A.G., Hariharan, I.K. and Cory, S., '*bcr-abl,* the hallmark of chronic myeloid leukaemia in man, induces multiple haemopoietic neoplasms in mice', *EMBO J.*, 9, pp. 1069-1078 (1990); Perkins, A., Kongsuwan, K., Visvader, J., Adams, J.M. and Cory, S., 'Homeobox gene expression plus autocrine growth factor production elicits myeloid leukemia', *Proc. Natl. Acad. Sci. USA*, 87, pp. 8398-8402 (1990); Strasser, A., Harris, A.W. and Cory, S., '*bcl-2* transgene inhibits T cell death and perturbs thymic self-censorship', Cell, 67, pp. 889-899 (1991); Adams, J.M. and Cory, S., 'The Bcl-2 protein family: arbiters of cell survival', *Science*, 281, pp. 1322-1326 (1998); Print, C.G., Loveland, K.L., Gibson, L., Meehan, T., Stylianou, A., Wreford, N., de Kretser D., Metcalf, D., Kontgen, F., Adams, J.M. and Cory, S., 'Apoptosis regulator Bcl-w is essential far spermatogenesis but appears otherwise redundant', *Proc. Natl. Acad. Sci. USA*, 95, pp. 12424-12431 (1998); Bouillet, P., Cory, S., Zhang L-C, Strasser, A., Adams, J.M., 'Degenerative disorders caused by Bcl-2 deficiency are prevented by loss of its BH3-only antagonist Bim Developmental Cell', 1, pp. 645-653 (2001).

Georges Marie Martin Card. Cottier

Date and place of birth: 25 April 1922, Geneva, Switzerland
Appointment to the Academy: 28 Oct. 1992
Scientific discipline: Theology and Philosophy
Academic title: Emeritus Professor at the University of Fribourg and Theologian to the Pontifical Household

Most important awards, prizes and academies Lect. et lic. en théol.; Doct. en phil.; Théologien de la Maison Pontificale; Secrétaire général de la Commission Théologique Internationale; Président de la Commission Théologique du Comité préparatoire du Grand Jubilé de l'An 2000; Consulteur à la Congrégation pour la Doctrine de la Foi; Consulteur du Conseil Pontifical pour les non-croyants; Consulteur du Conseil Pontifical 'Cor Unum'; Directeur de la revue 'Nova et Vetera'. Academies: Pont. Acad. Théol. Rom.; Acad. Pontificale de Saint Thomas d'Aquin; Comité Scientifique de l'Istituto Paolo VI, Brescia; Institut International de Synthèse de la Société Görres; Fondation Cardinal Journet; Cercle Jacques et Raïssa Maritain; Membre Correspondant Etranger de la Real Academia de Doctores, Madrid.

Summary of scientific research Problèmes frontières entre philosophie et théologie. Philosophie de la religion. Histoire de la Philosophie.

Main publications Cottier, G.M., *L'athéisme du jeune Marx et ses origines hégéliennes*, éd. Vrin, (Paris, 1959), 2ème éd. 1969; Cottier, G.M., *L'ateismo del giovane Marx. Le origini hegeliane*, ed. Vita e Pensiero (Milano, 1981); Cottier, G.M., *Du romantisme au marxisme*, éd. Alsatia (Paris, 1961); Cottier, G.M., *Horizons de l'athéisme*, éd. Le Cerf (Paris, 1969); Cottier, G.M., *Panoramica actual del ateismo*, ed. Studium (Madrid, 1971); Cottier, G.M., *La mort des idéologies et l'espérance*, éd. Le Cerf (Paris, 1970); Cottier, G.M., *Le conflit des espérances*, éd. Desclée de Brouwer (Paris, 1977); Cottier, G.M., *Speranza cristiana e speranza marxista*, Città Nuova Editrice, (Roma, 1979); Cottier, G.M., *Humaine raison*, Éditions Universitaires (Fribourg, 1980); Cottier, G.M., *Etica dell'intelligenza*, ed. Vita e Pensiero (Milano, 1988); Cottier, G.M., *Questions de la modernité*, FAC-éditions (Paris, 1985); Cottier, G.M., *Consacrés dans la vérité*, Mame (Paris, 1992);

Cottier, G.M., *Histoire et connaissance de Dieu*, Éditions Universitaires, (Fribourg, Suisse, 1993), pp. 255; Cottier, G.M., *Scritti di Etica*, ed. Piemme (Casale Monferrato, 1994); Cottier, G.M., *Défis Ethiques*, éd. Saint-Augustin (Saint-Maurice, Suisse, 1995); Cottier, G.M., *Valori e transizione. Il rischio dell'indifferenza*, ed. Studium (Roma, 1994), pp. 244; Cottier, G.M., *Chemins de la Raison*, éd. Parole et Silence (Paris, 1997); Cottier, G.M., *Mémoire et Repentance. Pourquoi l'Eglise demande pardon*, éd. Parole et Silence (Paris, 1998); Cottier, G.M., *Le désir de Dieu*, éd. Parole et Silence (Paris, 2002). Cottier, G.M., *Deviens ce que tu es*, éd. Parole et Silence (Paris, 2003).

George V. Coyne

Date and place of birth: 19 January 1933, Baltimore, MD, USA
Appointment to the Academy: 2 Sept. 1978
Scientific discipline: Sciences of the Universe
Academic title: Director of the Vatican Observatory

Most important awards, prizes and academies Academies: American Astronomical Society; American Physical Society; Astronomical Society of the Pacific; International Astronomical Union; Optical Society of America; Pontifical Academy of Sciences. Honours: Ph.D. *honoris causa*, St. Peter's University, Jersey City, NJ, USA (1980); Loyola University, Chicago, IL, USA (1994); University of Padua, Italy (1995); Jagiellonian University, Crakow, Poland (1997).

Summary of scientific research The research interests of George Coyne have ranged from study of the lunar surface, antecedent to the NASA Ranger and Apollo Programs, to the birth of stars. He has pioneered a special technique, polarimetry, as a powerful tool in astronomical research. Currently he is studying cataclysmic variable stars, binary stars where one star is a superdense object which is capturing matter from its companion. He is also searching for protoplanetary disks about young stars. He has published more than 100 articles in reviewed scientific journals and has been the editor of a number of books. Parallel to his scientific research he has developed an interest in the history and philosophy of science and in the relationship between science and religion. Thus he founded the series of studies concerning controversies about Galileo, entitled *Studi Galileiani*, and he is one of the principal organizers of a series of conferences on the theme of *Scientific Perspectives on Divine Action*.

Main publications Coyne, G.V., 'Comparative Spectrophotometry of Selected Areas on the Lunar Surface', *Astron. J.*, 67, p. 574 (1962); Coyne, G.V. and Gehrels, T., 'Wavelength Dependence of Polarization. VIII. Interstellar Polarization', *Astron. J.*, 71, p. 355 (1966); Coyne, G.V. and Gehrels, T., 'Wavelength Dependence of Polarization. X: Interstellar Polarization', *Astron.*

J., 72, p. 887 (1967); Coyne, G.V. and Kruszewski, A., 'Wavelength Dependence of Polarization. XI: Mu Cephei', *Astron. J.*, 73, p. 20 (1968); Coyne, G.V. and Kruszewski, A., 'Wavelength Dependence of Polarization. XVII: Be-type Stars', *Astron. J.*, 74, p. 528 (1969); Coyne, G.V. and Wickramasinghe, N.C., 'Wavelength Dependence of Polarization. XVIII. Interstellar Polarization and Composite Interstellar Particles', *Astron. J.*, 74, p. 1179 (1969); Coyne, G.V., 'Mass Exchange in Beta Lyrae', *Astrophys. J.*, 161, p. 1011 (1970); Coyne, G.V., Lee, T. and Rieke, G., 'Photometry and Polarimetry of V1057 Cygni', *Publ. Astron. Soc. Pacific*, 84, p. 37 (1971); Coyne, G.V., Gehrels, T. and Serkowski, K., 'Polarization by Interstellar Grains', *Proceedings of Symposium #52*, IAU, *Interstellar Dust and Related Topics*, (J. Mayo Greenberg and H.C. van de Hulst, eds.), 1973; Coyne, G.V., 'Polarimetry of R CrB at Visual Light Minimum', *Astrophys. J.*, 186, p. 961 (1973); Coyne, G.V., Capps, R. and Dyck, H.M., 'A Model for the Observed Polarized Flux for Zeta Tauri', *Astrophys. J.*, 184, p. 173 (1973); Coyne, G.V., 'Polarimetry in the Emission Lines of Shell Stars', *M.N.R.A.S.*, 169, p. 7 (1974); Coyne, G.V. *et al.*, 'The Peculiar Object HD 44179 (The Red Rectangle)', *Astrophys. J.*, 196 (1975); Coyne, G.V. and McLean, I.S., 'Wavelength Dependence of Polarization. XXX. Intrinsic Polarization in Phi Persei', *Astron. J.*, 80, p. 702 (1975); Coyne, G.V., Kemp, J.C., Tapia, S., Rieke, G. and Lebofsky, M., 'Infrared and Visible Polarimetry and Photometry of Highly Variably Quasi-Stellar Sources', *Astrophys. J. Lett.*, 218, L37 (1977); McLean, I.S. and Coyne, G.V., 'Spectropolarimetry of o Ceti (Mira): Discovery of Polarized Balmer Emission', *Astrophys. J. Lett.*, 226, L145 (1978); Coyne, G.V., McLean, I.S., Serkowski, K. and Frecker, J.E., 'High Resolution Polarization Structure of Hß in Be-Shell Stars Measured with a New Digicon Spectropolarimeter', *Astrophys. J.*, 228, p. 802 (1979); Coyne, G.V., Tapia, S. and Vrba, F., 'Wavelenght Dependence of Polarization. XXXIII. The α Persei Star Cluster', *Astron. J.*, 84, 356 (1979); Coyne, G.V., 'Wavelength Dependence of Polarization. XXXIV. Changes in Polarization Across Ti0 Bands', *Astron. J.*, 84, p. 1200 (1979); McLean, I.S., Coyne, G.V., Frecker, J.E. and Serkowski, K., 'Detection of Polarization Structure Across the Emission Lines of the Wolf-Rayet Star HD50896', *Astrophys. J. Lett.*, 231, L141 (1979); Tapia, S. and Coyne, G.V., 'Upper Limits for the Luminosity of a dM Companion in AM Herculis Objects', *Close Binary Stars: Observations and Interpretations*, IAU Symposium No. 88 (M.J. Plavec, D.M. Popper and R.K. Ulrich, eds.), D. Reidel: Dordrecht, p. 471, 1980; Vrba, F.J., Coyne, G.V. and Tapia, S., 'Observations of Grain and Magnetic Field Properties of the R. Coronae Australis Dark

Clouds', *Astrophys. J.*, 243, p. 489 (1981); Coyne, G.V., Magalhaes, A.M., Moffat, A.F., Schulte-Ladbeck, R., Tapia, S. and Wickramasinghe, D., *Polarized Radiation of Circumstellar Origin*, (eds.), Vatican Obs. Publ. (1988); Magalhaes, A.M., Piirola, V., Coyne, G.V. and Rodrigues, C.V., 'Optical Polarimetry of Reddened Stars in the Small Magellanic Cloud', *Interstellar Dust*, IAU Symposium 135 Dordrecht: Reidel (1988); Rubin, V. and Coyne, G.V., *Large Scale Motions in the Universe*, (eds.), Princeton, Princeton University Press (1988); Minniti, D., Coyne, G.V. and Tapia, S., 'Interstellar Polarization in the Field of the Globular Cluster M22', *Astron. Astrophys.*, 236, p. 371 (1990); Piirola, V., Coyne, G.V. and Reiz, A., 'Multicolor (UBVRI) Polarimetry of Magnetic Cataclysmic Variables', *Astrophys. Space Sci.*, 170 (1990); Piirola, V., Scaltriti, F. and Coyne, G.V., 'Circumstellar Disks Deduced from Sub-arcsecond Polarization Observations of Two Young Stars', *Nature*, 359, pp. 399-401 (1992); Piirola, V., Hakala, P. and Coyne, G.V., 'The Discovery of Variable Polarization Over the 13.9 Minute Spin Period of the Intermediate Polar RE 0751+14', *Astrophysical Journal*, 410, L107-L110 (1993); Vrba, F.J., Coyne, G.V. and Tapia, S., 'An Investigation of Grain Properties in the Rho Ophiuchi Dark Cloud', *Astron. J.*, 105, p. 1010 (1993); Piirola, V., Coyne, G.V., Larsson, S., Takalo, L. and Vilhu, O., 'Polarimetry of AM Her type Bianaries', V, 'The Asynchronous (?) Polar BY Cam = H0538+608', *Astron. Astrophys.*, 283, pp. 163-174 (1994).

Héctor Rezzio Croxatto

Date and place of birth: 28 July 1908, Valparaiso, Chile
Wife and children: Viola Avoni; Alice, Hector and Horacio
Appointment to the Academy: 2 Dec. 1975
Scientific discipline: Biology (Physiology)
Academic title: Emeritus Professor at the Pontificia Universidad Católica of Chile

Most important awards, prizes and academies Awards: National Award of Science, Educational Board of the Chilean Government, Chile (1979); Bernardo Houssay Award, Organization of American States (1981); The University of Chile bestowed on me the J. Gomez-Millas medal (given for the first time) in recognition of my activities as a Scientist-Humanist (1994). Academies: Permanent Member, Academia de Ciencias de Chile; Corresponding Member, Academia de Medicina de Chile; Vice President, Academy of History; Pontifical Academy of Sciences. Since 1990 I have been the President of the Academia Ciencias LatinoAmericanas, succeeding the illustrious Professor Carlos Chagas. Honours: Doctor Scientiae et Honoris Causa, Pontificia Universidad Católica de Chile (1983).

Summary of scientific research Since 1938 most of the research work of H.R. Croxatto has been devoted to the biological actions of vasoactive peptides, particularly in the realm of circulatory homeostasis. One of the first discoveries showed that the proteolytic hydrolysis (with pepsin) of plasma proteins (globulins) gives rise to potent peptides acting upon smooth muscles (vessels, uterus) and kidney functions. These findings provided strong support to the concept that still unknown peptidic molecules could have a broad and fundamental role in biological regulations. In the decade 1940-50, several peptide fractions released under the action of pepsin upon blood proteins were identified: pepsitensin, pepsitocin, pepsanurin and later anephrotensin. Among these peptides, pepsitensin and pepsitocin were of particular interest because, according to studies done in other laboratories, they were identical to angiotensin I (which is the precursor of angiotensin II, the most potent vasoconstrictor substance) and a precursor of bradykinin (one of the most potent vasodilator substances in vertebrates) respectively. Angiotensin and bradykinin

have an important role in blood pressure regulation. In the last fifteen years Dr. H.R. Croxatto has been engaged in the study of the renal kallikrein-kinin system, which appears to be involved in the mechanism of arterial hypertension. In 1970, he discovered that the urine of hypertensive rats has significantly lower amounts of kallikrein than the urine of normotensive rats. This finding opened up a wide field of research in order to elucidate the role of this system in the mechanism of blood pressure regulation in animals and human beings.

Main publications Croxatto, H.R., Huidobro, F., Croxatto, R. et Salvestrini, H., 'Action cholinestérasique du sang veineux pendant l'excitation musculaire directe et indirecte', *Compt. Rend. Seanc. Soc. Biol. Paris*, 130, p. 326 (1939); Croxatto, H.R. and Croxatto, R., 'Pepsitensin – A hypertensin-like substance produced by peptidic digestion of proteins', *Science*, 95, p. 101 (1942); Croxatto, H.R., Rojas, G. and Barnafi, L., 'The liberation of antidiuretic factor by the hypertensinogen pepsin reaction', *Acta Physiol. Latinoamer.*, 2, p. 178 (1951); Croxatto, H.R., Pereda, T. and Mellada, R., 'Peptides with oxytocin and pressor activity obtained from acidified rat serum', *Nature*, 184, p. 1496 (1959); Croxatto, H.R. and Barnafi, L., 'Hormone and hormone-like activity of active polypeptides', *Rec. Prog. Horm. Res.*, 16, p. 236 (1961); Croxatto, H.R. and Belmar, J., 'Hypertensive effects of bradykinin in rats', *Nature*, 192 (4805), p. 879 (1961); Croxatto, H.R., Pereda, T., Belmar, J. and Labarca, E., 'Polypeptides formed by acidification of blood serum', *Ann. N.Y. Acad. Sci.*, 104, p. 146 (1963); Croxatto, H.R. and San Martin, M., 'Kallikrein-like activity in the urine of renal hypertensive rats', *Experientia*, 26, p. 1216 (1970); Roblero, J., Croxatto, H.R., García, R. and Corthorn, J., 'Kininogenase in urine produced by isolated perfused Rat Kidneys', *Experientia*, 30 (7), p. 771 (1974); Porcelli, G., Marini-Bettòlo, G.B., Croxatto, H.R. and Di Iorio, M., 'Purification and chemical studies on rabbit urinary kallikrein', *Italian J. Biochem.*, 23 (3), p. 154 (1974); Porcelli, G., Bianchi, G. and Croxatto, H.R., 'Altered urinary kallikrein in spontaneously hypertensive rats, selectively bred', *Life Sci.*, 16 (5), p. 818 (1974); Croxatto, H.R., Albertini, R., Arriagada, R., Roblero, J., Rojas, M. and Rosas, R., 'Renal urinary kellikrein in normotensive and hypertensive rats under enhanced urinary excretion of water electrolytes', *Clin. Sci. Mol. Med.*, 51, p. 3259 (1976); Roblero, J.S., Croxatto, H.R. and Albertini, R.B., 'Release of renal kellikrein to the perfusate by isolated rat kidney', *Experientia*, 32, p. 1440 (1976); Croxatto, H.R., Silva, G. and Boric, P.M., 'Inhibition of kallikrein excretion by renin purified extracts', *Clin. Sci. and Mol. Med.*, 57,

pp. 243-245 (1979); Rosar, R., Albertini, R. and Croxatto, H.R., 'Arterial pressure, plasma volume and the renal Kallikrein System in rats', *Hypertension*, pp. 13-20 (H. Villareal, ed.), published by J. Wiley and Sons, Inc., copyright (1981); Croxatto, H.R., 'Changes in renal kallikrein activity during pregnancy in rats', *Arch. Biol. Med. Exp.*, 15, pp. 305-308 (1982); Croxatto, H.R., Rosas and Gengler, J., 'Potentiating effect of Aldosterone in the diuretic action of atrial extract', *Exp.*, 43, pp. 604-666 (1987); Croxatto, H.R., 'Blood plasma proteins as substrates for the formation of Peptide Hormones', in *International Symposium on Biologically Active Proteins and Peptides* (S.H. Chiou, K.T. Wang and Sh. Wu, eds.), pp. 23-27 (1988); Boric, P.M., Croxatto, H.R., Albertini, R. and Roblero, S.J., 'Inhibition of Atrial Natriretic Peptide-Induced Natriuresis by Plasma Hydrolysates Containing Pepsanurin', *Hypertension*, pp. 243-250 (1992); Croxatto, H.R., Boric, P.M., Roblero, S.J. and Albertini, R., 'Blunting effect of Pepsanurin Introduced in the Duodenum on ANP Diuretic Action in Rats', *Proc. Soc. Exp. Biol. and Med.*, 202, pp. 321-376 (1993); Croxatto, H.R., Silva, R., Figueroa, X., Albertini, R., Roblero, J. and Boric, M., 'A Peptide Released by Pepsin from Kininogen Domain 1 is a Potent Blocker of ANP Mediated Diuresis Natriuresis in the rat', *Hypertension*, 30, pp. 897-904 (1997); Croxatto, H.R., Figueroa, X., Roblero, J., Albertini, R., Ross and Boric, M., 'A fragment of human kininogen containing Bradykinin blunts the Diuretic Effect of Atrial Natriuretic Peptide', *Proc. Soc. Exp. Biol. and Med.*, pp. 212-134 (1996); Croxatto, H.R., Figueroa, X., Roblero, J., Boric, M., 'Kinin B_2 receptors mediate of ANP Natriuresis Induced by Glucose or feeding in fasted rats', *Hypertension*, accepted for publication (1999).

Paul Josef Crutzen

Date and place of birth: 3 December 1933, Amsterdam, The Netherlands
Wife and children: Married; two daughters
Appointment to the Academy: 25 June 1996
Scientific discipline: Atmospheric Chemistry
Academic title: Former Director of Research in Atmospheric Chemistry at the Max Planck Institute for Chemistry, Mainz

Most important awards, prizes and academies International and Other Awards: Leo Szilard Award for 'Physics in the Public's Interest' of the American Physical Society (1985); Tyler Prize for Environmental Achievement (1989); Volvo Environment Prize (1991); Deutscher Umweltpreis of the Federal 'Umweltstiftung' (1994): Max-Planck-Forschungspreis (with Dr. M. Molina) (1994); Nobel Prize in Chemistry (with Dr. M. Molina and F.S. Rowland) (1995). Academies: Fellow, American Geophysical Union (1986); Foreign Honorary Member, American Academy of Arts and Sciences (1986); Founding Member, Academia Europaea (1988); Corresponding Member, Royal Netherlands Academy of Art and Sciences (1990); Foreign Member, Royal Swedish Academy of Sciences (1992); Foreign Associate, US National Academy of Sciences (1994). Honorary Degrees: York University, Canada (1986); Université Catholique de Louvain-la-Neuve, Belgium (1992); University of East Anglia, Norwich, UK (1994); Aristotle University of Thessaloniki, Greece (1996); Oregon State University, USA (1997); Tel Aviv University, Israel (1997); Université de Liège (1997); University of San José, Costa Rica (1997); University of Chile, Chile (1997); Université de Bourgogne, Dijon, France (1997); University of Athens, Greece (1998); University of Xanthi, Greece (2001); Nova Gorica Polytechnic, Slovenia (2002); University of Hull, UK (2002).

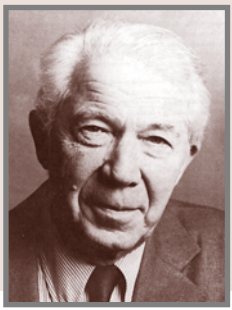
Summary of scientific research The research of Paul J. Crutzen has been mainly concerned with the photochemistry of the atmosphere, in particular the role of ozone both in the stratosphere and troposphere. In 1970 Crutzen hypothesized that ozone production by the action of solar ultraviolet radiation on molecular oxygen (O_2) could be mainly balanced by ozone destruction processes, involving NO and NO_2 as catalysts. These catalysts in

turn result from the oxidation of N_2O, a product of the microbiological nitrogen conversion in soils and waters. In 1971, together with Prof. Harold Johnston of the University of California, Berkeley, he pointed out that NO emissions from large fleets of supersonic aircraft could cause substantial ozone losses in the stratosphere. In the years 1972-1974 Crutzen proposed that NO and NO_2 could catalyze ozone production in the background troposphere by reactions occurring in the CO and CH_4 oxidation chains. Additional photochemical reactions leading to ozone loss were likewise identified. These gross ozone production and destruction terms are each substantially larger than the downward flux of ozone from the stratosphere, which until then had been considered the main source of tropospheric ozone. In 1979-1980 Crutzen and co-workers drew attention to the great importance of the tropics in atmospheric chemistry. In particular, some measurement campaigns in Brazil clearly showed that biomass burning in the tropics was a major source of air pollutants, on a par with or in some cases larger than industrial pollution in the developed world. In 1982 Crutzen, together with Prof. John Birks of the University of Colorado, drew attention to the risk of strong cooling occurring at the earth surface as a consequence of huge loadings of the atmosphere with black aerosol particles resulting from the many fires which would break out as a consequence of a nuclear war ('nuclear winter'). This study and additional studies by R. Turco, B. Toon, T. Ackerman, J. Pollack and C. Sagan and by the Scientific Committee on Problems of the Environment (SCOPE) showed that more people could die from the indirect consequences of a nuclear war than from the direct impacts of the nuclear explosions. In 1986, together with Dr. F. Arnold of the Max-Planck-Institute of Nuclear Physics in Heidelberg, Crutzen showed that nitric acid and water vapour could co-condense in the stratosphere, an important contributing process in a chain of events leading to rapid ozone depletion at high latitudes during late winter and spring (the so-called Antarctic 'ozone hole'). His most recent research is concerned with the role of clouds in atmospheric chemistry as well as photocemical reactions taking place in the marine boundary layer, involving catalysis by halogen radicals, derived from seasalt and photolysis of reactive organohalogen gases produced by marine organisms. In addition, his current research mainly deals with the chemical and climatic effects of the heavy air pollution which is found over Asia and other regions in the developing world: the so-called ABC (Atmospheric Brown Clouds) phenomenon.

Main publications Crutzen, P.J., 'The influence of nitrogen oxides on the atmospheric ozone content', *Quart. J. Roy. Meteor. Soc.*, 96, pp. 320-325

(1970); Crutzen, P.J., 'Ozone production rates in an oxygen-hydrogen-nitrogen oxide atmosphere', *J. Geophys. Res.*, 76, pp. 1490-1497 (1971); Crutzen, P.J., 'A discussion of the chemistry of some minor constituents in the stratosphere and troposphere', *Pure App. Geophys.*, 106-108, pp. 1385-1399 (1973); Fishman, J. and Crutzen, P.J., 'The origin of ozone in the troposphere', *Nature*, 274, pp. 855-858 (1978); Crutzen, P.J., Heidt, L.E., Krasnec, J.P., Pollock, W.H. and Seiler, W., 'Biomass burning as a source of atmospheric gases CO, H_2, N_2O, NO CH_3Cl and COS', *Nature*, 282, pp. 253-256 (1979); Crutzen, P.J. and Birks, J.W., 'The atmosphere after a nuclear war: Twilight at noon', *Ambio*, 2&3, pp. 114-125 (1982); Crutzen, P.J., Delany, A.C., Greenberg, J., Haagenson, P., Heidt, L., Lueb, R., Pollock, W., Seiler, W., Wartburg, A. and Zimmermann, P., 'Tropospheric chemical composition measurements in Brazil during the dry season', J. *Atmos. Chem.*, 2, pp. 233-256 (1985); Crutzen, P.J. and Arnold, F., 'Nitric acid cloud formation in the cold Antarctic stratosphere: A major cause for the springtime "ozone hole"', *Nature*, 324, pp. 651-655 (1986); Crutzen, P.J. and Andreae, M.O., 'Biomass burning in the tropics: Impact on atmospheric chemistry and biogeochemical cycles', *Science*, 250, pp. 1669-1678 (1990); Lelieveld, J. and Crutzen, P.J., 'Influence of cloud and photochemical processes on tropospheric ozone', *Nature*, 343, pp. 227-233 (1990); Vogt, R. and Crutzen, P.J., Sander, R., 'A mechanism for halogen release from sea salt aerosol in the remote marine boundary layer', *Nature*, 382, pp. 327-330 (1996); Crutzen, P.J. *et al.*, 'High spatial and temporal resolution measurements of primary organics and their oxidation products over the tropical forests of Surinam', *Atmos. Environ.*, 37, pp. 1161-1165 (2000); Lelieveld, J. and Crutzen, P.J. *et al.*, 'The Indian Ocean Experiment: Widespread Pollution from South and Southeast Asia', *Science*, 291, pp. 1031-1036 (2001); Ramanathan, V., Crutzen, P.J., Kiehl, J.T. and Rosenfeld, D., 'Aerosols, Climate and the Global Environment: A Hazy Future for the Blue Planet?', *Science* (submitted); Crutzen, P.J. and Ramanathan, V., 'The Parasol Effect on Climate', *Science*, 302, pp. 1679-1680 (2003); von Glasow, R., Lawrence, M.G., Sander, R. and Crutzen, P.J., 'Modeling the chemical effects of ship exhaust in the cloud-free marine boundary layer', *Atmos. Chem. Phys.*, 3, pp. 233-250 (2003); Ramanathan, V. and Crutzen, P.J., 'New Directions: Atmospheric Brown "Clouds"', *Atmos. Environ.*, 37, pp. 4033-4035 (2003).

Christian de Duve (Viscount)



Date and place of birth: 2 October 1917, Thames-Ditton, United Kingdom
Wife and children: Janine; Thierry, Anne, Françoise, Alain
Appointment to the Academy: 10 April 1970
Scientific discipline: Biochemistry and Cell Biology
Academic title: Emeritus Professor at the Catholic University of Louvain and at the Rockefeller University, New York; Founder-Administrator of the Christian de Duve Institute of Cellular and Molecular Pathology, Brussels

Most important awards, prizes and academies Awards: Prix Francqui, Belgium (1960); Gairdner Special Award, Canada (1967); Dr. H.P. Heineken-Prijs, Netherlands (1973); Nobel Prize in Physiology or Medicine (1974). Academies: Académie Royale de Médecine de Belgique; Académie Royale de Belgique; American Academy of Arts and Sciences; Deutsche Akademie der Naturforscher Leopoldina; Koninklijke Akademie voor Geneeskunde; National Academy of Sciences, USA; Académie des Sciences de Paris; European Academy of Arts, Sciences and Humanities; Académie des Sciences d'Athènes; Académie Nationale de Médecine; Academia Europaea; Pontifical Academy of Sciences; Royal Society; American Philosophical Society; Société Royale du Canada; Academia Romana. Honours: Honorary degrees from sixteen universities.

Summary of scientific research After a few years devoted to insulin and carbohydrate metabolism, in the course of which I rediscovered glucagon, I devoted my main efforts to the intracellular localization of enzymes by means of centrifugal fractionation techniques. Thanks to the collaboration of an excellent team, I was able to develop improved fractionation techniques and succeeded in identifying and characterizing biochemically two new groups of cytoplasmic particles: the lysosomes, so named because of their content of digestive enzymes, and the peroxisomes, which are centers of hydrogen peroxide metabolism. These particles were identified morphologically as corresponding to the 'dense bodies' and 'microbodies' described by electron microscopists, respectively. The main phases of this work took place in the years 1950-65. Since then I have continued to investigate many aspects of lysosomes and peroxisomes, including their enzymatic properties, physiological functions, and biogenesis. I have also become increasingly interested in the medical

applications of modern cellular and molecular biology. To this end, I created in Brussels the International Institute of Cellular and Molecular Pathology, founded in 1974, which now bears my name. In recent years, my main interests have become focused on the general properties of living cells and on the origin and evolution of life. I have written four books on these topics: *A Guided Tour of the Living Cell* (1984), *Blueprint for a Cell* (1991), *Vital Dust* (1995), and *Life Evolving* (2002). All four have appeared also in French and have been translated in several other languages.

Main publications de Duve, C., *Glucose, insuline et diabète*. Bruxelles: Goemaere; Paris: Masson (1945); de Duve, C., 'Glucagon, the hyperglycemic-glycogenolytic factor of the pancreas', *Lancet*, 265, pp. 99-104 (1953); de Duve, C., Pressman, B.C., Gianetto, R., Wattiaux, R. and Appelmans, F., 'Tissue fractionation studies. VI. Intracellular distribution patterns of enzymes in rat liver tissue', *Biochem. J.*, 60, pp. 604-617 (1955); de Duve, C., Berthet, J. and Beaufay, H., 'Gradient centrifugation of cell particles. Theory and applications', *Prog. Biophys. Chem.*, 9, pp. 325-369 (1959); de Duve, C., 'Principles of tissue fractionation', *J. Theor. Biol.*, 6, pp. 33-59 (1964); de Duve, C., 'The separation and characterization of subcellular particles', *The Harvey Lectures*, 59, pp. 49-87 (1965); de Duve, C. and Wattiaux, R., 'Functions of lysosomes', *Ann. Rev. Physiol.*, 28, pp. 435-492 (1966); de Duve, C. and Baudhuin, P., 'Peroxisomes and related particles (Microbodies)', *Physiol. Rev.*, 46, pp. 323-357 (1966); de Duve, C., de Barsy, T., Poole, B., Trouet, A., Tulkens, P. and Van Hoof, F., 'Lysosomotropic agents', *Biochem. Pharmacol.*, 23, pp. 2495-2531 (1974); de Duve, C., 'Exploring cells with a centrifuge', *Science*, 189, pp. 186-194 (1975); de Duve, C., *A Guided Tour of the Living Cell*, New York: Scientific American Books, Inc. (1984); de Duve, C., *Blueprint for a Cell*, Burlington, NC, Neil Patterson Publishers, Carolina Biological Supply Company (1991); de Duve, C., *Vital Dust*, New York: Basic Books (1995); de Duve, C., 'Réflexions sur l'origine et l'évolution de la vie', *C.R. Soc. Biol.*, 192, pp. 893-901 (1998); de Duve, C., 'Constraints on the origin and evolution of life', *Proc. Amer. Philos. Soc.*, 142, pp. 525-532 (1998); de Duve, C., *Life Evolving*, Oxford University Press (2002).

Manfred Eigen

Date and place of birth: 9 May 1927, Bochum, Germany
Wife and children: Elfriede; Gerald, Angela
Appointment to the Academy: 12 May 1981
Scientific discipline: Molecular Biology (Physical Chemistry)
Academic title: Professor, Director Emeritus of the Max-Planck-Institut für biophysikalische Chemie

Most important awards, prizes and academies Awards: Nobel Prize in Chemistry (1967); Otto-Hahn-Prize; Linus Pauling Medal; Carus Medal; Palmes Académiques; Ordre pour le mérite; Paul Ehrlich / Ludwig Darmstädter Prize; Paracelsus Medal; Keilin Medal; Faraday Medal; Helmholtz Medal; Diesel Medal, Küpfmüller Ring. Honorary Degrees: Washington (St. Louis), Harvard, Chicago, Nottingham, Jerusalem, Hull, Bristol, Cambridge, Debrecen, München, Bielefeld, Utah, Alicante. Academies: Deutsche Akademie der Naturforscher, Halle; Akademie der Wissenschaften, Göttingen; Bayerische Akademie der Wissenschaften, München; Berlin-Brandenburgische Akademie der Wissenschaften; Honorary member, Österreichische Akademie der Wissenschaften; Royal Society, London; Honorary member, Weizmann Institute of Sciences; Royal Danish Academy of Sciences; Institut de France, Paris; Académie Royale de Belgique; Honorary member, Hungarian Academy of Sciences; Pontifical Academy of Sciences; Russian Academy of Sciences; American Philosophical Society, Philadelphia; National Academy of Sciences, USA; American Academy of Arts and Sciences; Honorary member, New York Academy of Sciences; Honorary member, European Academy of Arts and Sciences.

Summary of scientific research The mechanisms of biochemical reactions (enzyme kinetics, code reading, biopolymerization); the origins and evolution of life (theory and experiments); evolutionary biotechnology.

Main publications Eigen, M., 'Über die Kinetik sehr schnell verlaufender Ionenreaktionen in wässriger Lösung', *Z. phys. Chem. N.F.*, 1, p. 176 (1954); Eigen, M., 'Methods for Investigation of Ionic Reactions in Aqueous Solutions with Half Times as Short as 10^{-9} sec.', *Disc. Farad. Soc.*, 17, p. 194 (1954); Eigen, M., 'Proton Transfer, Acid-Base Catalysis, and Enzymatic Hydrolysis',

Angew. Chem. Intern. Ed., 3, pp. 1-19 (1964); Eigen, M., 'Kinetics of reaction control and information transfer in enzymes and nucleic acids. Nobel Symp. 5 on Fast Reactions and Primary Processes', *Chem. Kinetics* (Stig Claesson, ed.), Almquist & Wiksell, Stockholm, Intersci. Publ., p. 333 (1968); Eigen, M., 'Die "unmeßbar" schnellen Reaktionen Nobelvortrag', *Les Prix Nobel en 1967*, p. 151 (1968); Eigen, M., 'Selforganization of Matter and the Evolution of Biological Macromeolecules', *Naturwissenschaften*, 58, p. 465 (1971); Eigen, M., Das Spiel – *Naturgesetze steuern den Zufall*, Piper-Verlag, München 1975 (with Winkler-Oswatitsch, R.), Laws of the Game – *How the Principles of Nature Govern Chance*, Alfred A. Knopf (New York, 1981) (with Winkler-Oswatitsch, R.); Eigen, M., 'The Hypercycle, "A Principle of Natural Self-Organization"', *Naturwissenschaften*, 64, pp. 541-565 (1977), 65, pp. 7-41 and 65, pp. 341-369 (1978) (with Schuster, P.); Eigen, M., Die Kunst zu Titrieren. 'Vom klassischen Endpunktverfahren zur modernen differentiellen und dynamischen Analyse', *Angew. Chem.*, 91, pp. 20-51 (1979) (with Winkler-Oswatitsch, R.); Eigen, M., 'Evolutionary Molecular Engineering Based on RNA Replication', *Pure & Appl. Chem.*, 56, pp. 967-978 (1984) (with Gardiner, W.); Eigen, M., *Stufen zum Leben. Die frühe Evolution im Visier der Molekularbiologie*, R. Piper-Verlag, München (1987), *Steps towards Life*, *A Perspective on Evolution*, Oxford University Press (Oxford, 1992), pp. 173 (with Winkler-Oswatitsch, R.); Eigen, M., 'The Molecular Quasispecies', *Adv. Chem. Phys.*, 75, Ch. 4, pp. 149-263 (1987) (with McCaskill, J.S. and Schuster, P.); Eigen, M., 'Sequence Space and Quasispecies Distribution', *RNA Genetic* (Domingo, E., Holland, J.J. und Ahlquist, P., Hrsg.), vol. III, *Variability of RNA Genomes*, pp. 211-245, CRC Press, Boca Raton, FL (1988) (with Biebricher, C.K.); Eigen, M., 'Statistical Geometry in Sequence Space: A Method of Quantitative. Comparative Sequence Analysis', *Proc. Natl. Acad. Sci. USA*, 85, pp. 5913-5917 (1988) (with Winkler-Oswatitsch, R. and Dress, A.); Eigen, M., *Perspektiven der Wissenschaften*, Deutsche Verlagsanstalt, Stuttgart, p. 288, S. (1988); Eigen, M., 'How Old Is the Genetic Code? Statistical Geometry of tRNA Provides an Answer', *Science*, 244, pp. 673-679 (1989) (with Lindemann, B.F., Tietze, M., Winkler-Oswatitsch, R., Dress, A. and von Haeseler, A.); Eigen, M., The Hypercycle, 'Coupling of RNA and Protein Biosynthesis in the Infection Cycle of an RNA Bacteriophage', *Biochem.*, 10, pp. 11005-11018 (1991) (with Biebricher, C.K., Gebinoga, M. and Gardiner, W.C.); Eigen, M., The Fifth Paul Ehrlich Lecture, 'Virus Strains as Models of Molecular Evolution', *Medicin. Res. Rev.*, 13, pp. 385-389 (1993); Eigen, M., 'Sorting single mol-

ecules: Application to diagnostic and evolutionary biotechnology', *Proc. Natl. Acad. Sci. USA*, 91, pp. 5740-5747 (1994) (with Rigler, R.); Eigen, M., 'Quasispecies: The concept and the word', *Molecular Basis of Viral Evolution* (A. Gibbs, C.H. Calisher, eds.), pp. 181-191, Cambridge University Press, Cambridge (1995) (with Domingo, E., Holland, J., Biebricher, C.); Eigen, M., *Die 'unmeßbar' schnellen Reaktionen. Frühe Arbeiten (1954-1967).* Mit einem Vorw. und Einf. von R. Winkler-Oswatitsch. Ostwalds Klassiker der exakten Wissenschaften Band 281, Verlag Harri Deutsch, Frankfurt am Main (1996); Eigen, M., 'Detection of HIV-1 RNA by nucleic acid sequence-based amplification combined with fluorescence correlation spectroscopy', *Proc. Natl. Acad. Sci. USA*, 93, pp. 12811-12816 (1995) (with Oehlenschläger, F. and Schwille, P.); Eigen, M., 'Prionics or the kinetic basis of prion diseases', *Biophysical Chemistry*, 63, (1996) A1-A18 – M. Eigen; Eigen, M., 'Rapid assay processing by integration of dual-color fluorescence cross-correlation spectroscopy: High throughput screening for enzyme activity', *Proc. Natl. Acad. Sci. USA*, 95, pp. 1421-1426 (1998) (Koltermann, A., Kettling, U., Bieschke, J., Winkler, T., Eigen, M.); Eigen, M., 'BSE und das Prionen-Problem', *Spektrum der Wissenschaft*, 4, pp. 40-49 (2001).

Albert Eschenmoser

Date and place of birth: 5 August 1925, Erstfeld, Switzerland
Wife and children: Elizabeth; Jürg, Esther, Philipp
Appointment to the Academy: 9 June 1986
Scientific discipline: Organic Chemistry
Academic title: Emeritus Professor at the Laboratorium für Organische Chemie, Zurich

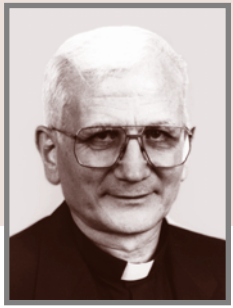
Most important awards, prizes and academies Awards: Benoist Prize, Swiss Gov. (1973); Welch Award, R.A. Welch Foundation, Houston, TX (1974); Cope Award, Amer. Chem. Soc. (1984); Wolf Prize in Chemistry, Israel Gov. (1986); Paracelsus Prize, Swiss Chem. Soc. Academies: Akademie der Naturforscher Leopoldina, Halle, Germany; Pontifical Academy of Sciences; Academia Europaea. Foreign Member: American Academy of Arts and Sciences, Boston, MA; National Academy of Sciences, Washington, DC; Royal Society, London; Akademie der Wissenschaften, Göttingen, Germany; Croatian Academy of Arts and Sciences. Ordre 'Pour le mérite', Berlin, Germany; Österreichisches Ehrenzeichen für Wissenschaft und Kunst, Wien, Austria.

Summary of scientific research A. *Reaction mechanism and reaction stereochemistry*: Early experimental and theoretical studies relevant to terpene biosynthesis on the course and stereochemistry of acid-catalyzed cyclizations of terpenoid polyenes (biogenetic isoprene rule, together with L. Ruzicka, 1953); the stereochemical interpretation of the biogenetic isoprene rule, together with D. Arigoni and L. Ruzicka (1955); the experimental demonstration of strain release control of the oxidation of alcohols with chromic acid (1955) and of stereoelectronic control of SN_2- reactions (1970); experimental and theoretical studies on nitrogen inversion (1969). B. *Chemical synthesis*: *development of new reactions and reagents*: Introduction of heterocyclic fragmentation reactions into organic synthesis (1952); epoxy-ketone → alkinone-fragmentation (1967); amide acetal version of Claisen rearrangement (1969); methods for making C, C-bonds: enamino-iminoester condensations (1964), sulfide-contractions (1968), dimethyl-methylidene-iminium iodide (1971) and α-Chloronitrone reactions (1972). C. *Chemical synthesis*: *synthesis of complex natural products and related structures*: Synthesis of the alcaloid of the autumn crocus,

Colchicin (1959); synthetic routes to corrins (1964, 1969); synthesis of vitamin B_{12} (collaboratively with R.B. Woodward) (1972); synthetic studies related to the problem of vitamin B_{12} biosynthesis (1980). D. *Contemporary studies*: Chemical etiology of nucleic acid structure; experimental and theoretical studies relevant to the problem of designing chemical models of biogenesis.

Main publications Eschenmoser, A., *Zur säurekatalysierten Zyklisierung bei Mono- und Sesquiterpenverbindungen*, Promotionsarbeit Nr 2018, ETH Zürich 1951; Eschenmoser, A., Ruzicka, L., Jeger, O. and Arigoni, D., 'Zur Kenntnis der Triterpene. Eine stereochemische Interpretation der biogenetischen Isoprenregel bei den Triterpenen', *Helv. Chim. Acta*, 38, p. 1890 (1955); Stadler, P.A., Nechvatal, A., Frey, A.J. and Eschenmoser, A., 'Untersuchungen über den sterischen Verlauf säurekatalysierter Cyclisationen bei terpenoiden Polyenverbindungen', *Helv. Chim. Acta*, 40, p. 1373 (1957); Schreiber, J., Leimgruber, W., Pesaro, M., Schudel, P., Threlfall, T. and Eschenmoser, A., 'Synthese des Colchicins', *Helv. Chim. Acta*, 44, p. 540 (1961); Bertele, E., Boos, H., Dunitz, J.D., Elsinger, F., Eschenmoser, A., Felner, I., Gribi, H.P., Gschwend, H., Meyer, E.F., Pesaro, M. and Scheffold, R., 'Ein synthetischer Zugang zum Corrinsystem', *Angew. Chem.*, 76, p. 393 (1964); Felix, D. and Eschenmoser, A., 'Language Inversion am pyramidal gebundenen Stickstoff: Isolierung von diastereomeren 7-Chlor-7-azabicyclo [4.1.0] heptanen bei Raumtemperatur', *Angew. Chem.*, 80, p. 197 (1968); Yamada, Y., Miljkovic, D., Wehrli, P., Golding, B., Löliger, P., Keese, R., Müller, K. and Eschenmoser, A., 'Ein neuer synthetischer Zugang zum Corrinsystem', *Angew. Chem.*, 81, p. 301 (1969); Tenud, L., Farooq, S., Seibl, J. and Eschenmoser, A., 'Endocyclische S_N-Reaktionen am gesättigten Kohlenstoff?', *Helv. Chim. Acta*, 53, p. 2059 (1970); Eschenmoser, A., 'Roads to Corrins' (Centenary Lecture), *Quart. Revs.*, 24, p. 366 (1970); Eschenmoser, A., *Post-B_{12}*. 'Problems in Corrin Synthesis', *Chem. Soc. Revs.*, 5, p. 377 (1976); Eschenmoser, A., 'Organische Naturstoffsynthese heute. Vitamin B_{12} als Beispiel', *Naturwiss*, 61, p. 513 (1974), erweiterte Version in Englisch: Eschenmoser, A. and Wintner, C.E., 'Natural Product Synthesis and Vitamin B_{12}', *Science*, 196, p. 1410 (1977); Pfaltz, A., Juan, B., Fässler, A., Eschenmoser, A., Jaenchen, R., Gilles, H.H., Diekert, G. and Thauer, R.K., 'Zur Kenntnis des Faktors F430 aus methanogenen Bakterien: Struktur des porphinoiden Ligandsystems', *Helv. Chim. Acta*, 65, p. 828 (1982); Eschenmoser, A., 'Chemistry of Corphinoids', *Ann. N.Y. Acad. Sci.*, 471, p. 108 (1986); Eschenmoser, A., 'Vitamin B_{12}: Experimente zur Frage nach dem Ursprung seiner molekularen Struktur', *Angew. Chem.*, 100, p. 5 (1988); Eschenmoser, A., 'Chemical Etiology of Nucleic Acid Structure', *Science*, 284, p. 2118 (1999).

Raffaele Farina



Date and place of birth: 24 September 1933, Buonalbergo, Benevento, Italy
Appointment to the Academy: 24 May 1997
Scientific discipline: History of the Church
Academic title: Prefect of the Apostolic Vatican Library and Former Rector of the Università Pontificia Salesiana

Most important awards, prizes and academies Professional associations: Associazione dei Professori di Storia Ecclesiastica in Italia, since its foundation (1971); A.I.E.P. (Association International d'Etudes Patristiques) (1980); Associazione Archivistica Italiana (1984); Historical-Theological Commission for the Great Jubilee of the year 2000 (1995); Honorary Member of the A.I.S.S.C.A. (Associazione Italiana per lo Studio della Santità, dei Culti e dell'Agiografia). Academies: Honorary Member of the Accademia Archeologica Italiana, Classe di discipline storiche, Roma (1980); Pontificia Accademia Teologica Romana (1995); Istituto di Studi Romani (1999); Monumenta Germaniae Historica (2000); Honorary Member of the Comité International de Paléographie Latine (2000); Società Romana di Storia Patria (2000). Honours: Distinguished Service Cross from the Government of the German Federal Republic (1991); Ordre des Arts et des Lettres of the French Republic (2000).

Summary of scientific research Prof. Farina's field of research essentially deals with two main points: 1) The first concerns the relationship between the Roman Empire and Christianity during the first three centuries, with particular interest in the passage from persecution to liberty and to a situation of privilege. The research has been focused more on ideological (and especially theological) roots than on facts. The main result has been the work on Eusebius of Cesarea and the first political theology of Christianity. 2) The second point concerns the study of the origin of Gnosticism (the doctrine and the movement) during the the second century A.D., and some themes coming from Gnostic texts of the Nag Hammadi compared to ones from the texts of the Fathers of the Church, such as the doctrine of the sacraments and ecclesiology.

Main publications Farina, R., *L'Impero e l'Imperatore cristiano in Eusebio di Cesarea. La prima Teologia politica del Cristianesimo*, Bibliotheca

Theologica Salesiana, Fontes 2, Zürich, Pas-Verlag (1966), p. 381; Farina, R., *Metodologia. Avviamento alla tecnica del lavoro scientifico*, Biblioteca di Scienze religiose 71, Roma, LAS (1988), 4ª edizione, seconda ristampa, p. 340; Farina, R., *Dalla fine del II secolo alla pace costantiniana (313)*, edizione italiana di Fliche Augustin – Martin Victor (ed.), *Storia della Chiesa*, II, Torino, SAIE (1972[3]), p. 772; Farina, R., Curatore del volume di Hans Jonas, *Lo Gnosticismo*. Presentazione di Manlio Simonetti, Postfazione di Raffaele Farina, Torino, SEI (1991), p. 437; Farina, R., 'Epískopos ton ektós *(Eusebio*, De vita Const. *IV,24)*', *Salesianum*, 29, pp. 409-413 (1967); Farina, R., 'La fine dell'"epoca costantiniana"', *Salesianum*, 38, pp. 523-547 (1968); Farina, R., 'Lo gnosticismo dopo Nag-Hammadi', *Salesianum*, 32, pp. 425-454 (1970); Farina, R., 'La Chiesa antica modello di riforma', *Salesianum*, 38, pp. 593-612 (1976); Farina, R., 'Leggere Don Bosco oggi. Note e suggestioni metodologiche', in Pietro Brocardo, *La formazione permanente interpella gli Istituti religiosi*, Torino-Leumann, LDC, 349-404 (1976); Farina, R., 'L'insegnamento della Patrologia: preparazione, obiettivi, mezzi didattici', *Seminarium*, 29, pp. 100-126 (1977); Farina, R., 'Religione e Politica a metà del sec. IV nella pars orientalis dell'Impero Romano', *XV Congrès International des sciences historiques*, Bucarest 10-17 août 1980, Rapports vol. II: Chronologie, Bucarest, Editura Academiei Repujblici Socialiste România, pp. 44-54 (1980); Farina, R., 'Eusebio di Cesarea e la "svolta costantiniana"', *Augustinianum*, *26,* pp. 313-322 (1986); Farina, R., 'La pace in Eusebio di Cesarea', *La pace: sfida all'Università Cattolica. Atti del Simposio fra le Università Ecclesiastiche e gli Istituti di Studi Superiori di Roma*, 3-6 dicembre 1986, Roma, Herder, pp. 327-337 (1988); Farina, R., 'La concezione della pace nel IV secolo. Costantino il Grande ed Eusebio di Cesarea', *Cristianesimo e Istituzioni politiche da Augusto a Costantino*, vol. II, a cura di E. dal Covolo e R. Uglione, Roma, LAS, pp. 95-105 (1997); Farina, R., 'Il popolo nella Chiesa secondo Eusebio di Cesarea', *Cristianesimo e Istituzioni politiche da Augusto a Costantino*, vol. I, a cura di E. dal Covolo e R. Uglione, Roma, LAS, pp. 117-122 (1995); Farina, R., 'La "pietas" del servo di Dio Costantino Imperatore: santità e culto di Costantino Imperatore nella "Vita di Costantino" di Eusebio di Cesarea', *Poteri religiosi e Istituzioni: il culto di San Costantino Imperatore tra Oriente e Occidente*, a cura di Francesco Sini e Pietro Paolo Onida, Torino, Giappichelli, Sassari-Cagliari, ISPROM (2003) pp. 297-304.

Antonio García Bellido

Date and place of birth: 30 April 1936, Madrid, Spain
Wife and children: María Paz Capdevila (deceased 1994); Antonio, Juan, Diego, Elvira
Appointment to the Academy: 24 June 2003
Scientific discipline: Biology, Developmental Genetics
Academic title: Professor

Most important awards, prizes and academies Awards: Principe de Asturias de Investigación Científica, Spain (1984); Leopold Mayer de l'Academie des Sciences de Paris, France (1986); Santiago Ramón y Cajal National Prize for Scientific Research, Spain (1995); Severo Ochoa Chair in Biology, Section: *Research abroad*, Spain (1996); Comunidad Autónoma de Madrid Research Prize, Spain (1998); Rey Jaime I Research Medal, Valencia, Spain (1998); Professional societies: European Molecular Biology Organization (EMBO) (1975); International Cell Research Organization (ICRO) (1978); Scientific Council of the EMBO (1988); Human Genome Organization, Geneva, Switzerland (1989); Honorary Member Sociedad Española Interdisciplinar de Criobiología, Oviedo, Spain (1992); Honorary Member Sociedad Española de Biologla Celular, Spain (1992); InterAmerican Medical and Health Association, USA (1993); European Science and Tecnology Assembly, Brussels (1994); Honorary Member Sociedad Española de Genética, Spain (1995); Neuroscience Institute, USA (2001). Academies: Real Academia de Ciencias Exactas Fisícas y Naturales, Spain (1984); Foreign Member, American Academy of Arts and Sciences, USA (1985); Foreign Member, Royal Society, London (1986); Foreign Member, Nat. Acad. of Sciences USA, Washington, DC (1987); Founder Member, Academia Europaea (1988); Foreign Member, Nat. Acad. of Sciences of France (1995). Honorary Degrees: Academy of Sciences USSR, Moscow (1990); University of La Coruña, Spain (1996); University of Barcelona, Spain (1996); University of Oviedo, Spain (1997); University of Salamanca, Spain (1998); University of Elche, Alicante, Spain (2001).

Summary of scientific research The work of Antonio García-Bellido has been pioneer and prevalent in exploring an 'apogenetic' notion of

Development: the genome, active in the individual cells, determines specific cell behaviour and this, in turn, the organization of cells in supracellular systems. The wealth of new ideas contributed by Antonio García-Bellido in the field of Developmental Biology is related with his outstanding experimental results in the studies of the genetic bases of cell recognition (1966-69); genetic mosaics and blastoderm maps (1968); clonal analysis of developing systems (1968-73) that lead him to the discovery of developmental compartments and the theory of selector genes; somatic cell genetics (1970-76); genetic trans-regulation and syntagmas (1972-82); cell-cell interactions in Morphogenesis (1984-). Venation and cell proliferation control (1989-). His ideas and new approaches to the problem of Development have been followed and continued by numerous researchers all over the world mainly in Europe and the United States of America, prompting similar research studies in other animal groups, such as mammals, and plants. The present flourishing of the Molecular Genetics of Development in Drosophila is due, in a large extent, to the important work of Antonio García-Bellido that is already quoted and explained in text books (e.g. 'Genetics', Strickberger, 'Molecular Biology of the Cell', B. Alberts *et al.*). Some of his papers have been qualified as 'citation classics' by Current Contents and commented and praised by many colleagues in research papers, review articles and dedications of books.

Main publications García-Bellido, A., 'Larvalentwicklung transplantierter Organe von Drosophila melanogaster im Adultmilieu', *J. Ins. Physiol.*, 11, pp. 1071-1078 (1965); García-Bellido, A., 'Pattern reconstruction by dissociated Imaginal Disk Cell of Drosophila Melanoaster', *Develop. Biol.*, 14, pp. 278-306 (1966); García-Bellido, A. and Merriam, J.R., 'Cell Lineage of the Imaginal Discs in Drosophila Gynandromorphs', *J. Exp. Zool.*, 170, pp. 61-76 (1969); García-Bellido, A. and Merriam, J.R., 'Parameters of the Wing Imaginal Disc Development of Drosophila Melanogaster', *Develop. Biol.*, 24, pp. 61-87 (1971); García-Bellido, A. and Merriam, J.R., 'Genetic Analysis of Cell Heredity in Imaginal Discs of Drosophila Melanogaster', *Proc. Natl. Acd. Sd. USA*, 68, pp. 2222-2226 (1971); García-Bellido, A., 'Some Parameters of Mitotic Recombination in Drosophila Melanogaster', *Molec. Gen. Genetics*, 115, pp. 54-72 (1972); García-Bellido, A., 'Pattern Formation in Imaginal Disks', *Results and Problems in Cell Differentiation*, vol. 5, pp. 59-91 (H. Ursprung, R. Nothiger, eds.), Springer-Verlag (Berlin,1972); García-Bellido, A. and Santamaria, P., 'Developmental Analysis of the Wing Disc in the Mutant Engrailed of Drosophila Melanogaster', *Genetics*, 72, pp. 87-104 (1972); García-Bellido, A., Ripoll, P. and Morata, G., 'Developmental Compartmentalization of the Wing Disk of

Drosophila', *Nature New Biology*, 245, pp. 251-253 (1973); Capdevila, M.P. and García-Bellido, A., 'Development and Genetic Analysis of Bithorax Phenocopies in Drosophila', *Nature*, 250, pp. 500-502 (1974); García-Bellido, A., 'Genetic Control of Wing Disc Development in Drosophila', *Cell Patterning, Ciba Foundation Symposium* 29, pp. 161-182, Elsevier (Amsterdam, 1975); García-Bellido, A. and Ripoll, P., 'The Number of Genes in Drosophila Melanogaster', *Nature*, 273, pp. 399-499 (1978); García-Bellido, A. and Moscoso del Prado, J., 'Genetic Analysis of Maternal Information in Drosophila', *Nature*, 278, pp. 346-348 (1979); García-Bellido, A., 'Genetic Analysis of the Achaete-Scute System of Drosophila Melanogaster', *Genetics*, 91, pp. 491-520 (1979); Capdevila, M.P. and García-Bellido, A., 'Genes Involved in the Activation of the Bithorax Complex of Drosophila', *Wilhelm Roux's Archiv.*, 190, pp. 339-350 (1981); García-Bellido, A. and Robbins, L.G., 'Viability of Female Germ-Line Cells Homozygous for Zigotic Lethals in Drosophila Melanoaster', *Genetics*, 103, pp. 235-247 (1983); Moscoso del Prado, J. and García-Bellido, A., 'Genetic Regulation of the Achaete-Scute Complex of Drosophila Melanoaster', *Roux's Arch. Dev. Biol.*, 193, pp. 242-245 (1984); Diaz-Benjumea, F.J. and García-Bellido, A., 'Genetics Analysis of the Wing Vein Pattern of Drosophila', *Roux's Arch. Dev. Biol.*, 198, pp. 336-354 (1990); Diaz-Benjumea, F.J. and García-Bellido, A., 'Behaviour of Cells Mutant for an EGF Receptor Homologue of Drosophila in Genetic Mosaics', *Proc. R. Soc. Lond. B*, 242, pp. 36-44 (1990); García-Bellido, A., Cortés, F. and Milán, M., 'Cell Interactions in the Control of Size in Drosophila Wings', *Proc. Natl. Acad. Sci. USA*, 91, pp. 10222-10226 (1994); Milan, M., Campuzano, S. and García-Bellido, A., 'Cell Cycling and Patterned Cell Proliferation in the Drosophila Wing during Metamorphosis', *Proc. Natl. Acad. Sci. USA*, 93, pp. 11687-11692 (1996); Cifuentes, F.J. and García-Bellido, A., 'Proximo-Distal Specification in the Wing Disc of Drosophila by the Nubbin Gene', *Proc. Natl. Acad. Sci. USA*, 94, pp. 11405-11410 (1997); García-Bellido, A.C. and García-Bellido, A., 'Cell Proliferation in the Attainment of Constant Sizes and Shapes: the Entelechia Model', *Int. J. Dev. Biol*, 42, pp. 353-362 (1998); Martin-Blanco, E., Pastor-Pareja J.C. and García-Bellido, A., 'JNK and *Decapentaplegic* Signaling Control Adhesiveness and Cytoskeleton Dynamics during Thorax Closure in *Drosophila*', *PNAS*, 97, n. 14, pp. 7667-8192 (2000).

Paul Marie Germain

Date and place of birth: 28 August 1920, St. Malo, France
Wife and children: Marie-Antoinette; Marie-Hélène, François
Appointment to the Academy: 9 June 1986
Scientific discipline: Mechanics
Academic title: Emeritus Professor at the University of Pierre et Marie Curie and Secrétaire perpétuel honoraire of the Academy of Sciences, Paris

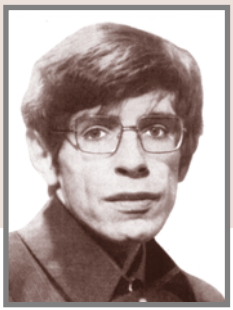
Most important awards, prizes and academies Honours and Awards: Lauréat Académie des Sciences (2 fois); Prix international 'Modesto Panetti', Académie de Turin. Academies: Académie Internationale d'Astronautique; Académie des Sciences, Paris (Secrétaire perpétuel honoraire); Foreign Member, American Academy of Arts and Sciences; Accademia Nazionale dei Lincei; Académie Polonaise des Sciences; National Academy of Engineering de Washington; Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique; Académie des Sciences de Russie; Académie Pontificale des Sciences. Honorary Degrees: Université de Louvain (1961); Strathclyde University, Glasgow (1975); Université Polytechnique de Madrid (1980); Université libre de Bruxelles (1984).

Summary of scientific research Les principaux travaux originaux et significatifs de Paul Germain portent tous sur la Mécanique Théorique et peuvent être classés comme suit: 1) *Aérodynamique*. Calcul des ailes en régime supersonique (théorie des écoulements coniques, des écoulements homogènes). Optimisation. 2) *Equations aux dérivées partielles de type mixte*. Théorème du maximum pour l'équation de Tricomi. Solutions élémentaires. Problèmes singuliers. Solution homogènes. Application à l'étude des écoulements transsoniques. 3) *Théorie locale des ondes de choc*. Relations liant les discontinuités et structure, aux divers ordres d'approximation. Applications et développements en dynamique des gaz, en magnétodynamique des fluides, en plasticité. 4) *La méthode des puissances virtuelles en mécanique des milieux continus*. Formulations fonctionnelles. Théorie du second gradient. Milieux micromorphiques. Applications aux plaques et coques. 5) *Thermodynamique des milieux continus*. Méthode de l'état local. Interprétation des variables internes. Milieux à dissipation normale (pseudopotentiel des dissipations).

Application à la formulation des lois de comportement-viscoplasticité; endommagement; stabilité.

Main publications Ouvrage: I: *Mécanique des Milieux Continus*, Masson (Paris, 1962), pp. 410; II: *Cours de Mécanique des Milieux Continus*, Masson (Paris, 1973), pp. 417; III: *Introduction à la Mécanique des Milieux Continus* (avec Muller, P.), Masson (Paris, 1979), pp. 350; IV: *Mécanique, cours à l'Ecole Polytechnique*, 2 tomes, Ellipse (Paris, 1986), pp. 900. Principaux Mémoires: 'Continuum Thermodynamics' (avec Nguyen, Q.S. et Suquet, P.), *Jour. Appl. Mech.*, 105, pp. 1010-1020 (1983); 'La méthode des puissances virtuelles en Mécanique des milieux continus', 1ère partie: 'La théorie du Second Gradient', *Journal de Mécanique*, 12, pp. 235-274 (1973); 'The Method of Virtual Power in Continuum Mechanics. Part II: Application to Continuum Media with Microstructure', *S.I.A.M. Jour. of App.*, 25, pp. 556-575 (1973); 'Méthodes Asymptotiques en Mécanique des Fluides', *Fluid Dynamics*, Gordon and Breach Pub. (1977), pp. 125; 'Duality and Convection in Continuum Mechanics', *Trends in Appl. of Pure Math to Mech.*, Pitman Pub. (1976), pp. 107-127; *Progressive Waves*, Jahrbuch der Deutschen Gesellschaft für Luft und Raumfahrt (1971), pp. 11-30; 'Shock Waves-Jump Relations and Structure', *Advances in Appl. Mech.*, 12, pp. 132-194 (1972); 'A model of some plasma shock structures', *Proceedings of Symposia in Appl. Math.*, 18, p. 1745 (1967); 'Conditions de choc et structure des ondes de choc dans un écoulement non stationnaire de fluide dissipatif' (avec Giraud, J.P.), *Jour. Math. pures et appl.*, 45, pp. 311-358 (1966); 'Ecoulements transsoniques homogènes', *Prog. in Aero. Sci.*, 5, pp. 143-273, Pergamon (1964); 'Shock waves and shock-wave structure in magneto-fluid dynamics', *Rev. Mod. Phys.*, 32, pp. 951-958 (1960); *Sur quelques problèmes relatifs à l'équation de type mixte de Tricomi* (avec Bader, R.), Pub. ONERA, n. 54 (1959), pp. 58; *La théorie générale des mouvements coniques et ses applications à l'aérodynamique supersonique*, Pub. ONERA, n. 34 (1949), pp. 197.

Stephen William Hawking



Date and place of birth: 8 January 1942, Oxford, United Kingdom
Wife and children: Jane Wilde; Robert, Timothy and Lucy
Appointment to the Academy: 9 Jan. 1986
Scientific discipline: Physics
Academic title: Lucasian Professor of Mathematics at the University of Cambridge

Most important awards, prizes and academies Awards: Adams Prize; Sherman Fairchild Distinguished Scholar at the California Institute of Technology; Eddington Medal, Royal Astronomical Society; Pius XI Medal, the Pontifical Academy of Sciences; Dannie Heinemann Prize; William Hopkins Prize; Maxwell Medal and Prize; The Hughes Medal; The Einstein Award of the Strauss Foundation; The Albert Einstein Medal; Commander of the British Empire. Academies: Fellow of the Royal Society; Pontifical Academy of Sciences. Honours: Professorial Fellow, Gonville and Caius College, Cambridge; Honorary Fellow, University College, Oxford. Honorary Degrees: Honorary Doctorate of Science, University of Oxford; Honorary Doctor of Sciences: University of Chicago, Notre Dame University, Princeton University, New York University, Leicester University.

Summary of scientific research I started research in gravitation and cosmology in 1962 at Cambridge under the supervision of Dr. D.W. Sciama. My first major work was on the question of whether there was a singularity, a point of infinite density and space-time curvature, at the beginning of the present expansion phase of the universe. Together with Roger Penrose I was able to show that there would be such a singularity in any reasonable cosmological model if the general theory of relativity was correct. The singularity would be a beginning of the universe, a place where the laws of physics break down. In 1970 I started to work on black holes. These are regions of space-time in which the gravitational field is so strong that nothing can escape. They are formed when burnt out stars or larger objects collapse. I was one of the people whose combined work proved the 'no hair' theorem which showed that a black hole would settle down to a state that depended only on the mass and angular momentum of the hole. I also showed that the event horizon, the boundary of the black hole, always increased in area as matter fell into the hole. This suggested a connec-

tion between the area and the thermodynamic concept of entropy, which became more definite in 1974 when I showed that quantum mechanics would cause small black holes to create and emit particles as if they were hot bodies. Since 1974 I have worked mainly on the problem of unifying gravity and quantum mechanics. With others at Cambridge I developed a Euclidean approach which is now generally accepted. I have been interested in the extra degree of predictability that gravity introduces because the topology of space-time can change. I have also done quite a lot of work on the very early universe. I worked on the inflationary model and more recently on the initial boundary conditions of the universe. I have suggested that the boundary conditions of the universe are that it has no boundary. This would mean that there was no singularity and no single event that could be identified as the creation. Instead one could say that the universe was created quantum mechanically from nothing.

Main publications Hawking, S.W., 'Occurrence of Singularities in Open Universes', *Phys. Rev. Lett.*, 15, p. 689; Hawking, S.W., *Singularities and the Geometry of Space-Time*, Adams Prize Essay; Hawking, S.W., 'Perturbations of an Expanding Universe', *Astrophys. J.*, 145, p. 544; Hawking, S.W., 'On the Rotation of the Universe', *Mon. Not. Roy. Astr. Soc.*, 142, p. 129; Hawking, S.W., 'The Singularities of Gravitational Collapse and Cosmology', *Proc. Roy. Soc.*, A314, p. 529; Hawking, S.W., 'Gravitationally Collapsed Objects of Very Low Mass', *Mon. Not. Roy. Astr. Soc.*, 152, p. 75; Hawking, S.W., 'Black Holes in General Relativity', *Commun. Math. Phys.*, 25, p. 152; Hawking, S.W., 'The Four Laws of Black Hole Mechanics', *Commun. Math. Phys.*, 27, p. 283; Hawking, S.W., *The Large Scale Structure of Space-Time*, Cambridge University Press; Hawking, S.W., 'Particle Creation by Black Holes', *Commun. Math. Phys.*, 43, p. 199; Hawking, S.W., 'Cosmological Event Horizons, Thermodynamics and Particle Creation', *Phys. Rev. D.*, 15, p. 2738; Hawking, S.W., 'Zeta Function Regularization of Path Integrals in Curved Space-Time', *Commun. Math. Phys.*, 56, p. 133; Hawking, S.W., 'Action Integrals and Partition Functions in Quantum Gravity', *Phys. Rev. D.*, 15, p. 2752; Hawking, S.W., *General Relativity: An Einstein Centenary Survey*, Cambs Univ. Press; Hawking, S.W., 'Spacetime Foam', *Nucl. Phys. B.*, 144, p. 349; Hawking, S.W., *Is the End in Sight for Theoretical Physics?*, Cambs Univ. Press; Hawking, S.W., 'The Unpredictability of Quantum Gravity', *Commun. Math. Phys.*, 87, p. 395; Hawking, S.W., 'The Development of Irregularities in a Single Bubble Inflationary Universe', *Phys Lett. B.*, 115, p. 295; Hawking, S.W., 'Wave Function of the Universe', *Phys. Rev. D.*, 28, pp. 2960-2975; Hawking, S.W., 'The Quantum State of the Universe', *Nucl. Phys. B.*, 239, p. 257 (1984); Hawking, S.W., 'The Origin of Structure in the Universe', *Phys. Rev. D.*, 31, p. 8.

Michael Heller

Date and place of birth: 12 March 1936, Tarnów, Poland
Appointment to the Academy: 4 Oct. 1990
Scientific discipline: Theoretical Physics, Relativistic Cosmology, Philosophy of Science
Academic title: Professor at the Pontifical Academy of Theology, Cracow, Poland

Most important awards, prizes and academies Awards: Zonn Medal, Polish Astronomical Society for the popularization of science (1986). Academies: Ordinary member, Saint Petersburg Academy of the History of Science and Technology (1998); Pontifical Academy of Sciences (1990). Honorary Degrees: Technological University A.G.H., Cracow (1996).

Summary of scientific research In the early seventies Prof. Michael Heller studied, as one of the first cosmologists, relativistic world models with bulk viscosity dissipation. Now such models are considered to be standard, and bulk viscosity is interpreted as due to various quantum and semiquantum effects (e.g. the creation of particles in a strong gravitational field). Heller also investigated the influence of bulk viscosity in the appearance of singularities in cosmology. He has always been interested in the problem of classical singularities in relativistic physics. It turned out that to cope with this problem one has to generalize the standard concept of smooth manifold. To this end, Heller and his co-workers developed the theory of differential spaces and later on (with W. Sasin) the theory of structured spaces. Both these theories, by using algebraic methods, generalize the standard differential geometry to various 'pathological' situations. It turns out that different kinds of singularities met in general relativity can be investigated with the help of the theory of structured spaces. Although in the case of the most malicious singularities this methods fails to be adequate, it at least explains the source of the problem. Happily enough, even the most malicious singularities surrender to the methods based on so-called non-commutative geometry. These methods have been adapted and successfully applied to the singularity problem in general relativity by Heller and Sasin. The generalization of Einstein's general relativity in terms of structured spaces (the so-called Einstein

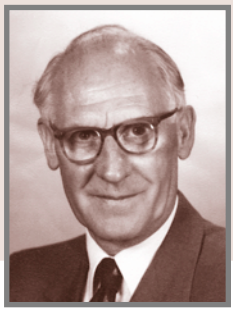
algebras) has also been worked out. By changing from commutative Einstein algebras to non-commutative Einstein algebras, one obtains the version of general relativity expressed in terms of mathematical structures which are very close to those used in quantum physics. Following this similarity, Heller and Sasin have proposed a model, based on non-commutative geometry, unifying general relativity and quantum mechanics. This model explains surprisingly well several non-local phenomena met in cosmology and quantum physics. M. Heller has written several books and about 700 papers on the history and philosophy of modern physics, and the relationship between science and theology.

Main publications Heller, M., *Questions to the Universe – Ten Lectures on the Foundations of Physics and Cosmology*, Pechart Publishing House (Tucson, 1986); Heller, M., *Theoretical Foundations of Cosmology – Introduction to the Global Structure of Space-Time*, World Scientific (Singapore-London, 1992); Heller, M., Klimek, Z. and Suszycki, L., 'Imperfect Fluid Friedmannian Cosmology', *Astrophysics and Space Science*, 20, pp. 205-212 (1973); Heller, M. and Klimek, Z., 'Viscous Universes without Initial Singularity', *Astrophysics and Space Science*, 33, L37-L39 (1975); Gruszczak J., Heller, M. and Multarzyński, P., 'A Generalization of Manifolds as Space-Time Models', *Journal of Mathematical Physics*, 29, pp. 2576-2580 (1988); Heller, M., 'Algebraic Foundations of the Theory of Differential Spaces', *Demonstratio Mathematica*, 24, n. 3-4, pp. 349-364 (1991); Heller, M., 'Einstein Algebras and General Relativity', *International Journal of Theoretical Physics*, 31, pp. 277-278 (1992); Heller, M. and Sasin, W., 'The Structure of the b-Completion of Space-Time', *General Relativity and Gravitation*, 26, pp. 797-811 (1994); Heller, M. and Sasin, W., 'Sheaves of Einstein Algebras', *International Journal of Theoretical Physics*, 34, pp. 387-398 (1995); Heller, M. and Sasin, W., 'Structured Spaces and Their Application to Relativistic Physics', *Journal of Mathematical Physics*, 36, pp. 3644-3662 (1995); Heller, M. and Sasin, W., 'Non-Commutative Structure of Singularities in General Relativity', *Journal of Mathematical Physics*, 37, pp. 5665-5671 (1996); Heller, M. and Sasin, W., 'Groupoid Approach to Non-commutative Quantization of Gravity', *Journal of Mathematical Physics*, 38, pp. 5840-5853 (1997); Heller, M. and Sasin, W., 'Origin of Classical Singularities', *General Relativity and Gravitation*, 31, pp. 555-570 (1999); Heller, M., *The World and the Word*, Pachart Publishing House (Tucson, 1986); Heller, M., *The Morality of Thinking*, Biblos, (Tarnów, 1993) (in Polish); Heller, M., *The New Physics and a New Theology*, Vatican

Observatory Publications (Vatican City State, 1996); Heller, M., *To Grasp the Transient Moment*, Znak (Cracow, 1997) (in Polish); Heller, M., *Happiness in the Banach Space*, Znak (Cracow, 1997) (in Polish); Heller, M., *Is Physics a Humanistic Science?*, Biblos (Tarnów, 1998) (in Polish); Heller, M., 'Time of the Universe', *The Far-Future Universe – Eschatology from a Cosmic Perspective*, (G.F.R. Ellis, ed.), Templeton Foundation Press, Philadelphia – London, 2002, pp. 53-64; Heller, M., Odrzygózdz, Z., Pysiak, L., and Sasin, W., 'Structure of Malicious Singularities', *International Journal of Theoretical Physics*, 42, pp. 427-41 (2003).

Hide

Raymond Hide



Date and place of birth: 17 May 1929, Doncaster, United Kingdom
Wife and children: Ann; Julia, Stephen and Kathryn
Appointment to the Academy: 25 June 1996
Scientific discipline: Geophysics
Academic title: Emeritus Professor of Physics at the University of Oxford. Senior Research Investigator in Mathematics, Imperial College, London

Most important awards, prizes and academies Awards: Chree Medal, British Institute of Physics (1974); Holweck Medal, French Physical Society (1982); Gold Medal, Royal Astronomical Society (1989); Commander of the British Empire (1990); Bowie Medal, American Geophysical Union (1997); Hughes Medal, Royal Society (1998); Richardson Medal, European Geophysical Society (1999); Symons Gold Medal, Royal Meteorological Society (2003). Academies: American Academy of Arts and Sciences (1964), Royal Society (1971); Academia Europaea (1988); Pontifical Academy of Sciences (1996). President: Royal Meteorological Society (1974-76); Royal Astronomical Society (1983-85); European Geophysical Society (1982-84). Honorary Degrees: Leicester (1985); Manchester, Institute of Science and Technology (1994); Paris (1995).

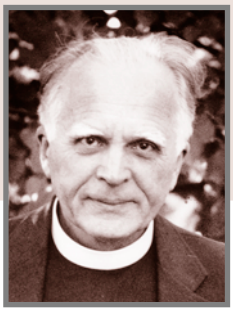
Summary of scientific research Main contributions in geophysics (geomagnetism, meteorology, geodesy, oceanography, etc.), planetary physics, fluid mechanics and nonlinear dynamics. His work on the hydrodynamics and magnetohydrodynamics (MHD) of spinning fluids has elucidated flow phenomena in planetary atmospheres, oceans and interiors. In laboratory studies of 'sloping thermal convection' he discovered various régimes of 'vacillation' and other multiply-periodic flows and aperiodic flows ('geostrophic turbulence'), which findings (a) influenced seminal mathematical studies of deterministic chaos and (b) provided a paradigm for interpreting large-scale flows in planetary atmospheres. Other contributions include the concept of 'dynamic superhelicity' as well as general theoretical results tested by crucial laboratory experiments on boundary layers and detached shear layers. His research on fluctuations in the Earth's rotation led to new developments in meteorology, oceanography and studies of the Earth's deep interior. He intro-

duced new types of self-exciting dynamo which show promise as low-dimensional theoretical models for investigating temporal fluctuations of stellar and planetary magnetic fields, including the irregular timeseries of geomagnetic polarity reversals. His discovery of 'nonlinear quenching' made during the course of this work has wide implications in the study of nonlinear systems. His contributions to electrodynamics and MHD include the concepts of 'potential magnetic field' and 'electrodynamic superhelicity' and discoveries of (a) basic theorems and other general results, (b) new types of MHD wave motion expected to occur in spinning planets and stars, (c) methods for locating interfaces and investigating their properties. He initiated research on the electromagnetic effects of hypervelocity impacts in connection with the magnetism of small bodies (Moon, meteorites, asteroids) in the Solar System.

Main publications More than 230 papers in learned journals, including: Hide, R., 'Experiments on thermal convection in a rotating liquid', *Quart. J. Roy. Meteorol. Soc.*, 79, p. 161 (1953), *Phil. Trans. Roy. Soc.*, A250, pp. 441-478 (1958); Hide, R., 'Hydrodynamics of the Earth's core', *Phys. Chem. Earth.*, 1, pp. 94-137 (1956); Hide, R., 'Hydrodynamics of Jupiter's atmosphere', *Mem. Soc. Roy. Liège*, 7, pp. 481-505 (1962); Hide, R., 'Free hydromagnetic oscillations of the Earth's core and the theory of the geomagnetic secular variation', *Phil. Trans. Roy. Soc.*, A259, pp. 615-647 (1966); Hide, R., 'Planetary magnetic fields', *Planet. Space Sci.*, 14, pp. 579-586 (1966); Hide, R., 'Motions of the Earth's core and mantle and variations of the main geomagnetic field', *Science*, 157, pp. 55-56 (1967), see also 'Interaction between the Earth's liquid core and solid mantle', *Nature*, 222, pp. 1055-1056 (1969); Hide, R., 'Dynamics of the atmospheres of the major planets', *J. Atmos. Sci.*, 26, pp. 841-847 (1969); Hide, R., 'Magnetohydrodynamic oscillations of neutron stars', *Nature*, 229, pp. 114-115 (1971); Hide, R., 'Comments on the Moon's magnetism', *The Moon*, 4, p. 39 (1972); Hide, R., 'How to locate the electrically-conducting fluid core of a planet from external magnetic observations', *Nature*, 271, pp. 640-641 (1978); Hide, R., 'The magnetic flux linkage of a moving medium: a theorem and geophysical applications', *J. Geophys. Res.*, 86, pp. 11681-11687 (1981); Hide, R., 'The magnetic analogue of Ertel's potential vorticity theorem', *Ann. Geophys.*, 1, pp. 59-60 (1983); Hide, R., 'Superhelicity, helicity and potential vorticity', *Geophys. Astrophys. Fluid Dyn.*, 48, pp. 69-79 (1989); Hide, R., 'Fluctuations in the Earth's rotation and the topography of the core-mantle interface', *Phil. Trans. Roy. Soc.*, A328, pp. 351-363 (1989); Hide, R., 'Sloping convection: a paradigm for large-scale waves and eddies in plane-

tary atmospheres' (with Lewis, S.R. and Read, P.L.), *Chaos*, 4, pp. 135-162 (1994); Hide, R., 'On the effects of rotation on fluid motions in containers of various shapes and topological characteristics', *Dyn. Atmos. Oceans*, 27, pp. 243-256 (1997); Hide, R., 'Nonlinear quenching of current fluctuations in a self-exciting homopolar dynamo', *Nonlinear Processes in Geophysics*, 4, pp. 201-205 (1997); Hide, R., 'Generic nonlinear processes in self-exciting dynamos and the long-term behaviour of the main geomagnetic field, including polarity superchrons', *Phil. Trans. Roy. Soc.*, A358, pp. 943-955 (2000); Hide, R., 'Helicity, superhelicity and weighted relative potential vorticity: Useful diagnostic pseudoscalars?', *Quart. J. Royal Meteorol. Soc.*, 128, pp. 1759-1762 (2002); Hide, R., 'Quenching Lorenzian chaos' (with McSharry, P.E., Finlay, C.C., and Peskett, G.D.), *Int. J. of Bifurcation and Chaos*, 13 (in press, 2004).

Stanley L. Jaki



Date and place of birth: 17 August 1924, Györ, Hungary
Appointment to the Academy: 5 Sept. 1990
Scientific discipline: Philosophy and History of Science
Academic title: Professor at the Seton Hall University, South Orange, USA, and Priest of the St Benedict Order

Most important awards, prizes and academies Lecomte du Nouy Prize (1970); Templeton Prize (1987). Gifford Lecturer, University of Edinburgh (1974-75, 1975-76). Pontifical Academy of Sciences (1990).

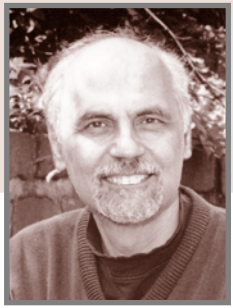
Summary of scientific research Of considerable importance should seem my application of Gödel's theorems, first in *The Relevance of Physics* (1967) and much more thematically in *God and the Cosmologists* (1980), to physical theories that aim at fundamental completeness. Such theories are systems of elementary particles, unified field theories, and comprehensive cosmological models. All such theories are heavily, and at times esoterically, mathematical and therefore must embody a far from trivial system of arithmetic. Therefore they are subject to the limitations set by Gödel's theorems in the sense that they cannot have the proofs of consistency within themselves. This should seem to undermine claims that can be heard again and again about a final physical theory having been formulated. The theory may be final but it cannot be proven to be such. If physics has a built-in incompleteness, reductionist and scientistic claims should be all the more suspect. This incompleteness of physics further supports what is known also as the contingency of all material beings, including their totality, the universe. The philosophy of science has indeed a theistic edge, although this by itself does not relate to the practice of the scientific method. Only when a scientific methodology is constructed which is either materialistic or agnostic would possible harmful precepts emerge for that practice. The history of science shows that all great creative advances in at least the physical sciences were made in terms of an epistemology which also underlies the classical proofs of the existence of God. These two themes are given a detailed presentation in my Gifford Lectures, *The Road of Science and the Ways to God*. Historically, too, this the-

istic perspective of science emerges from what I called the repeated stillbirths and the only viable birth of science. The former occurred in all great ancient cultures, whereas the latter is intimately tied to medieval Christianity. It was Christianity, and especially its dogma about the divinity of the Incarnate Logos, that gave a special strength to the biblical notion of a coherent universe, fully ordered in all its parts, an idea indispensable to the emergence of Newtonian science. All these themes are set forth in my *Science and Creation* and *The Savior of Science*. There and elsewhere I seized every opportunity to state my indebtedness to the writings of Pierre Duhem, to whom I devoted four monographs. Strange as this may seem, there is some originality in my insistence that any philosophical system must account for the means (usually a book) that carries its message. I set forth such a system in my book *Means to Message: A Treatise on Truth*. There I applied this principle to the articulation of a dozen major philosophical topics.

Main publications Publications relating to the history and philosophy of science in chronological order. Jaki, S.L., *The Relevance of Physics* (1967); Jaki, S.L., *Brain, Mind and Computers* (1969) (Lecomte du Nouy Prize, 1970); Jaki, S.L., *The Paradox of Olbers' Paradox* (1969); Jaki, S.L., *The Milky Way: An Elusive Road for Science* (1972); Jaki, S.L., *Science and Creation: From Eternal Cycles to an Oscillating Universe* (1974); Jaki, S.L., *Planets and Planetarians: A History of Theories of the Origin of Planetary Systems* (1978); Jaki, S.L., *The Road of Science and the Ways to God* (Gifford Lectures: University of Edinburgh, 1975 and 1976); Jaki, S.L., *The Origin of Science and the Science of its Origin* (Fremantle Lectures, Balliol College, Oxford, 1977); Jaki, S.L., *Cosmos and Creator* (1978); Jaki, S.L., *Angels, Apes and Men* (1981); Jaki, S.L., *Uneasy Genius: The Life and Work of Pierre Duhem* (1984); Jaki, S.L., *Chesterton: A Seer of Science* (1986); Jaki, S.L., *Chance or Reality and Other Essays* (1988); Jaki, S.L., *The Physicist as Artist: The Landscape of Pierre Duhem* (1988); Jaki, S.L., *The Absolute beneath the Relative and Other Essays* (1988); Jaki, S.L., *The Savior of Science* (Wethersfield Institute Lectures, 1987) (1988); Jaki, S.L., *Miracles and Physics* (1989); Jaki, S.L., *God and the Cosmologists* (Farmington Institute Lectures, Oxford, 1988) (1989); Jaki, S.L., *The Only Chaos and Other Essays* (1990); Jaki, S.L., *The Purpose of It All* (Farmington Institute Lectures, Oxford, 1989) (1990); Jaki, S.L., *Cosmos in Transition: Studies in the History of Cosmology* (1990); Jaki, S.L., *Olbers Studies* (1991); Jaki, S.L., *Scientist and Catholic: Pierre Duhem* (1991); Jaki, S.L., *Reluctant Heroine: The Life and Work of Hélène Duhem* (1992); Jaki, S.L.,

Universe and Creed (1992); Jaki, S.L., *Genesis 1 through the Ages* (1992) (2nd rev. and enlarged edition, 1998); Jaki, S.L., *Is there a Universe?* (1993); Jaki, S.L., *Patterns or Principles and Other Essays* (1995); Jaki, S.L., *Bible and Science* (1996); Jaki, S.L., *Means to Message: A Treatise on Truth* (1999); Jaki, S.L., *The Limits of a Limitless Science and Other Essays* (2000). Translations with introduction and notes: *The Ash Wednesday Supper* (Giordano Bruno) (1975); *Cosmological Letters on the Arrangement of the World Edifice* (J.-H. Lambert) (1978); *Universal Natural History and Theory of the Heavens* (I. Kant) (1981).

Fotis C. Kafatos



Date and place of birth: 16 April 1940, Heraklion, Crete, Greece
Wife and children: Sarah; Helen, Zoe
Appointment to the Academy: 23 Jan. 2003
Scientific discipline: Biology
Academic title: Professor

Most important awards, prizes and academies Awards: G.J. Mendel Honorary Gold Medal for Merit in the Biological Sciences, Academy of Sciences of the Czech Republic (1995); Honorary Professor, University of Heidelberg, Germany (2000); Honorary Medal for Distinction in Biology, Academy of Athens (2000); Taxiarchis of Phoenix Medal, awarded by the President of the Hellenic Republic (2003); Bundesverdienstkreuz 1. Klasse, awarded by the President of the Federal Republic of Germany (2004). Academic Appointments: Instructor of Biology, Harvard University (1965); Assistant Professor of Biology, Harvard University (1965-69); Professor of Biology, Harvard University (1969-94); Chair, Cellular and Developmental Biology, Harvard University (1978-81); Instructor, Embryology Course, MBL, Wood's Hole (summers 1972-74); Professor of Biology, University of Athens (1972-82); Professor of Biology, University of Crete, on leave (1982-); Founder and Director, Institute of Molecular Biology and Biotechnology, Research Centre of Crete (1982-93); Director General, European Molecular Biology Laboratory (1993-); Visiting Professor, Department of Biology, Imperial College of Science, Technology and Medicine, London (2000-03). Academies: European Molecular Biology Organisation (1977); Fellow, American Academy of Arts and Sciences (1980); National Academy of Sciences, USA (1982); Academia Europaea (1991); Overseas Fellow, Churchill College, University of Cambridge (1993); Foreign Member of the French Academy of Sciences (2002); Pontifical Academy of Sciences (2003); Foreign Member, Royal Society, London (2003). Honours: Phi Beta Kappa (1961); Multiple lectures as Distinguished Speaker. Honorary Degrees: Agricult. Univ., Athens, Greece (1992); Univ. Thessaloniki, Greece (1994); University Louis Pasteur, Strasbourg, France (2002).

Summary of scientific research My group is studying the interactions between *Plasmodium* parasites and the mosquito, *Anopheles gambiae.* Molecular genetic studies on this socially important organism, a vector responsible for more than two million deaths from malaria each year in Africa, capitalise on recent developments in genome analysis, transgenesis and the comparative study of innate immunity. We aim to trace the immune responses of the mosquito to the parasite, through highly collaborative research, involving close interactions with laboratories in Europe, the USA and Africa (see references). Genomic characterisation of *Anopheles is an* important aspect of our studies. Our pilot EST project identified for the first time a wealth of new *A. gambiae* genes. We have constructed detailed genetic and physical maps of *A. gambiae,* localizing genes that are involved in refractoriness to the parasite. The genetic markers are also facilitating the analysis of mosquito population biology and refractoriness in Africa. Sequencing of a 528 kb chromosomes DNA region encompassing one of these genes has permitted a first genomic comparison between *A. gambiae* and *D. melanogaster*. Furthermore, we actively promoted, participated in and helped lead an international collaboration for the whole genome sequencing of A. *gambiae,* which was achieved in 2002 and was recognised as a landmark in malaria research. Previously, we generated hemocyte-like cell lines which help in analysing mosquito immunity by DNA microarrays and other techniques. Insects and vertebrates share ancient, potent defence mechanisms of innate immunity (distinct from the antibody and T-cell receptor-based adaptive immunity of vertebrates). Our major aim is to dissect these mechanisms in the mosquito, and focus on those pertaining to parasite intrusion. To this effect, we have constructed *A. gambiae* cDNA microarrays and used them to analyse global expression profiles of cells and whole mosquitoes in response to microbial challenge, sterile or septic injury and malaria infection. These studies identified novel immune elicitor-specific gene clusters potentially implicated in biochemical and physiological responses to infections. Responses to the parasite extensively overlap with responses to bacterial challenge but not to injury. Furthermore, parasites co-cultured with mosquito cell lines elicit robust responses suggesting specific recognition of the parasite by the mosquito immune surveillance system. Comparison of response profiles of malaria susceptible and refractory mosquitoes has indicated significant differences in immune competence and redox state. Some of the differentially expressed genes are likely to be implicated in the mechanism of parasite killing in the refractory mosquitoes. Among the molecules

transcriptionally up-regulated by bacterial and parasite infections, we have identified a new family of thioester-containing proteins (aTEPs), resembling the complement factors that until recently were considered a hallmark of vertebrates. Using dsRNA knock-down in cell lines, we demonstrated that TEP1 is required for promotion of early phagocytosis, indicating conservation of an ancient complement-like function. We are now extending our analysis to other members of the family. Cell biological studies use advanced light microscopy techniques in conjunction with specific antibodies. The aTEP system is of particular interest, as *Plasmodium* needs to evade two complement systems – in the mammalian host and in the insect vector. We have recently shown that TEP1 is responsible for killing *Plasmodium* in a refractory strain of *A. gambiae*. Transformation techniques provide a crucial tool for genetic and genomic studies. We have participated in developing two genetic transformation methods based on the Minos transposable element in the *A. gambiae* cell lines and in the germ line of *A. stephensi* (an important urban vector of malaria in the Indian subcontinent). Refinements underway include development of inducible systems for conditional gene expression and vectors for in vivo RNAi knock-down of genes. With these techniques we can analyse in vivo functions of candidate genes (selected by genetics, cell biology, biochemistry, microarray profiling and bioinformatics) that may be involved in vital physiological pathways of the mosquito, or in mosquito/parasite interactions. Ultimate benefits may be the identification of targets for new environmentally friendly insecticides or targets to block parasite transmission. Future research will continue to address the genetic, genomic, molecular, and cellular mechanisms that permit the malaria parasite to develop within the mosquito.

Main publications *Books Edited*: Subtelny, S. and Kafatos, F.C., 1983: *Gene Structure and Regulation in Development. 41st Symposium of the Society for Developmental Biology*, Alan R. Liss, Inc., NY; Zheng, L., Collins, F.H., Kumar, V. and Kafatos, F.C., 'A detailed genetic map for the X chromosome of the malaria vector, *Anopheles gambiae*', *Science*, 261, pp. 605-608 (1993); Zwiebel, L.J., Saccone, A.Z., Besansky, N.J., Favia, G., Collins, F.H., Louis, C. and Kafatos, F.C., 'The *White* Gene of *Ceratitis Capitata:* A Phenotypic Marker for Germline Transformation', *Science*, 270, pp. 2005-2008 (1995); de Celis, J.F., Barrio, R. and Kafatos, F.C., 'Regulation and function of the *spalt/spalt-related* gene complex during sensory organ development in the *Drosophila* thorax', *Development*, 126, pp. 2653-2662 (1999); Hoffmann, J.A., Kafatos, F.C., Janeway Jr, C.A. and Ezekowitz,

R.A.B., 'Phylogenetic Perspectives in Innate Immunity', *Science*, 284, pp. 1313-1318 (1999); Benos, P.V. *et al.*, 'From Sequence to Chromosome: The tip of the X chromosome of *D. melanogaster*', *Science*, 287, pp. 2220-2222 (2000); Catteruccia, F., Nolan, T., Loukeris, T.G., Blass, C., Savakis, C., Kafatos, F.C. and Crisanti, A., 'Stable germline transformation of the malaria mosquito *Anopheles stephensi*', *Nature*, 405, pp. 959-962 (2000); Han, Y.S., Thompson, J., Kafatos, F.C. and Barillas-Mury, C., 'Molecular interactions between *Anopheles stephensi* midgut cells and *Plasmodium berghei*: The Time Bomb Theory of ookinete invasion of mosquitoes', *EMBO Journal*, 19 (22), pp. 6030-6040 (2000); Levashina, E., Moita, L., Blandin, S., Vriend, G., Lagueux, M. and Kafatos, F.C., 'Conserved Role of a Complement-like Protein in Phagocytosis Revealed by dsRNA Knockout in Cultured Cells of the Mosquito, *Anopheles gambiae*', *Cell*, 104, pp. 709-718 (2001); Thomasova, D. *et al.*, 'Comparative genomic analysis in the region of a major *Plasmodium*-refractoriness locus of *Anopheles gambiae*', *PNAS*, 99 (12), pp. 8179-8184 (2002); Dimopoulos, G., Christophides, G.K., Meister, S., Schultz, J., White, K.P., Barillas-Mury, C., Cantera, R. and Kafatos, F.C., 'Genome expression analysis of *Anopheles gambiae:* Responses to Injury, Bacterial challenge and Malaria Infection', *PNAS*, 99, pp. 8814-8819 (2002); Blandin, S. *et al.*, 'Reverse genetics in the mosquito *Anopheles gambiae*: targeted disruption of the *Defensin* gene', *EMBO*, *reports* 3 (9), pp. 852-856 (2002); Holt, R. *et al.*, 'The genome sequence of the malaria mosquito *Anopheles gambiae*', *Science*, 298, pp. 129-149 (2002); Zdobnov, E.M. *et al.*, 'Comparative genome and proteome analysis of *Anopheles gambiae* and *Drosophila melanogaster*', *Science*, 298, pp. 149-159 (2002); Christophides, G.K. *et al.*, 'Immunity-related genes and gene families in *Anopheles gambiae*: A comparative genomic analysis', *Science*, 298, pp. 159-165 (2002); Niaré, O. *et al.*, 'Genetic Loci Affecting Resistance to Human Malaria Parasites in a West African Mosquito Vector Population', *Science*, 298, pp. 213-216 (2002); Kafatos, F.C., 'Address to the EMBO Council. EMBL: principles for the next decade', *EMBO Journal*, 12, pp. 2587-2588 (1993); Kafatos, F.C., 'A Revolutionary Landscape: the Restructuring of Biology and its Convergence with Medicine', *Journal of Molecular Biology*, 319 (4), pp. 861-867 (2002); Osta, M.A., Christophides, G.K. and Kafatos, F.C., 'Effects of Mosquito Genes on *Plasmodium* Development', *Science*, 303, pp. 2030-2032 (2004); Blandin, S., Shiao, S.-H., Moita, L.F., Waters, A.P., Kafatos, F.C. and Levashina, E.A., 'Complement-like protein TEP1 is a determinant of vectorial capacity in the malaria vector *Anopheles gambiae*', *Cell*, 116, pp. 661-670 (2004).

Vladimir Isaakovich Keilis-Borok

Date and place of birth: 31 July 1921, Moscow, Russia
Wife and children: L.N. Malinovskaya (deceased); one daughter
Appointment to the Academy: 16 Oct. 1994
Scientific discipline: Earth Sciences; Non-Linear Dynamics
Academic title: Research Group Leader IIEPTMG, Russian Ac. of Sciences, Moscow; Professor-in-residence, U. of California, Los Angeles

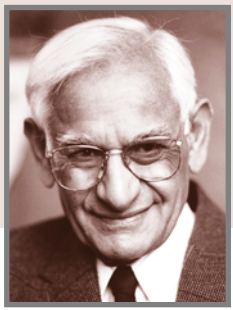
Most important awards, prizes and academies Awards: First Richardson medal for non-linear dynamics (1998). Academies: American Academy of Arts and Sciences (1969); US National Ac. Sci. (1971); Russian Ac. Sci. (1988); Royal Astronomical Society (1989); Austrian Ac. Sci. (1992); Academia Europaea (1999); President, Int. Union of Geodesy and Geophysics (1987-91); Pontifical Academy of Sciences (1994); Russian Ac. Sci. Committee for International Security and Disarmament (1997-). Expert, technical meetings on the nuclear test ban treaty (1960-62, 1987-90); Chairman of several international projects for basic research; member of the editorial boards of several international journals.

Summary of scientific research He studied the dynamics and structure of solid Earth, with applications to earthquake prediction, the identification of nuclear explosions, and mineral exploration. Later on, his research was extended to the dynamics of chaotic and complex systems, with applications to the prediction of critical phenomena, socio-economic crises included. A distinctive tradition of these studies has been the involvement of world-class 'pure' mathematicians, and direct transition from fundamental research to major applications. In this tradition he founded the International Institute of the Russian Academy of Sciences; the biannual International Symposia for Mathematical Geophysics; annual workshops at the Abdus Salam International Centre for Theoretical Physics, Trieste; and an international series of publications.

Main publications Keilis-Borok, V.I. (ed.), *Computational Seismology and Geodynamics,* Series currently published in Russia and USA (1966-); Keilis-Borok, V.I. and Sánchez Sorondo, M. (eds.), *Science for survival and sustainable development,* Pontifical Academy of Sciences, (Vatican City, 2000), pp.

427; Keilis-Borok, V.I., 'Seismology and logic', *Research in Geophysics*, 2, The MIT, Press, pp. 61-79 (1964); Keilis-Borok, V.I. and Yanovskaya, T.B., 'Inverse problems of seismology (structural review)', *Geophys. J.R. Astr. Soc.*, 13, pp. 223-234 (1967); Keilis-Borok, V.I., Press, F., 'On seismological applications of pattern recognition', *Source Mechanism and Earthquake Prediction Applications* (Paris, 1980); Gabrielov, A.M. and Keilis-Borok, V.I., 'Patterns of stress corrosion: geometry of the principal stresses', *PAGEOPH*, 121, n. 3, pp. 477-494 (1983); Lichtman, A.J. and Keilis-Borok, V.I., 'Aggregate-level analysis and prediction of midterm senatorial elections in the United States, 1974-1986', *Proc. Natl. Acad. Sci. USA*, 86, pp. 10176-10180 (1989); Keilis-Borok, V.I. (ed.), 'Intermediate-term earthquake prediction: models, phenomenology, worldwide tests', *Physics of the Earth and Planetary Interiors*, 61, pp. 1-144 (1990); Kantorovich, L.V. and Keilis-Borok, V.I., 'Earthquake prediction and decision making: social, economic, legislative and civil defence domains', *Proc. of International Conference 'Earthquake Prediction: State-of-the-Art'*, Strasbourg, France, 15-18 October, pp. 586-593 (1991); Gabrielov, A., Keilis-Borok, V. and Jackson, D., 'Geometric incompatibility in a fault system', *Proc. Natl. Acad. Sci. USA*, 93, pp. 3838-3842 (1996); Keilis-Borok, V.I. and Shebalin, P.N. (eds.), 'Dynamics of the lithosphere and earthquake prediction, Physics of the Earth and Planetary Interiors', 111, pp. 179-327 (1999); Gabrielov, A., Keilis-Borok, V., Zaliapin, I. and Newman, W., 'Critical transitions in colliding cascades', *Physical Review* E, 62, pp. 237-249 (2000); Keilis-Borok, V., Stock, J.H., Soloviev, A. and Mikhalev, P., 'Pre-recession pattern of six economic indicators in the USA', *Journal of Forecasting*, 19, pp. 65-80 (2000); Keilis-Borok, V., 'Earthquake prediction: state-of-the-art and emerging possibilities', *Annu. Rev. Earth Planet. Sci.*, 30, p. 38 (2002); Keilis-Borok, V.I., and Soloviev, A.A. (eds.), *Nonlinear Dynamics of the Lithosphere and Earthquake Prediction*, Springer-Verlag, (Heidelberg, 2003), p. 337; Keilis-Borok, V.I., Gascon, D.J., Soloviev, A.A., Intriligator, M.D., Pichardo, R. and Winberg, F.E., 'On predictability of homicide surges in megacities', in Beer, T. and Ismail-Zadeh, A. (eds.), *Risk Science and Sustainability*, Kluwer Academic Publishers, Dordrecht, pp. 91-110 (2003); Keilis-Borok, V.I., Soloviev, A.A., Allegre, C.B., Sobolevskii, A.N. and Intriligator, M.D., 'Dynamics of macroeconomic indicators before the rise of unemployment in Western Europe and the USA', submitted to *European Economic Review* (2003); Zaliapin, I., Keilis-Borok, V. and Ghil, M., 'A Boolean delay equation model of colliding cascades. Part II: Prediction of critical transitions', *Journal of Statistical Physics*, 111, pp. 839-861 (2003); Keilis-Borok, V., Shebalin, P., Gabrielov, A. and Turcotte, D., 'Reverse detection of short-term earthquake precursors', *Physics of the Earth and Planetary Interiors* (2004), in print.

Har Gobind Khorana



Date and place of birth: 9 January 1922, Raipur, India
Wife and children: Esther (deceased); Julia, Elizabeth, and Dave Roy
Appointment to the Academy: 17 April 1978
Scientific discipline: Biochemistry, Molecular Biology
Academic title: Emeritus Professor of Biology and Chemistry at the Massachusetts Institute of Technology

Most important awards, prizes and academies Awards: Dannie-Heinneman Preiz, Göttingen, Germany (1967); Louisa Gross Horwitz Prize (1968); Lasker Foundation Award for Basic Medical Research (1968); Nobel Prize in Physiology or Medicine (1968); William Gibbs Medal of the Chicago Section of the American Chemical Society (1974); Gairdner Foundation Annual Award, Toronto, Canada (1980); M.I.T. School of Science Distinguished Service Award (2000); Centennial Honorary Degree, Rockefeller University (2001). Academies: National Academy of Sciences, Washington, DC (1966); American Academy of Arts and Sciences (1967); Deutsche Akademie der Naturforscher Leopoldina, Halle/Saale, Germany (1968); Foreign Member, USSR Academy of Sciences (1971); Foreign Member, Indian Academy of Sciences (1978); Pontifical Academy of Sciences (1978); Foreign Member, Royal Society, London (1978); Foreign Member, Royal Society of Edinburgh, London (1982).

Summary of scientific research With my background as an organic chemist and interest in biology, I have always attempted to attack current biological problems by chemical approaches. In the fifties, my laboratory was interested in studying energy-rich phosphate esters, e.g. ATP and coenzyme A and related compounds, and general methods for their synthesis were developed. This was followed by investigations of the chemistry of nucleic acids and especially the synthesis of polynucleotides containing specific sequences. The methods thus developed made possible definitive studies of the genetic code by the synthesis of defined messenger RNAs. Following elucidation of the genetic code, I then became interested in the problem of the total synthesis of genes in the laboratory. These studies carried out in the sixties and early seventies led to simple and general methods that have now led to the synthesis of

large numbers of genes in different laboratories. My interests then turned to studies of biological membranes. In recent years, I have been particularly interested in membrane proteins that transduce light. Thus, Bacteriorhodopsin uses light energy to pump protons and the membrane potential thus generated is used by the organism for the synthesis of ATP. Vision in vertebrates and invertebrates depends on light transduction by photoreceptors in the rod cells. These topics form my current research interests.

Main publications Khorana, H.G., 'Carbodiimides. Part V: A novel Synthesis of Adenosine Di- and Tri-phosphate and p^1, p^2 -Diadenosine-5, -pyrophosphate', *J. Am. Chem. Soc.*, 76, p. 3517 (1954); Khorana, H.G., 'Studies on Polynucleotides. XLIV. The Synthesis of Dodecanucleotides Containing the Repeating Trinucleotide Sequence, Thymidylyl-(3'– > 5')-thymidylyl-(3' – > 5')-deoxycytidine' (with Jacob, T.M.), *J. Am. Chem. Soc.*, 87, p. 2971 (1965); Khorana, H.G., 'Studies on Polynucleotides. XLVII. The in vitro Synthesis of Homopeptides as Directed by a Ribopolynucleotide Containing a Repeating Trinucleotide Sequence. New Codon Sequences for Lysine Glutamic Acid and Arginine' (with Nishimura, S., Jones, D.S., Ohtsuka, E., Hayatsu, H. and Jacob, T.M.), *J. Miol. Biol.*, 13, p. 283 (1965); Khorana, H.G., 'Studies on Polynucleotides. XLVII. The in vitro Synthesis of a Co-polypeptide Containing Two Amino Acids in Alternating Sequence Dependent upon a DNA-like Polymer Containing Two Nucleotides in Alternating Sequence' (with Nishimura, S. and Jones, D.S.), *J. Mol. Biol.*, 13, p. 302 (1965); Khorana, H.G., 'Nucleic Acid Synthesis in the Study of the Genetic Code', *Les Prix Nobel en 1968*, pp. 196-220 (1969); Khorana, H.G., 'Total Synthesis of a Gene', *Science*, 203, p. 614 (1979); Khorana, H.G., 'Refolding of an Integral Membrane Protein: Denaturation, Renaturation and Reconstitution of Intact Bacteriorhodopsin and Two Proteolytic Fragments' (with Huang, K.-S., Bayley, H., Liao, M.-J. and London, E.), *J. Biol. Chem.*, 256, pp. 3802-3809 (1981); Khorana, H.G., 'The Bacteriorhodopsin Gene' (with Dunn, R., McCoy, J., Simsek, M., Majumdar, A., Chang, S.H. and Raj Bhandary, U.L.)', *Proc. Natl. Acad. Sci.*, 78 11, pp. 6744-6748 (1981); Khorana, H.G., 'Specific Amino Acid Substitutions in Bacterio-opsin: Replacement of a Restriction Fragment in the Structural Gene by Synthetic DNA Fragments Containing Altered Codons' (with Lo, K.-M., Jones, S.S. and Hackett, N.R.)', *Proc. Natl. Acad. Sci. USA*, 81, pp. 2285-2289 (1984).

Nicole Marthe Le Douarin

Date and place of birth: 20 August 1930, Lorient, France
Husband and children: Jean David; Claire, Laure-Anne
Appointment to the Academy: 3 Sept. 1999
Scientific discipline: Animal and Plant Biology (Developmental Biology)
Academic title: Honorary Professor at the Collège de France and Secrétaire Perpétuelle of the Academy of Sciences, Paris

Most important awards, prizes and academies Awards: Academy of Sciences, France; Royal Academy of Belgium; Kyoto Prize in Advanced Technology, Japan; Jeantet Prize in Medicine; Grand Prix de la Fondation pour la Recherche Médicale; Ross Harrison Prize of Columbia University, New York; Grand Officier dans l'Ordre National du Mérite; Commandeur dans l'Ordre de la Légion d'Honneur. Academies: Academy of Sciences, France; American Academy of Arts and Sciences; Academia Europaea; Pontifical Academy of Sciences; Foreign Member, National Academy of Sciences of the USA; Foreign Member, Royal Society, UK; Foreign Member, Royal Academy of Medicine of Spain; Foreign Member, Royal Academy of Belgium.

Summary of scientific research My work deals with the development of the nervous and the hemopoietic and angiogenic systems in the vertebrate embryo. I devised a cell marking technique which enables the migration and fate of cells to be followed within the embryo during the entire developmental period. With my colleagues, we have particularly studied the fate of the neural crest, an embryonic structure composed of pluripotent stem cells. Neural crest cells undergo extensive migrations within the embryo and differentiate into a large variety of cell types. The neural crest plays a crucial role in the construction of the vertebrate head and of the peripheral nervous system. It also yields pigment and endocrine cells. We established the embryonic origin of the hemopoietic stem cells and how the development of the immune system proceeds in the embryo and early post-natal life. We demonstrated that immune tolerance to self involves, in addition to the elimination of self reactive T cells in the thymus, an active mechanism which consists in the production in the thymic environment of regulatory cells that suppress the activity of the effector T cells that have escaped thymic elimination.

Main publications Le Douarin, N.M., *The Neural Crest* (Cambridge University Press, 1982; 2000); Le Douarin, N.M., *Des Chimères, des Clones et des Gènes* (Editions Odile Jacob, 2000). Author of over twenty published articles and essays including: 'A Biological Cell Labeling Technique and its Use in Experimental Embryology', *Dev. Biol.*, 30, pp. 217-222 (1973); 'The Ontology of the Neural Crest in Avian Embryo Chimeras', *Trends in Neurosciences*, 3, pp. 39-42 (1980); 'Cell Line Segregration during Peripheral Nervous System Ontogeny', *Science*, 231, pp. 1515-1522 (1986); 'Embryonic Neural Chimeras in the Study of Brain Development', *Trends in Neurosciences*, 16, 2m, pp. 64-72 (1993); 'Les chimères de caille et de poulet pour étudier l'embryogenèse', *Pour la Science*, 252, pp. 46-54 (1998); 'Problèmes éthiques liés aux progrès de la biologie du développement', *C. R. Soc. Biol.*, Cent cinquantenaire, 192, pp. 869-882 (1998). Joint author of over four hundred published articles and essays including: Le Douarin, N.M. and Jotereau, F.V., 'Tracing of Cells of the Avian Thymus through Embryonic Life in the Interspecific Chimeras', *J. Exp. Med.*, 142, pp. 17-40 (1975); Teillet, M.-A. and Le Douarin, N.M., 'Consequences of Neural Tube and Notochord Excision on the Development of the Peripheral Nervous System in the Chick Embryo', *Dev. Biol.*, 98, pp. 192-211 (1983); Baroffio, A., Dupin, E. and Le Douarin, N.M., 'Common Precursors for Neural and Mesectodermal Derivatives in the Cephalic Neural Crest', *Development*, 112, pp. 301-305 (1990); Lecoin, L., Gabella, G. and Le Douarin, N.M., 'The Origin of the *c-kit* Positive Interstital Cells in the Avian Bowel', *Development*, 122, pp. 725-733 (1996); Fournier-Thibault, C., Pourquié, O., Rouaud, T. and Le Douarin, N.M., 'BEN/SC1DM-GRASP Expression during Neuromuscular Development: A Cell Adhesion Molecule Regulated by Innervation', *J. Neurosc.*, 19 (4), pp. 1382-1392 (1999); Charrier, J.-B., Teillet, M-.A., Lapointe, F., and Le Douarin, N.M., 'Defining subregions of Hensen's node essential for caudalward movement, midline development and cell survival', *Development*, 126, pp. 4771-4783 (1999); Dupin, E., Glavieux, C., Vaigot, P. and Le Douarin, N.M., 'Endothelin 3 induces the reversion of melanocytes to glia through a neural crest-derived glial-melanocytic progenitor', *Proc. Natl. Acad. Sci., USA*, 97, pp. 7882-7887 (2000); Monsoro-Burq, A.-H. and Le Douarin, N.M., 'BMP4 plays a key role in left-right patterning in chick embryos by maintaining Sonic Hedgehog asymmetry', *Mol. Cell.*, 7, pp. 789-799 (2001).

Joshua Lederberg

Date and place of birth: 23 May 1925, Montclair, NJ, USA
Wife: Marguerite Stein
Appointment to the Academy: 4 March 1996
Scientific discipline: Molecular Genetics
Academic title: Sackler Foundation Scholar at the Rockefeller University, New York

Most important awards, prizes and academies Awards: Nobel Prize in Physiology or Medicine, for studies on organization of the genetic material in bacteria (1958); US National Medal of Sciences (1989); Commandeur, L'ordre des arts et des lettres, République Française (1993); Allen Newell Award, Association for Computing Machinery (1995); New York Academy of Medicine – John Stearns Award for Lifetime Achievement (1996); Columbia P&S Distinguished Service Medal (1988); Columbia Alexander Hamilton Award (1961); Yale's Wilbur Cross Medal (1990); Sigmi Xi's Procter Medal (1990). Academies: National Academy of Sciences, US (1957); For. Member, Royal Society of London, (1979); Hon. Life Member, New York Academy of Sciences (1980); Chairman (1994-95); Hon. Fellow, New York Academy of Medicine (1981); Fellow, AAAS; Am. Phil. Soc.; Am. Acad. Arts Sci. (1982); Hon. Member AOA (medical honorary society) (1983); Founding Member, Academie Universelle des Cultures (1993). Honorary Degrees: Turin (1969); Tufts (1985); Yale (1960); Wisconsin (1967); Columbia (1967); Yeshiva (1970); Mt. Sinai (1979); Rutgers (1981); NYU (1984); Jewish Theological Seminary (1979); Pennsylvania (1979); Tel Aviv (1991); Uniformed Services University of Health Sciences (USUHS) (1998); Rockefeller (1999). Adjunct Professor of Biology at Columbia (1990).

Summary of scientific research Joshua Lederberg was born in Montclair, NJ, near New York, the son of Rabbi Zwi H. and Esther Goldenbaum Lederberg, recently emigrated from Israel, on May 23, 1925. He was educated in New York. After a period of study at Columbia P&S medical school, where he began his life-long research in molecular biology, he received his Ph.D. in microbiology at Yale. He served as Professor of genetics at the University of Wisconsin, then at Stanford School of Medicine, before coming to the Rockefeller in 1978. His

lifelong research, for which he received the Nobel Prize in 1958 (at the age of 33), has been in genetic structure and function in microorganisms. He has been actively involved in artificial intelligence research (in computer science) and in the NASA experimental programs seeking life on Mars. He has also been a consultant on health-related matters for government and the international community, e.g. having had long service on WHO's Advisory Health Research Council. He received the US National Medal of Science in 1989, where his consultative role was specifically cited. He has been a member of the National Academy of Sciences since 1957, and a charter member of its Institute of Medicine, has served as Chairman of the President's Cancer Panel, and of the Congress' Technology Assessment Advisory Council, as well as on numerous other consultative panels. From 1978 to 1990 he served as president of the Rockefeller University. He continues his research activities there in the field of genetic control of rapid growth in bacteria. His current station there is Sackler Foundation scholar and professor emeritus of molecular genetics and informatics. His wife Marguerite Stein Lederberg was born in Paris, was saved during World War II as an 'enfant caché', was educated as a physician in the US and now serves as Professor of Clinical Psychiatry at Memorial Sloan Kettering Cancer Center in New York.

Main publications Lederberg, J., 'A View of Genetics', *Les Prix Nobel en 1958*, pp. 170-189 (1959); Mark S. Smolinski, Margaret, A. Hamburg and Joshua Lederberg (eds.), *Microbial threats to health: Emergence, Detection and Response*, Institute of Medicine (IOM) 2003, http://books.nap.edu/books/030908864X/html/245.html; Lederberg, J. (ed. in chief), *Encyclopedia of Microbiology*, 4 vols. (Academic Press, San Diego, 1992); Lederberg, J. (ed.), *Biological Weapons: Limiting the Threat* (MIT Press, 1999); Lederberg, J., 'Infectious History', *Science*, 288, pp. 287-293 (2000).

Tsung-Dao Lee

Date and place of birth: 25 November 1926, Shanghai, People's Republic of China
Wife and children: Jeannette (deceased); James, Stephen
Appointment to the Academy: 14 April 2003
Scientific discipline: Physics
Academic title: Professor

Most important awards, prizes and academies Awards: Nobel Prize in Physics (1957); Albert Einstein Award in Science; Galileo Galilei Medal; Order of Merit, Grande Ufficiale, Republic of Italy; Science for Peace Prize, China National-International Cooperation Award; Naming of Small Planet 3443 as the T.-D. Lee Planet; New York City Science Award; New York Academy of Sciences Award. Academies: American Physical Society; Academia Sinica; American Academy of Arts and Sciences; National Academy of Sciences; American Philosophical Society, Accademia Nazionale dei Lincei; Chinese Academy of Sciences; Pontifical Academy of Sciences.

Summary of scientific research Lee began his research under Enrico Fermi at the University of Chicago, with his first paper on the universality of the Fermi Interaction and his thesis on white dwarfs stars. He then worked with collaborators on phase transitions in statistical mechanics and polarons in condensed matter physics. After joining Columbia University in 1953, Lee worked mainly in particle physics and field theory. He created the Lee Model and the fields of high energy neutrino physics and the relativistic heavy ion physics. More recently, his interests have turned into high T_c superconductivity, lattice physics, difference equations and new ways to solve the Schrödinger Equation.

Main publications Lee, T.D., Rosenbluth, M., and Yang, C.N., 'Interaction of Mesons with Nucleons and Light Particles', *Physical Review*, 75, p. 905 (1949); Lee, T.D., 'Hydrogen Content and Energy Productive Mechanism of White Dwarfs', *Astrophysical Journal*, 111, p. 625 (1951); Lee, T.D. and Yang, C.N., 'Statistical Theory of Equations of State and Phase Transitions. II. Lattice Gas and Ising Model', *Physical Review*, 87, p. 404 (1952); Lee, T.D. and Pines, D., 'Motion of Slow Electrons in Polar Crystals', *Physical Review*, 88, p. 960 (1952); Lee, T.D., 'Some Special Examples in Renormalizable

Field Theory', *Physical Review*, 95, p. 1329 (1954); Lee, T.D. and Yang, C.N., 'Question of Parity Conservation in Weak Interaction', *Physical Review*, 104, p. 254 (1956); Lee, T.D. and Yang, C.N., 'Theoretical Discussions on Possible High Energy Neutrino Experiments', *Physical Review Letters*, 4, p. 307 (1960); Lee, T.D., 'A Possible New Form of Matter at High Density', *Report of the Workshop on BeV/Nucleon Collisions of Heavy Ions – How and Why*, Bear Mountain 1974 (*Brookhaven National Laboratory Report* BNL-50445), p. 1; Lee, T.D., 'Abnormal Nuclear States and Vacuum Excitations', *Review of Modern Physics*, 47, p. 267 (1975); Friedberg, R., Lee, T.D. and Sirlin, A., 'Class of Scalar-field Soliton Solutions in Three Space Dimensions', *Physical Review*, D1 3, p. 2739 (1976); Christ, N.H., Friedberg, R. and Lee, T.D., 'Random Lattice Field Theory: General Formulation', *Nuclear Physics*, B 202, p. 89 (1982); Lee, T.D., 'Can Time Be a Discrete Dynamical Variable?', *Physics Letters*, 12213, p. 217 (1983); Lee, T.D., 'Soliton Stars and the Critical Masses of Black Holes', *Physical Review*, D, p. 3637 (1987); Lee, T.D., 'Bosonization of Lattice Fermions and High T_c Superconductivity', *Physica*, 186 (1994); Friedberg, R., Lee, T.D., Zhao, W.Q., and Cimenser, A., 'A Convergent Iterative Solution of the Quantum Double-well Potential', *Annal Physics*, 294, p. 67 (2001).

Jean-Marie Lehn

Date and place of birth: 30 September 1939, Rosheim, France
Wife and children: Sylvie Lederer; David, Mathias
Appointment to the Academy: 30 May 1996
Scientific discipline: Chemistry
Academic title: Professor at the Collège de France, Paris

Most important awards, prizes and academies Awards: Gold Medal of the Pontifical Academy of Sciences (1981); Gold Medal of the CNRS (1981); Paracelsus Prize of the Swiss Chemical Society (1982); Alexander von Humboldt Forschungspreis (1983); Prize of the Commissariat à l'Energie Atomique, Académie des Sciences (1984); Rolf-Sammet Prize, Frankfurt University (1985); Nobel Prize in Chemistry (1987); Karl-Ziegler Prize (1989); Bonner Chemiepreis (1993); 'Ettore Majorana-Center-Erice-Science for Peace' Prize (1994); Davy Medal (1997); Lavoisier Medal (1997); Messel Medal (1998); Giulio Natta Medal (2003). Academies: Member or Foreign Member or Honorary Member of 33 Academic bodies. Honorary Degrees: Jerusalem (1984); Madrid (1985); Göttingen and Brussels, (1987); Crete and Bologna (1989); Prague (1990), Sheffield and Twente (1991); Athens and Athens Polytech. (1992); Illinois Wesleyan and Montréal (1995); Bielefeld, Hefei, Nanjing and Rehovot (1998); Brussels (1999); Nagoya and Sherbrooke (2000); Trieste (2001); Shanghai, Nanjing and Stockholm, KTH (2003).

Summary of scientific research Jean-Marie Lehn received his Doctorat-ès-Sciences in 1963 from the University of Strasbourg working in the laboratory of Guy Ourisson. The following year he joined the group of Robert Burns Woodward at Harvard University, where he participated in the total synthesis of vitamin B_{12}. On his return to Strasbourg he started to work in areas on the frontier between organic and physical chemistry, later taking an interest in biological processes as well. In 1970 Lehn became Professor of Chemistry at the Université Louis Pasteur in Strasbourg and since 1979 he has been Professor at the Collège de France in Paris. The research work of Jean-Marie Lehn led in 1968 to the synthesis of cage-like molecules that form inclusion complexes, the cryptates, with various metal ions. With this began his research on the

chemical basis of 'molecular recognition' (i.e. the way in which a receptor molecule recognizes and selectively binds a substrate), which also plays a fundamental role in biological processes. For these studies Lehn received the Nobel Prize for Chemistry in 1987. In the 1975-85 period he also conducted research on the photochemical splitting of water and artificial photosynthesis for which he received the Gold Medal of the Pontifical Academy of Sciences in 1981. Over the years, Lehn's main line of research has expanded from the studies on molecular recognition to the definition and exploration of a new field of chemistry, which he proposed calling 'supramolecular chemistry' as it deals with the complex entities formed by the association of two or more chemical species held together by intermolecular forces, whereas molecular chemistry studies the features of the entities constructed from atoms linked by covalent bonds. His work has also covered supramolecular catalysis, artificial enzymes and transport processes. It has further extended to the design of functional molecular and supramolecular devices belonging to the areas of molecular electronics, ionics and photonics. More recently a main line of development has been the design of 'programmed' systems that undergo self-organization by the spontaneous assembly of suitable components into well-defined supramolecular architectures following an Aufbau plan. The long-range goal is the study and design of organized matter and the progressive build-up of complexity. The results of the work of Jean-Marie Lehn have been described in more than 700 scientific publications.

Main publications Dietrich, B., Lehn, J.-M., Sauvage, J.-P., 'Les Cryptates', *Tet. Letters*, p. 2889 (1969); Lehn, J.-M., 'Nitrogen inversion: experiment and theory', in *Fortschritte der chemischen Forschung*, 15, p. 311 (1970), Springer-Verlag; Lehn, J.-M., 'Design of organic complexing agents. Strategies towards properties', *Structure and Bonding*, 16, p. 1 (1973); Lehn, J.-M., 'Cryptates: the chemistry of macropolycyclic inclusion complexes', *Acc. Chem. Res.*, 11, p. 49 (1978); Lehn, J.-M., 'Cryptates: inclusion complexes of macropolycyclic receptor molecules', *Pure & Appl. Chem.*, 50, p. 871, 1978; Lehn, J.-M., 'Macrocyclic receptor moleculaes: Aspects of chemical reactivity. Investigations into molecular catalysis and transport processes', *Pure & Appl. Chem.*, 51, p. 979 (1979); Lehn, J.-M., 'Cryptate inclusion complexes. Effects on solute-solute and solute-solvent interactions and on ionic reactivity', *Pure & Appl. Chem.*, 52, p. 2303 (1980); Lehn, J.-M., in *Photochemical conversion and storage of solar energy*, (S. Connolly, ed.), Academic Press, Chapitre 6, p. 161 (1981); Lehn, J.-M., 'Chemistry of transport processes – Design of synthetic carrier molecules', *Physical Chemistry of*

Transmembrane Ion Motions, (G. Spach, ed.), p. 181 (Elsevier, 1983); Lehn, J.-M., 'Supramolecular chemistry: Receptors, catalysts and carriers', *Science*, 227, p. 849 (1985); Lehn, J.-M., 'Supramolecular chemistry – Scope and perspectives. Molecules, supermolecules, and molecular devices', (Nobel Lecture, 8.12.1987), *Angew. Chem. Int. Ed. Engl.*, 27, pp. 89-112 (1988); Lehn, J.-M., 'Perspectives in supramolecular chemistry – From molecular recognition towards molecular information processing and self-organization', *Angew. Chem. Int. Ed. Engl.*, 29, p. 1304 (1990); Lehn, J.-M., 'Supramolecular Chemistry – Concepts and Perspectives', VCH (1995); Lehn, J.-M., 'Supramolecular chemistry / Science. Some conjectures and perspectives', (R. Ungaro, E. Dalcanale, eds.), *Supramolecular Science: Where It is and Where It is Going*, Kluwer Academic Publisher, pp. 287-304 (1999); Lehn, J.-M., 'Dynamic combinatorial chemistry and virtual combinatorial libraries', *Chem. Eur. J.*, 5, pp. 2455-2463 (1999); Lehn, J.-M., 'Programmed chemical systems: Multiple subprograms and multiple processing / expression of molecular information', *Chem. Eur. J.*, 6, pp. 2097-2102 (2000); Lehn, J.-M., 'Supramolecular Polymer Chemistry – Scope and Perspectives', *Supramolecular Polymers*, (Alberto Ciferri, ed.), pp. 615-641 (2000); Lehn, J.-M., 'Toward complex matter: Supramolecular Chemistry and self-organization', *Proc. Natl. Acad. Sci. USA*, 99, pp. 4763-4768 (2002).

Pierre Jean Léna

Date and place of birth: 22 November 1937, Paris, France
Wife and children: Shaohua; Clément, Etienne, Cécile
Appointment to the Academy: 18 Jan. 2001
Scientific discipline: Astrophysics
Academic title: Professor at the Université Denis-Diderot (Paris 7), Paris

Most important awards, prizes and academies Awards: Chevalier de la Légion d'honneur; Officier de l'ordre du Mérite; Prix Deslandres et Henri de Parville, Académie des Sciences; Prix Maurice Pérouse, Fondation de France; Prix Holweck, Société française de physique / Institute of Physics; Médaille Janssen, Société astronomique de France. Academies: Académie des Sciences, Paris (1991); Academia Europaea (1991); Pontifical Academy of Sciences (2001).

Summary of scientific research The scientific work of Pierre Léna is centred on infrared astronomy, a major branch of astronomy born in about 1960. With novel observations, he helped to model the solar atmosphere and its temperature minimum, then switched to the far infrared emission of molecular clouds in our Galaxy and the diffuse emission of interstellar medium observed with an airborne telescope. Adapting to infrared the *speckle interferometry* discovered by the French scientist Antoine Labeyrie, he was the first, with his students, to apply it to star formation and to measure the size of dust cocoons around forming stars. This work led him to organize the European *Very Large Telescope* as an interferometer, again following Labeyrie's ideas. This is the world's most powerful instrument and is now operating. He then worked on a new interferometer, connecting with optical fibers large telescopes on Mauna Kea (Hawaii). Beginning in 1984, he led a team which was the first to implementing adaptive optics on a telescope, a technique now adopted worldwide on giant instruments. With his students, he applied it to various astronomical objects. As an experimental physicist, he contributed to numerous techniques required by infrared astronomy, such as bolometers, Fourier spectrometers, bidimensional arrays, and air- and space-borne instruments. He represented France on the governing Council of the European Southern Observatory

(1986-1993), and directed the Graduate School of Astrophysics at Université Paris 7 (1976-1984 and 1992-1996) before becoming Director of the École Doctorale Astronomie d'Ile-de-France. His interest in educational matters led him to become President of the Institut National de Recherche Pédagogique (1991-1997) and to be an active member of *La Main à la Pâte* ('Hands On') activity designed to renovate science education in schools. He was President of the Société Française de Physique in 1989 and currently is President of the Comité d'éthique du CNRS.

Main publications Articles: Eddy, J., Léna, P. and McQueen, R.M., 'Far infrared measurement of the solar minimum temperature', *Solar Physics*, 10, pp. 330-341 (1969); Léna, P., 'Le rayonnement continu de la photosphère solaire', *Astron. Astrophys.,* 4, pp. 202-219 (1970); Turon, P. and Léna, P., 'First observation of the granulation at 1.65 micrometers. Center to limb variation of the contrast', *Solar Physics*, 30, pp. 3-14 (1973); Léna, P. *et al.*, 'The thermal emission of the dust corona during the eclipse of June 30, 1973', 1, *Astron. Astrophys.*, 37, pp. 75-79 (1974); Rouan, D., Léna, P., Puget, J.L., de Boer, K. and Wijnbergen, J., 'Far infrared observations of the galactic plane and molecular cloud S 140', *Ap. J.*, 213, L35-39 (1977); Chelli, A., Léna, P. and Sibille, F., 'Angular dimensions of accreting young stars', *Nature*, 278, pp. 143-146 (1979); Sibille, F., Chelli, A. and Léna P., 'Infrared speckle interferometry', *Astron. Astrophys.*, pp. 315-328 (1979); Chelli, A., Perrier, C. and Léna, P., 'The sub-arcsecond structure of I Rc at 5 µm', *Astrophys. J.*, 280, p. 163 (1984); Jiang Dong-rong, Perrier, C. and Léna, P., 'NGC2024 IRS2, Infrared speckle interferometry and nature of the source', *Astron. Astrophys.,* 135, pp. 249-254 (1984); Roddier, F. and Léna, P., 'Long baseline Michelson interferometry with large ground based telescopes at optical wavelengths, I & II', *Journ. Optics,* 15, pp. 171-182 & pp. 363-374 (1984); Léna, P. and Merkle, F., 'The interferometric mode of the European Very Large Telescope', *Astroph. Sp. Sc.,* 160, pp. 363-368 (1989); Rousset, G., Fontanella, J.C., Kern, P., Gigan, P., Rigaut, F., Léna, P. *et al.*, 'First diffraction-limited astronomical images with adaptive optics, *Astron. Astrophys.,* 230, L29-32 (1990); Gendron, E. and Léna, P., 'Astronomical adaptive optics. I. Modal control optimization', *Astron. Astrophys.,* 291, pp. 337-347 (1994); Mariotti, J.-M., Coudé du Foresto, V., Perrin, G., Zhao, P. and Léna, P., 'Interferometric connection of large ground based telescopes', *Astron. Astrophys. Suppl. Series,* 116, pp. 381-393 (1996); Clénet, Y., Rouan, D., Gendron, E., Montri, J., Rigaut, F., Léna, P. and Lacombe, F., 'Adaptive optic L-band observations of the Galactic Center region', *Astron. Astrophys.*, 376,

p. 124 (2001); Glanc, M., Gendron, E., Lacombe, F., Lafaille, D., Le Gargasson, J.F. and Léna, P., 'Towards wide field retinal imaging with adaptive optics', *Opt. Comm.*, 230, pp. 225-238 (2004). Books: *Lumières. Une introduction aux phénomènes optiques,* avec A. Blanchard, InterEditions, 1990; *Astrophysique: méthodes physiques de l'observation*, 2e éd. 1996, avec F. Lebrun & F. Mignard, EDP, Paris. *Astrophysical Observation,* Springer, 1998; *Adaptive optics for Astronomy* (F. Roddier, ed.), Cambridge University Press, 1998. Other Publications: *L'espace pour l'homme*, coll. Dominos, Flammarion (1993) (traduit en coréen et portuguais); *La main à la pâte. L'enseignement des sciences à l'école primaire*, ouvr. coll. présenté par G. Charpak, Flammarion (1996) (traduit en portuguais, vietnamien, arabe, chinois); *Les Sciences du ciel*, sous la direction de P. Léna, Flammarion (1996); *Le Trésor, dictionnaire des sciences*, ouvr. coll. dirigé par Michel Serres et Nayla Farouki, Flammarion (1997); *Paysages des sciences*, ouvr. coll. dirigé par Michel Serres & Nayla Farouki, Le Pommier (1999); *La science*, Yang Huanming and Pierre Léna, Desclée de Brouwer (2003); *Eclipse* 73, film documentaire réalisé par M. Dassonville, Service du Film de recherche scientifique (Paris, 1974); *Tours du Monde, Tours du Ciel*, dix heures d'émission pour la télévision, en collaboration avec Michel Serres, auteur et réalisateur R. Pansard-Besson (1990).

Rita Levi-Montalcini

Date and place of birth: 22 April 1909, Turin, Italy
Appointment to the Academy: 24 June 1974
Scientific discipline: Cellular and Molecular Biology
Academic title: Emeritus Professor at the Institute of Neurobiology, Rome

Most important awards, prizes and academies Awards: Feltrinelli Award (1968); St Vincent Award (1979); Max Weinstein Award (1962); William Thomson Wakeman Award (1974); Schmitt Award, Cambridge, MA (1981); Lewis Rosensteil Award, Boston, MA (1982); Horwitz Award, Columbia University, NY (1983); R. Gerard Neuroscience Award, Dallas, TX (1985); Nobel laureate in Physiology or Medicine (1986); Lasker Award (1986); US National Medal of Science (1987). Academies: National Academy of Sciences, USA (1968); Pontificia Academia Scientiarum (1974); Accademia Nazionale dei Lincei, Rome (1976); National Acad. of Sciences 'dei XL', Rome (1981); Acad. Européenne des Sciences, des Arts et des Lettres, Paris (1981); Academy of Arts and Science, Florence (1981); American Philosophical Society, USA (1986). Honorary Degrees: Sweden (1977); Israel (1978); USA (1980, 1982, 1989); UK (1987, 1998); Argentina (1987); Brazil (1987).

Summary of scientific research The main contributions of Prof. Rita Levi-Montalcini are in the study of the dynamic processes which take place in the building of the vertebrate nervous system. Early work by this author resulted in the discovery of different developmental events which play an important role in the shaping of this system. The two most significant findings are: a) the occurrence of massive cell death during early neurogenesis in the central and peripheral vertebrate nervous system; b) the occurrence of massive migratory processes of neuronal cell populations at an incipient stage of their differentiation in all segments of the cerebro-spinal axis from the telencephalon to the lowest levels of the spinal cord. The results of these studies performed between 1941 and 1949 are presented in a 1964 review article on 'Events in the Developing Nervous System'. These findings were followed

by the major discovery in 1952 of a humoral factor which plays an essential role in the growth and differentiation of sensory and sympathetic nerve cells. To the study of this factor, which became known as the Nerve Growth Factor (NGF), of its chemical nature, source(s), biological activity, and mechanism of action, Levi-Montalcini and her colleagues have devoted these past three decades. An ever-growing number of investigators all over the world have joined in this research. While these findings gave unequivocal evidence for the *trophic* and differentiative role of NGF on its target nerve cells, a third distinct but no less important NGF property is to exert a trophic directional action on sympathetic and sensory nerve fibres. This property, first hypothesized at the time of the discovery of the humoral nature of NGF, was definitely proved by experiments of intracerebral injections of NGF in neonatal rodents. The recent discovery by Prof. Levi-Montalcini, that in lower vertebrates (amphibia) a large number of nerve cells in the Central Nervous System undergo enhanced growth and differentiation upon treatment with murine NGF, opened up a new area of research now actively pursued at the Institute of Neurobiology in Rome.

Main publications Levi-Montalcini, R., 'Effects of mouse tumor transplantation on the nervous system', *NY Acad. Sci.*, 55, pp. 330-343 (1952); Levi-Montalcini, R., Meyer, H. and Hamburger, V., 'In vitro experiments on the effects of mouse sarcoma 180 and 37 on the spinal and sympathetic ganglia of the chick embryo', *Cancer Res.*, 14, pp. 49-57 (1954); Levi-Montalcini, R. and Booker, B., 'Excessive growth of the sympathetic ganglia evoked by a protein isolated from mouse salivary glands', *Proc. Natl. Acad. Sci. USA*, 46, pp. 373-384 (1960); Levi-Montalcini, R. and Booker B., 'Destruction of the sympathetic ganglia in mammals by an antiserum to a nerve growth protein', *Proc. Natl. Acad. Sci. USA*, 46, pp. 384-391 (1960); Levi-Montalcini, R. and Angeletti, P.U., 'Immunosympathectomy', *Pharmacol. Rev.*, 18, pp. 619-629 (1966); Levi-Montalcini, R., 'The nerve growth factor: its role in growth, differentiation and function of the sympathetic adrenergic neuron', *Perspectives in Brain Research*, (M.A. Corner and D.F. Swaab, eds.)(1976); Aloe, L. and Levi-Montalcini, R., 'Mast cells increase in tissues of neonatal rats injected with the nerve growth factor', *Brains Res.*, 133, pp. 358-366 (1977); Aloe, L. and Levi-Montalcini, R., 'Nerve growth factor-induced transformation of immature chromaffin cells in vivo into sympathetic neurons: effects of antiserum to nerve growth factor', *Proc. Natl. Acad. Sci. USA*, 76, pp. 1246-1250 (1979); Levi-Montalcini, R., 'Developmental neurobiology and the natural history of nerve growth factor', *Ann. Rev. Neurosci.*, 5, pp. 341-362

(1982); Levi-Montalcini, R. and Aloe, L., 'The effect of nerve growth factor on autonomic ganglion cells', in *Autonomic Ganglia*, (L. Elfvin, ed.), J. Wiley and Sons, Chichester, NY, pp. 401-426 (1983); Levi-Montalcini, R. and Calissano, P., *Nerve Growth Factor*, *Encyclopedia of Neuroscience*, vol. 2, (G. Adelman, ed.), Birkhauser, Boston-Basel-Stuttgart, pp. 744-746 (1987); Levi-Montalcini, R., Dal Toso, R., Della Valle, F., Skaper, S.D. and Leon, A., 'Update of the NGF Saga*', J. Neurol. Sci.*, 130, pp. 119-127 (1995); Levi-Montalcini, R., Skaper, S.D., Dal Toso, R. and Leon, A., 'Nerve Growth Factor: From Neurotrophin to Neurokine', *TINS*, 19, pp. 514-520 (1996); Levi-Montalcini, R., Skaper, S.D., Aloe, L. and Leon, A., 'Nerve Growth Factor', *Encyclopedia of Neurosciences*, edited by Elsevier Science (1999); Levi-Montalcini, R., *Elogio dell'imperfezione*, Garzanti Editore (Italy, 1988); Levi-Montalcini, R., *Il Tuo Futuro*, Garzanti Editore (Italy, 1993); Levi-Montalcini, R., *Senz'olio Contro Vento*, Baldini & Castoldi (Italy, 1996); Levi-Montalcini, R., *The Saga of the Nerve Growth Factor*, World Scientific Publishing Company Singapore (1997); Levi-Montalcini, R., *L'Asso nella Manica a Brandelli*, Baldini & Castoldi (Italy, 1998); Levi-Montalcini, R., *La Galassia Mente*, Baldini & Castoldi (Italy, 1999); Levi-Montalcini, R., *Cantico di una vita*, Cortina Editore (Italy, 2000); Levi-Montalcini, R., *Tempo di mutamenti*, Baldini & Castoldi (Italy, 2002).

Jean-Michel Maldamé

Date and place of birth: 31 August 1939, Algiers, Algeria
Appointment to the Academy: 29 Jan. 1997
Scientific discipline: Philosophy
Academic title: Professor at the Institut Catholique de Toulouse

Most important awards, prizes and academies 1er Prix des Libraires Catholiques, Siloë (1999). Pontifical Academy of Sciences (1997).

Summary of scientific research Dialogue Science/Foi; Recherche sur la théologie de la Crèation; Relation entre la théologie et la cosmologie; approche de Dieu à partir des questions posées par la sciences de la nature.

Main publications Livres: *Le Christ et le cosmos, Incidence de la cosmologie moderne sur la théologie,* Desclée (Paris, 1993), traduction italienne: *Cristo e il cosmo: Cosmologia e teologia*, San Paolo (Milan, 1995), pp. 281; *Le Saint Suaire,* 'Dossiers sur des questions actuelles', 'Que penser de ...? 33', Fidélité (Bruxelles, 1997), pp. 50, traduction en espagnol, Mensajero (Madrid, 2000); 'Le Christ pour l'Univers'*, Jésus et Jésus-Christ*, n. 73, Desclée (Paris, 1998), 1 vol. de pp. 294; *Un livre inspiré, la Bible,* Cerf (Paris, 1998), pp. 132; *En travail d'enfantement, création et évolution*, Aubin (Saint-Étienne, 2000), 1 vol. de pp. 160; *Le scandale du mal. Une question posée à Dieu*, Cerf (Paris, 2001), pp. 146; *L'univers du Big-bang. Lecture biblique*, Vrin (Paris, 2001), pp. 256; *De l'ombre de la mort... à la vie*, Sources de la Vie (Toulouse, 2002), pp. 120; 'Science et foi en quête d'unité'. *Discours scientifiques et discours théologiques*, Cerf (Paris, 2003), pp. 360. Collaboration à des livres ou actes de colloques: 'Réflexion philosophique et théologique sur le moment de la mort', *The Determination of Brain Death and its Relationship to Human Death*, *Pontificiae Academiae Scientiarum Scripta Varia*, 83 (Vatican City, 1992), pp. 177-186; 'Science, culture et théologie', *Pontificiae Academiae Scientiarum Scripta Varia*, 85 (Vatican City, 1994), pp. 397-431; 'L'origine de la vie en philosophie et en théologie', *Commentarii*, vol. V, n. 5, Académie pontificale des sciences (Vatican City, 1997), pp. 33-49; 'Fondements épistémologiques des sciences cognitives', *Le*

Défi des sciences cognitives, Colloque Institut catholique, 1997, *Chronique,* pp. 21-41; 'Culture scientifique et déplacement du religieux', *Le temps des religions sans Dieu, Esprit* (juin 1997), pp. 70-73; 'Identité humaine et génétique', *Pontificiae Academiae Scientiarum Scripta Varia,* 92 (Vatican City, 1998), pp. 157-170; 'Actualité de la démarche de saint Thomas d'Aquin pour comprendre la vie', *La Vita, storia et teoresi*, Pont. Univ. Lateranense (Rome, 1999), pp. 77-91; 'The Concept of Nature in Morality and Theology', *Changing Concepts of Nature*, *Pontificiae Academiae Scientiarum Scripta Varia*, 95 (Vatican City, 2000), pp. 303-316; 'L'entrée du Christ dans la gloire, renouvellement du rapport de l'homme et de l'espace', *Dieu, l'Église et les extraterrestres*, 'Questions de n. 122' (Paris, 2000), pp. 47-68; 'Le face-à-face Église et science au XX^{e} siècle', *Les grandes révolutions de la théologie moderne*, Bayard (Paris, 2003), pp. 9-60. Articles de revue: 'La pensée de la fin', *Recherches de science religieuse*, LXXXIV, 2, pp. 193-218 (1996); 'Encore le saint Suaire de Turin. Note épistémologique', *Bulletin de littérature ecclésiastique,* XCVII, 3, pp. 280-287 (juillet-septembre 1996); 'Evolution et création. La théorie de l'évolution: ses rapports avec la philosophie de la nature et la théologie de la création', *Revue Thomiste*, 4, pp. 575-616 (1996); 'Darwin et Dieu. Etude de l'itinéraire spirituel de Darwin en lien avec l'élaboration de la théorie de l'évolution', *Bulletin de littérature ecclésiastique*, XCVIII, pp. 155-179 (1997); 'L'origine de la vie', *Etudes*, pp. 641-650 (mai 1997); 'Science et foi, conditions nouvelles du dialogue', *Revue Thomiste*, 3, pp. 525-562 (1997); 'Le Christ et l'univers. Dialogue entre la théologie et la cosmologie scientifique', *Angelicum,* LXXIV, pp. 335-358 (1997); 'A la recherche de l'un, la cosmologie', *Revue des Questions scientifiques,* 168, pp. 225-243 (Namur, Belgique, 1997); 'Sciences cognitives, neurosciences et âme humaine', *Revue Thomiste,* 2, pp. 282-322 (1998); 'Origines de l'homme. Confrontation entre les résultats scientifiques et la tradition chrétienne', *Esprit et Vie*, 13, pp. 289-297 (1998); 'Quelques remarques théologiques sur l'Intelligence artificielle', *Esprit et Vie*, 13, pp. 298-306 (1998); 'L'Eglise et la science en dialogue', *Bulletin de littérature ecclésiastique*, 3, pp. 303-321 (juillet-septembre 1998); 'Dessein de Dieu et Providence. Finalité et finalités en théologie', *Revue d'éthique et de théologie morale,* 208, pp. 139-160, Cerf (mars 1999); 'Présentation de l'encyclique de Jean-Paul II *Fides et ratio*', *Cahiers saint Dominique* (juin 1999); 'La science est-elle un chemin vers Dieu?', *Esprit et Vie*, 15, pp. 337-354 (5 août 1999); 'Le monde a-t-il été créé imparfait?', *Esprit et Vie*, 21, pp. 457-464 (4 novembre 1999); 'Dieu et le temps', *Cahiers saint Dominique*, pp. 5-20

(décembre 1999); 'Dessein de Dieu et Providence. Finalité et finalités en théologie', *Revue d'Ethique et de théologie morale,* 'Le Supplément', 208, pp. 139-160 (mars 1999); 'Entre maîtrise et chaos. Civilisation techno-scientifique, possibilité de maîtrise', *Revue d'Ethique et de théologie morale,* 'Le Supplément', 209, pp. 129-135 (juin 1999); 'Sciences cognitives: L'âme perdue et retrouvée?', *Théophilyon*, IV-2, pp. 327-353 (1999); 'La place de l'homme dans l'univers. Astrophysique et foi chrétienne', *L'Homme dans la création,* revue *Christus*, 185, pp. 55-60 (janvier 2000); 'Emergence d'un nouveau paradigme scientifique et déplacements dans la catégorie du divin', *Lumière et vie*, 245, pp. 25-44 (janvier-mars 2000); 'Mieux dire le péché originel, grâce au sciences de la nature', *Esprit et Vie*, 7 et 8, pp. 8-15 et 4-12 (5 et 19 avril 2000); 'Église et science d'après les discours des papes à l'Académie pontificale des sciences', *Connaître*, Cahiers de l'Association Foi et Culture scientifique, 14, pp. 36-62 (décembre 2000); 'Le mystère du temps: temps des hommes et temps de Dieu. A l'occasion du commencement du nouveau millénaire', *Esprit et vie,* 3 livraisons (janvier et février 2001); 'Peut-on parler de la pluralité des mondes', *Rev. des Quest. Scient.*, 172, pp. 245-275 (2001); 'Situation actuelle du début science-foi. Impasses, renouveaux et ouvertures', *l'Église à la croisée des chemins*, Cerf (Paris, 2002).

Félix Malu wa Kalenga

Date and place of birth: 22 September 1936, Boma, Zaïre
Wife and children: Thienza Kanieba; Malu Mano, Malu Odia, Malu Disanka, Malu Dinanga, Malu Muluilayi
Appointment to the Academy: 26 Sept. 1983
Scientific discipline: Applied Physics
Academic title: Commissaire Général à l'Energie Atomique, Kinshasa

Most important awards, prizes and academies Awards: Médaille d'Argent du Mérite Civique, R.D.C.; Médaille d'Or du Mérite des Sciences et Lettres, Zaïre; Commandeur de l'Ordre National du Léopard, R.D.C.; Chevalier de l'Ordre de la Francophonie et du Dialogue des Cultures 'La Pléiade', France; Prix international du 'Mercure d'Or', Italie. Academies: Membre Correspondant, Académie des Sciences d'Outre-Mer, Belgique; Membre-fondateur, Académie du Tiers-Monde, Trieste, Italie; Membre-fondateur, Académie Africaine des Sciences, Naïrobi; Académie Pontificale des Sciences.

Summary of scientific research Dans le domaine de l'étude des phénomènes non linéaires et stochastiques, le Dr. Malu wa Kalenga s'est principalement attaché à l'étude des circuits électroniques comme le paramétron, l'oscillateur de Van Der Pol et le circuit de Duffing. L'étude du paramétron a permis de préciser les conditions de son emploi comme élément de mémoire dans les ordinateurs, dans le cas de signaux corrompus par du bruit. Dans le domaine du génie atomique, le Dr. Malu wa Kalenga, qui a dirigé la construction du réacteur Triga Mark II du Centre Régional d'Etudes Nucléaires de Kinshasa (CREN-K) (puissance en continu: 1 MW; puissance en pulsation: 1600 MW), s'intéresse à l'étude des réacteurs pulsés et des effets de bruit associés. Il a en particulier montré comment les neutrons retardés et les effets d'inertie en température pouvaient être pris en compte dans la dérivation sous une forme analytique compacte de la réactivité en mode pulsé. Il a plus généralement travaillé à la promotion et à l'utilisation de l'énergie atomique en Afrique et au Zaïre qui a abouti à la création, sous les auspices de l'OUA, du Centre Régional d'Etudes Nucléaires de Kinshasa (CREN-K) dont il assure la direction. L'importance de l'énergie dans le processus de développement des pays du Tiers-Monde, l'a conduit très tôt à s'in-

téresser à l'étude comparative des systèmes énergétiques et singulièrement des systèmes d'énergie renouvelable dans le contexte de l'Afrique. Ses travaux et publications dans le secteur de l'énergie solaire ont été déterminants dans l'éclosion de cette forme d'énergie au Zaïre. Les recherches du Professeur Malu wa Kalenga restent orientées actuellement sur les problèmes posés par les énergies nouvelles et renouvelables, sur les problèmes de l'appréciation de la demande d'énergie, et sur le comportement de réacteur Triga Mark II en mode pulsé. Les problèmes posés par les interactions 'science, technologie et société', rencontrés dans le domaine des économies des systèmes énergétiques, amènent le Professeur Malu à s'intéresser de plus près à la science de la complexité et aux conséquences épistémologiques du paradigme évolutif en science.

Main publications Malu, F.W.K., 'Evaluation of the envelope dispersion of oscillations in a Van der Pol's type oscillator acted upon by weak noise', *5th International Conference on non-linear oscillations*, 4, pp. 308-321 (Kiev, USSR, 1969); Malu, F.W.K., 'Influence des perturbations aléatoires sur le comportement dynamique du paramétron à inductance non linéaire', *Presse Universitaire*, pp. 155, Université de Louvain (Belgique, 1969); Malu, F.W.K., 'Influence des pertes linéaires et non linéaires sur le comportement dynamique du paramétron à inductance non linéaire', *Revue H.F.*, vol. VIII, 1, pp. 9-18 (Belgique, 1970); Malu, F.W.K., 'Étude et réalisation d'un générateur de bruit à basse fréquence utilisant une source radioactive au Cobalt', *Utilisation de l'Energie Atomique à des fins pacifiques en Afrique*, pp. 455-456, IAEA (Vienne, 1970); Malu, F.W.K., 'Extension de la théorie des processus markoviens à des cas non-markoviens', I, *Bulletin de la Société Mathématique de Belgique*, 23 (3), pp. 264-270 (1971); Malu, F.W.K., 'Les solutions possibles du problème du déficit énergétique de la Province Minière du Katanga en RDC*', Presse de l'ONRD*, pp. 145 (1971); Malu, F.W.K., 'Le phénomène de commutation de phase du paramétron à inductance non linéaire en présence de bruit (transitoire d'amorçage)', *Annales de la Faculté Polytechnique*, II, vol. 1, pp. 107-141, Presse Universitaire du Zaïre (1976); Malu, F.W.K., 'Power stabilisation of the Triga Mark II reactor of CREN-K', *Conférence sur les Réacteurs Triga*, *General Atomic Press*, TOC-7, pp. 3-38 à 3-48 (Salt Lake City, USA, 1976); Malu, F.W.K., 'Modification de la conception originale de la cuve du réacteur Triga Mark II du CREN-K', *General Atomic Press*, TOC-8, pp. 2-24 à 2-48 (1976); Malu, F.W.K., *Rapport de sécurité du réacteur Triga Mark II du CREN-K; puissance en continu: 1000 KW, puissance de pulsation: 1600 MW*; (en collaboration), Édition du CGEA (Zaïre, 1976), pp. 475;

Malu, F.W.K., *Les utilisations de l'énergie nucléaire: cas de l'Afrique*, Presse Universitaire du Zaïre (1977), pp. 219; Malu, F.W.K., 'Les perspectives de l'énergie nucléo-électrique en Afrique Centrale', *L'énergie nucléaire et son cycle de combustible*, *AIEA*, 6, pp. 127-140 (1978); Malu, F.W.K., *Sur les énergies nouvelles: l'énergie solaire*, Presse SPE (1978), pp. 201; Malu, F.W.K., 'Hydrogen as a feed-stock in chemical and petrochemical: the case of Zaïre', in Veziroglu, T.N., Fueki, K., Ohta, T., *Hydrogen Energy Progress*, Pergamon Press, pp. 1265-1272 (1980); Malu, F.W.K., 'Inertial effect on the CREN-K Triga reactor on pulsed mode', *Revue Zaïroise des Sciences Nucléaires*, vol. 1, 1, pp. 1-14 (1980); Malu, F.W.K., 'Solenoid pick-up problem in the CREN-K Triga Mark II Reactor', *Revue Zaïroise des Sciences Nucléaires*, vol. II, 1-2, pp. 111-115 (juin-déc. 1981); Malu, F.W.K., 'Un modèle économétrique de l'appréciation de la demande d'énergie par tête au Zaïre', *Revue Zaïroise des Sciences Nucléaires*, vol. III, 1, pp. 119-134 (1982); Malu, F.W.K., 'Incidence énergétique du phénomène de l'exode rural et de l'explosion démographique en Afrique au Sud du Sahara', *Dossier Méthodologique*; Presse Universitaire du Zaïre, pp. 185 (1983); Malu, F.W.K., 'Nuclear power and the demand problem in LDC's', *Revue Zaïroise des Sciences Nucléaires*, vol. IV, pp. 1-18 (1984); Malu, F.W.K., 'Science et technologie en Afrique (histoire, leçon et perspective)', *Académie Royale des sciences d'Outre-Mer de Belgique mémoire*, in-8; nouvelle série, Tome 18, pp. 266 (Bruxelles, 1992).

Yuri Ivanovich Manin

Date and place of birth: 16 February 1937, Simferopol, Russia
Wife and children: Xenia Semenova; Dimitri
Appointment to the Academy: 25 June 1996
Scientific discipline: Mathematics
Academic title: Professor at the Max-Planck-Institut für Mathematik

Most important awards, prizes and academies Awards: Moscow Mathematical Society (1963); Lenin Prize for work in Algebraic Geometry (1967); Brouwer Golden Medal for work in Number Theory, Royal Society and Mathematical Society of the Netherlands (1987); Frederic Esser Nemmers Prize in Mathematics, Northwestern University, Evanston, IL, USA (1994); Rolf Schock Prize in Mathematics, Swedish Royal Academy of Sciences (1999); Georg Cantor Medal, German Mathematical Society (2001); King Faisal Prize in Science, Saudi Arabia (2002). Academies: Academy of Sciences, Russia (1990); Royal Society of Sciences, Netherlands (1990); Academia Europaea (1993); Max-Planck-Gesellschaft (1993); Göttingen Academy of Sciences, Class of Physics and Mathematics (1996); Pontificia Academia Scientiarum (1996); Academia Leopoldina (2000). Honorary Degrees: Honorary Professor, Bonn University (1993); Université Pierre et Marie Curie, Paris (1999); University of Oslo (2002).

Summary of scientific research The main contributions of Prof. Yuri Manin are in the domains of algebraic geometry, number theory, differential equations, and mathematical physics. In algebraic geometry, he proved the Mordell conjecture for algebraic curves over functional fields: non-constant curves of genus more than 1 have only finitely many rational points. In the course of proof, he introduced an important tool which is now widely used under the name of Gauss-Manin connection in algebraic geometry, theory of singularities, theory of differential equations and mathematical physics. Another significant contribution is his counterexample to the classical Lüroth conjecture (joint work with V.A. Iskovskih) which revived the birational techniques of Italian algebraic geometry. In number theory, he constructed the so-called Manin-Brauer obstruction to the solvability of Diophantine equations.

In many cases vanishing of this obstruction is the necessary and sufficient condition of the existence of solutions. His work on the arithmetic of modular forms led him to the construction of *p*-adic *L*-functions and the theory of modular symbols. In recent years he started a program of algebraic geometric investigation of Diophantine equations with many solutions complementing the circle method when it becomes inapplicable or leads to wrong heuristic conclusions. Among the main ingredients of this program is the general notion of point-accumulating subvarieties and their algebraic geometric characterization, depending on the so-called 'linear growth conjecture'. Recently he started applying methods of noncommutative geometry to number theory and formulated an approach to the class field theory of real quadratic fields in which quantum tori replace elliptic curves. In the theory of differential equations, he developed a wide extension of the twistor methods using the cohomology theory of coherent sheaves. Building upon the earlier work of R. Penrose and E. Witten, he has shown that the twistor transform of Yang-Mills equations with current is encoded in the formalism of obstruction theory for infinitesimal extensions. His work with B. Kupershmidt and D. Lebedev on the equations of long waves and completely integrable systems led to the group theoretic explanation of their Hamiltonian structure. In mathematical physics, he made a contribution to the theory of quantum strings using algebraic geometric methods for the classification of instantons (jointly with M. Atiyah, N. Hitchin, V. Drinfeld) and the calculation of the Polyakov measure on the moduli spaces of curves. He introduced the technique of quantum spaces and universal coactions in the theory of quantum groups. His latest research is devoted to the quantum cohomology of algebraic varieties which physically is related to the study of partial compactification of the ten-dimensional Universe. From a mathematical viewpoint, this theory opens a new chapter of enumerative algebraic geometry giving a deep insight into the analytic properties of various generating functions. Yuri Manin has devoted a number of publications to the philosophy of science and the problems of the early stages of the development of language and mathematics. In computer science, Yuri Manin studied algebraic-geometric error-correcting codes, and was one of the first proponents of the project of quantum computing.

Main publications Manin, Yu.I., 'Selected Papers', *World Scientific Series in 20th Century Mathematics*, vol. 3, World Sci., Singapore, 1996, pp. xii + 600; Manin, Yu.I., 'Cubic Forms: Algebra, Geometry, Arithmetic', Russian: Nauka, Moscow, pp. 307, 1972, English trans., North Holland, Amsterdam, pp. 292, 1974, and pp. 326, 1986; Manin, Yu.I., *Gauge Fields and*

Complex Geometry, Russian trans., Nauka, Moscow, pp. 355, 1984, English trans., Springer Verlag, pp. 295, 1988; Kobzarev, I.Yu. and Manin, Yu.I., *Elementary Particles: Mathematics, Physics and Philosophy*, Reidel, Dordrecht, pp. 227, 1989; Manin, Yu.I., *Topics in Non-commutative Geometry*, Princeton University Press, pp. 163, 1991; Manin, Yu.I., 'The mythological trickster in psychology and history of culture', Russian trans., *Priroda*, 7, pp. 42-52 (1987); Manin, Yu.I., 'Archetype of Empty City', Russian trans., *Arbor Mundi*, 1, pp. 28-34 (1992), (E. Meletinsky, ed.); Kontsevich, M., Manin, Yu.I., 'Gromov-Witten classes, quantum cohomology and enumerative geometry', *Comm. Math. Phys.*, 164:3, pp. 525-562 (1994); Gelfand, S.I., Manin, Yu.I., *Methods of homological algebra,* Springer Verlag, pp. xv+372, 1996; Manin, Yu.I., 'Truth, rigor and common sense', *Truth in Mathematics*, (H.G. Dales and G. Oliveri, eds.), Clarendon Press, Oxford, pp. 147-159 (1998); Manin, Yu.I., *Frobenius Manifolds, Quantum Cohomology, and Moduli Spaces*, AMS Colloquium Series, Providence, Rhode Island, pp. 365, 1999; Manin, Yu.I., 'Classical computing, quantum computing, and Shor's factoring algorithm', *Séminaire Bourbaki*, 862, vol. 266, pp. 375-404, Astérisque (June 1999); Manin, Yu.I. and Marcolli, M., 'Continued fractions, modular symbols, and noncommutative geometry', *Selecta math.*, new. ser., 8, pp. 475-521 (2002).

Carlo Maria Card. Martini

Date and place of birth: 15 February 1927, Turin, Italy
Appointment to the Academy: 13 Nov. 2000
Scientific discipline: Holy Scripture and Theology
Academic title: Honorary Professor and Former Rector of the Pontifical Biblical Institute and of the Pontifical Gregorian University

Most important awards, prizes and academies Cardinal Martini was ordained priest in 1952 and received his Ph.D. in fundamental theology at the Pontifical Gregorian University in 1958. In 1962 he was appointed to the chair of textual criticism at the Pontifical Biblical Institute in Rome, where from 1968 to 1978 he was also Rector. In 1978 he was appointed Rector of the Gregorian University by Pope Paul VI and was invited by the Pope to preach at the annual retreat in the Vatican, the last held by Pope Montini. He was also called to be a member of the Commission for Relations with the Jews. After being appointed Archbishop of Milan by Pope John Paul II on 29 December 1979, he was consecrated Bishop on 6 January 1980, and made Cardinal on 2 February 1983. In the same year, His Holiness appointed him Speaker to the Synod of Bishops on 'Reconciliation and Penance in the Mission of the Church'. In 1989, in recognition of his contribution to the cause of education, the Università Pontificia Salesiana conferred on him the degree honoris causa in education science. From 1987 to 1993 he was President of the CCEE, the organising body of the Bishops' Conferences of the European nations, and in this capacity and others he has made a substantial contribution to the dialogue between, and the ecumenical journey of, the Christian Churches.

Summary of scientific research Cardinal Martini's scientific research has centred around biblical studies. After writing a Ph.D. on the historical question of the Resurrection in recent literature in the late 1950s he continued his studies of Holy Scripture abroad. In 1966 he published an important monographic study of the Codex B in the light of the Papyrus Bodmer XIV (*Il problema della recensionalità del Codice B alla luce del Papiro Bodmer XIV*). As the holder of the chair of textual criticism at the Pontifical Biblical Institute in Rome he prepared a new edition of A. Merk's *Novum Testamentum Graece*

et Latine and was then a member of the committee entrusted with the task of preparing an edition of *The Greek New Testament*. The second edition of this work was published in 1975. This Greek version of the New Testament was the basis for more than 800 versions of the Gospel in the world and Cardinal Martini was the only Catholic member of the group of five editors. Subsequently, his research was directed towards the early Christian community as it appears in the New Testament and to commentary on the Acts of the Apostles. Such studies of the Holy Scripture have been accompanied by constant reflection on the role of the Word of God within the Church. The thoughts and insights of Cardinal Martini, especially in relation to the New Testament, have also found expression in the publication of works for a less specialist audience, which have often been translated into several foreign languages. Another educational initiative of Cardinal Martini of great relevance was the series of meetings in his archdiocese on 'questions of faith' (known as the 'Cattedra dei non credenti') directed, within a complex social and cultural context, towards those who encounter difficulties in relation to faith or obstacles on the path to its attainment. During these meetings he also directed attention to the subject of science and the tenth meeting was specifically dedicated to the subject 'the horizons and limits of science'. Loyal to the spirit of St Ignatius, he has constantly organised and personally directed, for a broad number of social groups, the spiritual exercises created by that Saint, in which he has engaged in an absolute originality of approach involving an accompanying *lectio divina* of Holy Scripture. Together with all these cultural and spiritual initiatives, Cardinal Martini has also laid emphasis on always being near in a spirit of charity to the weakest, to the humble, and to those most in need in the poorest districts of Rome, Milan and other parts of the world.

Main publications In addition to reviews and smaller writings and numerous contributions to articles, collections, lexicons, his major works include the following: Martini, C.M., 'Il problema storico della risurrezione negli studi recenti', *Analecta Gregoriana*, 104, P.U.G. (Roma, 1959); Martini, C.M., 'Galileo e la teologia', *Saggi su Galileo Galilei*, pp. 1-11 (Firenze, 1967); Martini, C.M., *The Greek New Testament*, 2ª ed. riveduta (in collaborazione con Aland, K., Blanck, M., Metzger, B.M., Wikgren, A.)(Stuttgart, 1968); Martini, C.M., *In principio la Parola*, ed. Leumann Centro Ambr. Doc. Studi (Milano, 1982); Martini, C.M., *David Sinner and Believer*, St Paul Publications (1990); Martini, C.M., *The Joy of the Gospel*, The Liturgical Press (1994); Martini, C.M., *Ripartiamo da Dio*, Centro Ambrosiano (1995); Martini, C.M., *Et Dieu se fit vulnérable,* Cerf (Paris, 1995); Martini, C.M., *Alla fine del mil-*

lennio lasciateci sognare, ed. Centro Ambrosiano (Milano, 1996); Martini, C.M. e Eco, U., *In cosa crede chi non crede?*, 'Liberal-Sentieri', Atlantide ed. (Roma, 1996); Martini, C.M., *Jérémie; parole pour aujourd'hui,* Saint Augustin (1996)*;* Martini, C.M., *Dialoghi in Cattedrale*, San Paolo (1997); Martini, C.M., *Cristo è tutto per noi*, ed. Centro Ambrosiano (Milano, 1997); Martini, C.M., *L'assurdo di Auschwitz; e il mistero della Croce* (con Bettinelli, C., Formigoni, G., Gallas, A., Vecchio, G.), ed. Àncora (1998); Martini, C.M., *Sogno un'Europa dello Spirito*, ed. Piemme (Casale Monferrato, 1999); Martini, C.M., *Orizzonti e limiti della scienza. Decima cattedra dei non credenti*, Raffaello Cortina Editore (Varese, 1999), pp. 160; Martini, C.M., *Un cammino educativo*, ed. Gribaudi (2000); Martini, C.M., *Conversazioni pastorali*, ed. Àncora (2000); Martini, C.M., *Si può amare la Chiesa? Descrizione e parresia del ministero*, ed. Àncora (2000); Martini, C.M., *La pratica del Testo biblico*, ed. Piemme (Casale Monferrato, 2000); Martini, C.M., *La bellezza che salva*, ed. Indialogo (2000), pp. 78; Martini, C.M., *Mi ha mandato. Omelia nella messa crismale del giovedì santo*, ed. Centro Ambrosiano (Milano, 2001); Martini, C.M., *Notti e giorni del cuore. Un cammino di introspezione con Maria*, ed. Indialogo (2001)*,* pp. 80.

Mambillikalathil Govind Kumar Menon

Date and place of birth: 28 August 1928, Mangalore, India
Wife and children: Indumati (née Patel); Anant Kumar, Preeti
Appointment to the Academy: 12 May 1981
Scientific discipline: Physics
Academic title: Dr. Vikram Sarabhai Distinguished Professor, Indian Space Research Organisation, Govt. of India

Most important awards, prizes and academies Awards: Senior Award, Royal Comm. for the Exhbn. of 1851 (1953-55); Shanti Swarup Bhatnagar Award, Physical Sciences, CSIR (1960); Cecil Powell Medal, European Physical Society (1978); Durga Prasad Khaitan Memorial Medal of the Asiatic Society (1978); Kerala State Cte. for Sci. and Technology Prize (1979); Jawaharlal Nehru Award for Science of M.P. State Govt. (1983); J.C. Bose Fourth Triennial Gold Medal of Bose Institute (1985); C.V. Raman Medal of Indian Nat. Sci. Academy (1985). *Indian Sci. Congress. Assn. awards*: G.P. Chatterjee Award (1984); First Sir Asutosh Mookerjee Gold Medal (1988); Shatabdi Puraskar for overall contributions to the development of Science (1999); Millennium Award for lifetime achievements (2001). *National Awards from the President of India*: Padma Shri (1961); Padma Bhushan (1968); Padma Vibhushan (1985). Academies: Fellow, Royal Society; Foreign Honorary Member, American Academy of Arts and Sciences; Foreign Member, USSR Academy of Sciences; Honorary Member, Inst. of Electrical and Electronic Engrs. (IEEE); Honorary Pres., Asia Electronics Union; Fellow and Vice President, Third World Academy of Sciences; Fellow, Indian Nat. Sci. Academy (Pres. 1981-82); Fellow, Indian Academy of Sciences (Pres. 1974-76); Honorary Fellow, National Academy of Science, India; Pontifical Academy of Sciences; Past President of the ICSU (1988-93). For more than two decades, Prof. Menon has been at the highest levels in the Government of India in matters relating to science policy, management and administration.

Summary of scientific research Prof. Menon's principal scientific work has been on: 1) The development of nuclear emulsion techniques and their applications to the elucidation of the properties of the strange particles; in par-

ticular, establishing for the first time the existence of muons of varying energies, mono-energetic high energy charged pions, and of electrons, as secondaries in the decays of heavy mesons, thereby contributing significantly to establishing the $K_{\mu}3$, $K_{\pi}2$ and K_e3 modes of decay; extension of nuclear emulsion work to stacks of very large volume; and the first demonstration of scattering phenomena involving the K-particles, and discussion of this in terms of the 'strangeness' concept which had just then been introduced theoretically. 2) High altitude balloon studies near the geomagnetic equator: for this a dependable high altitude balloon facility was established (and is presently one of the major international facilities used by groups from all over the world with balloons of 10 m. cu. ft. that can carry ton payloads for level flights at 120,000 ft.). This was used initially for studies on the primary cosmic radiation with various electronic detector systems; and now for a range of research on x-rays, gamma rays, particle radiations, atmospheric sciences and the like. 3) Deep underground studies since 1960: Prof. Menon has been connected with the growing programme of deep underground observations on particle intensities, angular distributions and other related phenomena in the Kolar Gold Fields. In these experiments interactions due to natural neutrinos were observed and analyzed for the first time; multiparticle, so-called 'Kolar', events were observed which cannot yet be explained on any known basis, and could represent unknown particle decays or other types of new phenomena; evidence was obtained that muons are essentially produced through decays of pions and kaons even at very high energies and not directly. The later major effort related to a 150-ton detector, and then a 400-ton detector, operated calorimetrically at great depths to search for stability of the nucleon, up to lifetimes of 10^{31} - 10^{32} years, which was the first major experiment operated for this.

Main publications Menon, M.G.K., 'Nuclear Reactions produced by Slow Negative π-Mesons' (with Muirhead, H. and Rochat, O.), *Phil. Mag.*, 41, p. 583 (1950); Menon, M.G.K., 'Masses and Modes of Decay of Heavy Mesons. Pt. III. Particles' (with Fowler, P.H. *et al.*), *Phil. Mag.*, 42, p. 1040 (1951); Menon, M.G.K. *et al.*, 'A Search for Nuclear Disintegrations Produced by Slow Negative Heavy Mesons', *Proc. Roy. Soc.*, A221, p. 394 (1954); Menon, M.G.K., 'Observations on the Decay of Heavy Mesons in Photographic Emulsions' (with O'Ceallaigh, C.), *Proc. Roy. Soc.*, A221, p. 292 (1954); Menon, M.G.K., 'Evidence for the β-Decay of a K-Meson' (with Friedlander, M.W. *et al.*), *Phil. Mag.*, 45, p. 1043 (1954); Menon, M.G.K., 'The Interaction of Fast K-Mesons' (with Friedlander, M.W. and Keefe, D.),

Nuovo Cim., 1, p. 694 (1955); Menon, M.G.K. *et al.*, 'On the Masses and Modes of Decay of Heavy Mesons Produced by Cosmic Radiation', *Nuovo Cim.*, 2, p. 1063 (1955); Menon, M.G.K., 'Cosmic Ray Intensity at Great Depths and Neutrino Experiments' (with Ramana Murthy, P.V. *et al.*), *Nuovo Cim.*, 30, p. 1208 (1963); Menon, M.G.K., 'Cosmic Ray Intensities Deep Underground', *Prog. in Cosmic Ray and Elementary Particle Phys*, IX (with Ramana Murthy, P.V.) (1967); Menon, M.G.K., 'Studies of Cosmic Ray Neutrino Interactions in the KGF Experiment' (with Naranan, S. *et al.*), *Proc. Roy. Soc.*, A301, p. 137 (1967); Menon, M.G.K., 'The Kolar Gold Field Neutrino Experiment', Pt. I (with Krishnaswamy, M.R. *et al.*), *Proc. Roy. Soc.*, A323, p. 489 (1971); Menon, M.G.K., 'The Kolar Gold Field Neutrino Experiment', Pt. II (with Krishnaswamy, M.R. *et al.*), *Proc. Roy. Soc.*, A323, p. 511 (1971); Menon, M.G.K. *et al.*, 'Evidence for the Production of New Particles in Cosmic Ray Experiments Deep Underground', *Pramana*, 2, pp. 59-77 (1975); Menon, M.G.K. *et al.*, 'Candidate events for Nucleon Decay in the Kolar Gold Field Experiment', *Physics Letters*, 106B, n. 4, p. 339 (1981); Menon, M.G.K. *et al.*, 'Fully confined Events indicative of Proton Decay in the Kolar Gold Fields Detector', *Physics Letters*, 115B, n. 4, p. 349 (1982); Menon, M.G.K., 'Neutrino Backgrounds in the Kolar Gold Field Proton Decay Experiment' (with Krishnaswamy, M.R. *et al.*), *Pramana*, 19, p. 552 (1982); Menon, M.G.K., 'Results on Proton Decay from the Kolar Gold Field Experiments' (with Krishnaswamy, M.R. *et al.*), *Pramana*, 5, p. 518 (1983); Menon, M.G.K., 'Limits on the flux of monopoles from the Kolar Gold Mine Experiments' (with Krishnaswamy, M.R. *et al.*), *Physics Letters*, 142B, p. 99 (1984); Menon, M.G.K., 'Results from the KGF Proton Decay Experiments' (with Krishnaswamy, M.R. *et al.*), *Nuovo Cim.*, 9C, p. 167 (1986); Menon, M.G.K. *et al.*, 'Search for High Energy Neutrinos from SN1987A in KGF Nucleon Decay Experiment', *J. Astrophysics & Astr.*, 11, p. 73 (1990).

Beatrice Mintz

Date and place of birth: 24 January 1921, New York, NY, USA
Appointment to the Academy: 9 June 1986
Scientific discipline: Genetics
Academic title: Jack Schultz Chair in Basic Science, Institute for Cancer Research, Fox Chase Cancer Center, Philadelphia, PA, USA

Most important awards, prizes and academies Awards: Bertner Foundation Award in Fundamental Cancer Research (1977); New York Academy of Sciences Award in Biological and Medical Sciences (1979); Papanicolaou Award for Scientific Achievement (1979); Lewis S. Rosenstiel Award in Basic Medical Research (1980); Genetics Society of America Medal (1981); Ernst Jung Gold Medal for Medicine (1990); John Scott Award for Scientific Achievement (1994); March of Dimes Prize in Developmental Biology (1996); American Cancer Society National Medal of Honor for Basic Research (1997). Academies: National Academy of Sciences (1973); Fellow, American Association for the Advancement of Science (1976); Honorary Fellow, American Gynecological and Obstetrical Society (1980); American Philosophical Society (1982); Fellow, American Academy of Arts and Sciences (1982); Pontifical Academy of Sciences (1986). Honorary Degrees: Doctor of Science, New York Medical College (1980); Medical College of Pennsylvania (1980); Northwestern University (1982); Hunter College (1986); Doctor of Humane Letters, Holy Family College (1988).

Summary of scientific research Utilizing novel methods in experiments with mouse embryos, Beatrice Mintz demonstrated the genetic and developmental flexibility of the early embryo. These methods have enabled many aspects of development and disease to become accessible to analysis within the context of the intact organism. She first showed that early-stage embryo cells were developmentally totipotent and could be recombined from genetically different embryos. Normal mice resulted, in which genetically distinguishable cells were used to reveal clonal lineages, cell interactions, and tissue organization. She next found, even before cloned genes were available,

that the genome of the embryo can be stably modified by introduction of exogenous DNA. These were the first 'transgenic' mice, as they were later termed. Subsequently, her lab was one of four in which specific genes were microinjected into fertilized mouse eggs, became functional, and were transmitted to progeny through the germ line. Mintz then discovered that the various disorganized tissues in malignant teratocarcinomas arise from a reserve of self-renewing and developmentally totipotent stem cells, equivalent to early-embryo cells. She established, from a mouse teratocarcinoma, the first karyotypically normal and developmentally totipotent stem cell line in culture, and showed that the cells could be genetically engineered so as to derive laboratory animal models of human malignancies and other genetic diseases. In recent years, she has produced a transgenic mouse model of malignant metastatic melanoma in which the characteristics of the malignancy strikingly parallel those in the human disease. These animals are providing a means of testing potential therapies.

Main publications Mintz, B., 'Genetic mosaicism in adult mice of quadriparental lineage', *Science*, 148, pp. 1232-1233 (1965); Mintz, B., 'Gene control of mammalian pigmentary differentiation. I. Clonal origin of melanocytes', *Proc. Natl. Acad. Sci. USA*, 58, pp. 344-351 (1967); Mintz, B., 'Clonal basis of mammalian differentiation', *Sympos. Soc. Exp. Biol.*, 25, pp. 345-370 (1971) Cambridge University Press; Jaenisch, R. and Mintz, B., 'Simian virus 40 DNA sequences in DNA of healthy adult mice derived from preimplantation blastocysts injected with viral DNA', *Proc. Natl. Acad. Sci. USA*, 71, pp. 1250-1254 (1974); Mintz, B. and Illmensee, K., 'Normal genetically mosaic mice produced from malignant teratocarcinoma cells', *Proc. Natl. Acad. Sci. USA*, 72, pp. 3585-3589 (1975); Dewey, M.J., Martin, D.W., Jr., Martin, G.R. and Mintz, B., 'Mosaic mice with teratocarcinoma-derived mutant cells deficient in hypoxanthine phosphoribosyltransferase', *Proc. Natl. Acad. Sci. USA*, 74, pp. 5564-5568 (1977); Mintz, B., Cronmiller, C. and Custer, R.P., 'Somatic cell origin of teratocarcinomas', *Proc. Natl. Acad. Sci. USA*, 75, pp. 2834-2838 (1978); Fleischman, R.A. and Mintz, B., 'Prevention of genetic anemias in mice by microinjection of normal hematopoietic stem cells into the fetal placenta', *Proc. Natl. Acad. Sci. USA*, 76, pp. 5736-5740 (1979); Mintz, B. and Cronmiller, C., 'METT-1: A karyotypically normal in vitro line of developmentally totipotent mouse teratocarcinoma cells', *Somatic Cell Genet.*, 7, pp. 489-505 (1981); Stewart, T.A. and Mintz, B., 'Successive generations of mice produced from an estab-

lished culture line of euploid teratocarcinoma cells', *Proc. Natl. Acad. Sci. USA*, 78, pp. 6314-6318 (1981); Wagner, E.F., Stewart, T.A. and Mintz, B., 'The human β-globin gene and a functional viral thymidine kinase gene in developing mice', *Proc. Natl. Acad. Sci. USA*, 78, pp. 5016-5020 (1981); Mintz, B. and Silvers, W.K., 'Transgenic mouse model of malignant skin melanoma', *Proc. Natl. Acad. Sci. USA*, 90, pp. 8817-8821 (1993).

Jürgen Mittelstrass

Date and place of birth: 11 October 1936, Düsseldorf, Germany
Wife and children: Renate; Bettina, Katharina, Julia, Johanna
Appointment to the Academy: 10 Apr. 2002
Scientific discipline: Philosophy
Academic title: Professor of Philosophy and Philosophy of Science at the University of Constance, Germany

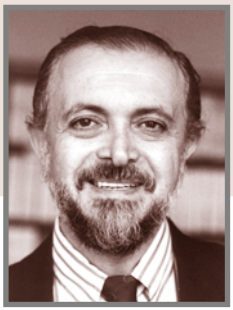
Most important awards, prizes and academies Awards: Leibniz-Prize, German Research Society (1989); Arthur Burkhardt Prize (1992); Lorenz Oken Medal, Society of German Scientists and Physicians (1998); Order of Merit of the State of Berlin (1993); Officer's Cross of the Order of Merit of the Federal Republic of Germany (1999). Academies: Berlin Academy of Sciences (1987-90); Vice-President (1988, 1994-2000) and President (2002-), Academia Europaea; Berlin-Brandenburg Academy of Sciences (1992); Corresponding Member, Académie Internationale d'Histoire des Sciences (1993); German Academy of Scientists Leopoldina (1998); Pontifical Academy of Sciences (2002); Austrian Academy of Sciences (2003). Honorary Doctorates: University of Pittsburgh, PA (2000); Humboldt University of Berlin (2000); University of Iasi, Romania (2000); University of Tartu, Estonia (2003).

Summary of scientific research Jürgen Mittelstrass' main subject and field of interest is history and philosophy of science, also epistemology, philosophy of language, philosophy of mind, and ethics. His interests developed out of his dissertation which dealt with the history of a Greek research principle in astronomy ('saving the appearences'). These studies were continued with an extensive analysis of the genesis of modern science and philosophy in the 17th and 18th centuries. In philosophy of science he devoted most of his work to models of scientific rationality, particularly to the concepts of justification and reconstruction, and to concepts like the apriori, the unity of science, scientific explanation, and time. He is also editor of an encyclopedia dealing mainly with philosophy of science, history of science, epistemology and scientific methodology (*Enzyklopädie Philosophie und Wissenschaftstheorie*, I-IV, 1980-1996).

Main publications *Die Rettung der Phänomene: Ursprung und Geschichte eines antiken Forschungsprinzips*, Berlin: de Gruyter 1962; *Neuzeit und*

Aufklärung: Studien zur Entstehung der neuzeitlichen Wissenschaft und Philosophie, Berlin and New York: de Gruyter 1970; *Das praktische Fundament der Wissenschaft und die Aufgabe der Philosophie,* Konstanz: Universitätsverlag 1972; *Die Möglichkeit von Wissenschaft,* Frankfurt: Suhrkamp 1974; (with Janich, P. and Kambartel, F.) *Wissenschaftstheorie als Wissenschaftskritik,* Frankfurt: Aspekte 1974; *Wissenschaft als Lebensform: Reden über philosophische Orientierungen in Wissenschaft und Universität,* Frankfurt: Suhrkamp 1982; *Die Modernität der Antike: Zur Aufgabe des Gymnasiums in der modernen Welt,* Konstanz: Universitätsverlag 1986; *Die Wahrheit des Irrtums: Über das schwierige Verhältnis der Geisteswissenschaften zur Wahrheit und über ihren eigentümlichen Umgang mit dem Irrtum*, Konstanz: Universitätsverlag 1989; (with Carrier, M.) *Geist, Gehirn, Verhalten: Das Leib-Seele-Problem und die Philosophie der Psychologie,* Berlin and New York: de Gruyter 1998, English edition (revised and enlarged): *Mind, Brain, Behavior: The Mind-Body Problem and the Philosophy of Psychology*, Berlin and New York: de Gruyter 1991; *Der Flug der Eule: Von der Vernunft der Wissenschaft und der Aufgabe der Philosophie,* Frankfurt: Suhrkamp 1989; (with Frühwald, W. *et al.*) *Geisteswissenschaften heute: Eine Denkschrift,* Frankfurt: Suhrkamp 1992, 2nd ed. 1996; (with Pinkau, K. *et al.*) *Umweltstandards: Grundlagen, Tatsachen und Bewertungen am Beispiel des Strahlenrisikos,* Berlin and New York: de Gruyter 1992, English edition: *Environmental Standards: Scientific Foundations and Rational Procedures of Regulation with Emphasis on Radiological Risk Management*, Boston and Dordrecht and London: Kluwer 1998; *Leonardo-Welt: Über Wissenschaft, Forschung und Verantwortung*, Frankfurt: Suhrkamp 1992; *Die unzeitgemäße Universität,* Frankfurt: Suhrkamp 1994; *Machina mundi: Zum astronomischen Weltbild der Renaissance,* Basel and Frankfurt: Helbing & Lichtenhahn 1995; *Das Undenkbare denken: Über den Umgang mit dem Undenkbaren und Unvorstellbaren in der Wissenschaft,* Konstanz: Universitätsverlag 1998; *Die Häuser des Wissens: Wissenschaftstheoretische Studien,* Frankfurt: Suhrkamp 1998; *Über philosophische Sprache,* Bonn: Bouvier 2000; *Zwischen Naturwissenschaft und Philosophie: Versuch einer Neuvermessung des wissenschaftlichen Geistes*, Konstanz: Universitätsverlag 2000; *Wissen und Grenzen: Philosophische Studien,* Frankfurt: Suhrkamp 2001; *Konstruktion und Deutung: Über Wissenschaft in einer Leonardo- und Leibniz-Welt,* Berlin: Humboldt-Universität zu Berlin 2001; *Transdisciplinarität: wissenschaftliche Zukunft und Institutionelle Wirklichkeit*, Konstanz: Universitätsverlag 2003; Editor of: *Enzyklopädie Philosophie und Wissenschaftstheorie,* vols. I-IV, Stuttgart and Weimar: Metzler 1980-1996.

Mario José Molina



Date and place of birth: 19 March 1943, Mexico City, Mexico
Wife and children: Luisa; Felipe
Appointment to the Academy: 24 July 2000
Scientific discipline: Atmospheric Chemistry
Academic title: Professor at the Massachusetts Institute of Technology

Most important awards, prizes and academies Awards: Tyler Ecology and Energy Prize (1983); UNEP-Sasakawa Prize (1999); Esselen Award (1987); Newcomb-Cleveland Prize (AAAS) (1988); Nobel Prize in Chemistry (1995). Academies: National Academy of Sciences; Institute of Medicine, USA; American Chemical Society; American Physical Society; Fellow, American Geophysical Union.

Summary of scientific research Prof. Molina predicted in 1974 (together with F.S. Rowland) that CFC gases being used in spray cans, as refrigerants and solvents, etc., would eventually deplete the ozone layer. This laid the ground for the discovery of the 'ozone hole' over the Antarctic. Subsequent work in large measure explained the mechanism by which ozone depletion over the poles comes about.

Main publications Author or joint author of over a hundred articles and essays, including: Molina, M.J. and Rowland, F.S., 'Stratospheric sink chlorofluromethanes-chlorine atom catalysed destruction of ozone', *Nature*, 249, p. 810 (1974); Molina, M.J., Tso, T.L., Molina, L.T. and Wang, F.C.-Y, 'Antarctic Stratospheric chemistry of chlorine nitrate, hydrogen chloride, and ice: release of active chlorine', *Science*, 238, p. 1253 (1987); Molina, M.J., Lipson, J.B., Elrod, M.J., Beiderhase, T.W. and Molina, L.T., 'Temperature dependance of the rate constant and branching ration for the OH+C1O reaction', *J. Chem. Soc. Farady Trans.*, 93, p. 2665 (1997); Molina, M.J., Zhang, R. and Molina, L.T., 'Development of an electrostatic ion guide in chemical ionisation mass spectrometry', *Rev. Sci. Instrum.*, 69, p. 4002 (1998); Molina, M.J., Koop, T., Ng, H.P. and Molina, L.T., 'A new optical technique to study aerosol phase transitions: The nucleation of ice from H_2SO_4 aerosols', *J. Phys. Chem.*, 102, p. 8924 (1998); Molina, M.J.,

Zhang, R., Broekhuizen, R., Lei, W., Navarro, R. and Molina, L.T., 'Experimental Study of intermediates from OH initiated reactions of toluene', *J. Am. Chem. Soc.*, 121, pp. 10225-10226 (1999); Molina, M.J., Lipson, J.B., Beiderhase, T.W., Molina, L.T. and Olzmann, M., 'Production of HC1 in the OH + C1O: Laboratory measurements and statistical rate theory calculations', *J. Phys. Chem.,* 103, p. 6540 (1999); Molina, M.J., Koop, T., Bertram, A.K. and Molina, L.T., 'Phase transitions in aqueous NH_4HSO_4 solutions', *J. Phys. Chem*, 103, pp. 9042-9048 (1999); Molina, M.J., Lee, S.H., Leard, D.C., Zhang, R. and Molina, L.T., 'The HC1 + C1ONO2 reaction rate on various water ice surfaces', *Chem Phys. Lett.*, 315, pp. 7-11 (1999); Molina, M.J., Salcedo, D. and Molina, L.T., 'Nucleation rates of nitric acid dihydrate in 1:2 HNO_3 / H_2O solutions at stratospheric temperatures', *Geophys. Res. Lett.,* 27, p. 193 (2000).

Marcos Moshinsky

Date and place of birth: 20 April 1921, Kiev, the Ukraine, USSR (resident in Mexico since 1927)
Wife: Esperanza del Río de Moshinsky
Appointment to the Academy: 9 June 1986
Scientific discipline: Physics
Academic title: Professor at the Universidad Nacional Autónoma de México

Most important awards, prizes and academies Awards: Academia de la Investigación Científica (1961); Fomento Educativo (1966); National Science Prize (1968); Luis Elizondo (1971); Research Prize – Universidad Nacional Autónoma de México (1985); Bernardo A. Houssay, Organization of American States (1990); UNESCO Science (1997); Wigner Medal (1998); The Weizmann Award in Science and Humanities (2003). Academies: President (1962-63), Academia de la Investigación Científica, México (1960-); Academia Brasileira de Ciencias (1963); President, Sociedad Mexicana de Física (1967-69); El Colegio Nacional, México (1972); Academia Latinoamericana de Ciencias (1963); Third World Academy of Sciences (1985); Pontifical Academy of Sciences (1986); American Academy of Arts and Sciences. Honorary Degrees: Goethe University, Frankfurt, Germany (2000).

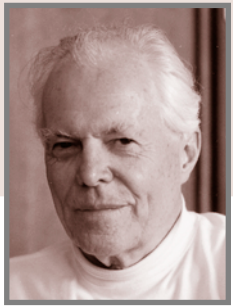
Summary of scientific research After receiving my Ph.D. in Princeton in 1949 working with Wigner on 'Boundary conditions for the description of relativistic interactions', my interest turned to a schematic theory of nuclear reactions with the help of these boundary conditions and the possibility of a time dependent description of the scattering and reaction process. Later I was interested in nuclear structure problems based on the shell model, and in particular ways of simplifying the calculations through the concept of transformation brackets for harmonic oscillator states. This concept became a basic tool in nuclear shell and Hartree-Fock calculations. My interest in harmonic oscillator states led me to try to understand their underlying group structure and thus to the irreducible representations of the unitary groups and their applications, first in 2s-1d shell and later in collective models of the nucleus. This continues to be an interest of mine, though now through the symplectic Lie algebras related to the microscopic understandings of the collective motions. Along the way I

became interested in the representation of canonical transformations in quantum mechanics, particularly when these transformations are non-bijective as happens when we go to action and angle variables. This gave rise to many publications and is also an interest being continued up to the present time. A line of research I initiated concerns the structure of matter in strong electric and magnetic fields. I am also concerned with problems of relativistic quantum mechanics through the introduction of a new concept I call sign spin.

Main publications Books: Moshinsky, M., *Tables of Transformation Brackets* (with Brody, T.A.), Gordon and Breach, 1969; Moshinsky, M., *Group Theory and the Many Body Problem*, Gordon and Breach, 1967; Moshinsky, M., *The Harmonic Oscillator in Modern Physics: From Atoms to Quarks*, Gordon and Breach, 1969, Russian trans. by MIR in 1972; Moshinsky, M., *The Harmonic Oscillator in Modern Physics* (with Smirnov, Yu.F.), second enlarged edition, Harwood Academic Publishers (1996). Over 275 research papers most of them in international journals. Among the most recent ones: Moshinsky, M., 'Boundary conditions for the description of nuclear reactions and their time dependent behavior', *Phys. Rev.*, 81, p. 347 (1951); 84, pp. 525-533 (1951); 88, p. 625 (1952); Moshinsky, M., 'Transformation brackets for harmonic oscillator functions', *Nuclear Physics*, 13, p. 104 (1959); Moshinsky, M., 'Group Theory of Harmonic Oscillators', *Nuclear Physics*, 18, p. 697 (1960); 23, p. 177 (1961) in collaboration with V. Bargmann; Moshinsky, M., 'Basis for irreducible representations of unitary groups and some applications', *J. Math. Phys.*, 4, p. 1128 (1963); 6, p. 682, p. 1540 (1985); 7, p. 691 (1966); 10, p. 455 (1969); Moshinsky, M., 'Canonical transformations and their representation in quantum mechanics'. Over twenty publications in *J. Math. Phys.* and *Annals of Physics* starting in 1970. Among the most relevant ones: *Ann. Phys.* (NY), 114, p. 243 (1978); 120, p. 402 (1979); 127, p. 458 (1980); (1986); Moshinsky, M., 'Collectivity and Geometry'. Over twenty papers dealing with collective models of the nucleus viewed from a group theoretical standpoint and appearing mainly in *J. Math. Phys.* Among the most relevant ones: *J. Math. Phys.*, 25, p. 1555, p. 1565, p. 2815 (1984). Moshinsky, M., 'Pseudoatoms and atoms in strong magnetic fields', *Ann. Phys.* (NY), 163, 1 (1985); Moshinsky, M., 'The Dirac oscillator', *J. Phys. A: Math Gen.*, 22, L817 (1989); Moshinsky, M., 'Art or Science: The symmetry Lie algebra for a Hamiltonian with accidental degeneracy', *Ann. Phys.*, 198, p. 103 (1990); Moshinsky, M., 'A relativistic cockroach nest', *Can. J. Phys.*, 72, p. 453 (1994); Moshinsky, M., 'Supermultiplets and relativistic problems', *J. Phys. A. Math. Gen.*, I. 29, p.

6027 (1996); II. 31, p. 6045 (1998); III. 31, pp. 10017-10028 (1998); Moshinsky, M., 'Diffraction in time with dissipation', *J. Phys. A. Math Gen.*, 34, p. 4217 (2001); Moshinsky, M., 'Matrix representation of the Sturm-Coulomb problem in a magnetic field and its implications for chaos', *Rev. Mex. Fis.*, 46, supplement 1, (2003); Moshinsky, M., 'The relativistic and quantum mechanical and applications to bottomonium', *J. Phys. A. Gen.*, 36, p. 2163 (2003).

Rudolf Ludwig Mössbauer



Date and place of birth: 31 January 1929, Munich, Germany
Wife and children: Christel; Peter, Regine, Susanne
Appointment to the Academy: 10 April 1970
Scientific discipline: Physics
Academic title: Professor at the Technical University of Munich

Most important awards, prizes and academies Awards: Research Corporation Award, New York, USA (1961); Röntgen-Prize, University of Giessen, FRG (1961); Elliot Cresson Medal, Franklin Institute, USA (1961); Nobel Prize in Physics (1961); Guthrie Medal, Institute of Physics, London, UK (1974); Lomonossov Medal, Soviet Academy of Sciences, Moscow, USSR (1984); Einstein Medal, Einstein Society, Switzerland (1986). Academies: German Academy Leopoldina; Pontifical Academy of Sciences; Bavarian Academy of Sciences, FRG; Accademia Nazionale dei XL, Italy; National Academy of Sciences, USA; American Academy of Arts and Sciences; Academy of Sciences, USSR; Indian Academy of Sciences.

Summary of scientific research Discovery of the phenomenon of recoilless nuclear resonance absorption of gamma radiation (Mössbauer effect) and its direct verification in a Doppler-shift experiment. Application of the method to numerous studies of nuclear hyperfine interactions in efforts to derive various nuclear and solid state properties such as values of nuclear moments and the behavior of magnetic fields and electric field gradients in solids under different physical or chemical conditions. Development of a new method for the structure analysis of macromolecules based on phase variation techniques. Measurements of the dynamical diffraction of gamma radiation under resonant conditions, in particular studies of the frequency and polarization dependence and the anomalous transmission features. Studies of the dynamical behavior of proteins and of their anomalous dependence on temperature. Analysis of the temporal aspects or recoilless resonance absorption of gamma radiation and of related phenomena. More recent research efforts were devoted to the problem of the restmass of the neutrinos. Extensive measurements of neutrino oscillations at nuclear power reactors have yielded no mixing and no mass values. Measurements with solar neutrinos (Gallex project in the Gran

Sasso mountain range in Italy) gave oscillation parameters. The interpretation in terms of neutrino masses is still open. Efforts in Munich (Garching) have yielded cryogenic detectors with unsurpassed resolution in energy.

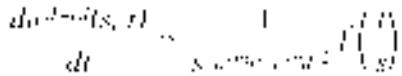
Main publications Mössbauer, R.L., 'Kernresonanz-Fluoreszenz von Gamma-Strahlung in ^{191}Ir.', *Z. Phys.*, 151, pp. 124-143 (1958); Mössbauer, R.L., 'Kernresonanzabsorption von Gamma-Strahlung in ^{191}Ir.', *Z. Naturforschung*, 14A, p. 211 (1959); Mössbauer, R.L., 'Recoilless Resonance Absorption and Hyperfine Structure of the 6.3 keV-State in ^{181}Ta' (with Sauer, C. and Matthias, E.), *Phys. Rev. Lett.*, 21, p. 961 (1968); Mössbauer, R.L., 'Structure Analysis of Macromolecules by Means of Anomalous Dispersion Methods', *Die Naturwissenschaften*, 60, pp. 493-500 (1973); Mössbauer, R.L., 'Suppression of Nuclear Inelastic Channels in Nuclear Resonance and Electronic Scattering of γ-quanta for Different Hyperfine Transition in Perfect ^{57}Fe Single Crystals' (with van Bürck, U., Smirnov, G.V., Parak, F. and Semioschkina, N.A.), *J. Phys. C: Solid State Phys.*, 11, pp. 2305-2321 (1978); Mössbauer, R.L., 'A Solution of the Phase Problem in the Structure Determination of Biological Macromolecules in Mössbauer Effect' (with Parak, F. and Hoppe, W.), *The Exotic Side of Method; Topics in Current Physics*, vol. 25, (U. Gonser, ed.), pp. 5-30 (1981); Mössbauer, R.L., 'Gamma Resonance Revisited: Temporal Aspects of Absorption and Scattering', *International Conference on the Application of the Mössbauer Effect 83*, Alma-Ata, 1983, *Applications of the Mössbauer Effect*, (Yuri M. Kagan, I.S. Lyubutin, eds.), Gordon and Breech, 1 (1985), 1; Mössbauer, R.L., 'The Search for Massive Neutrinos', Proc. First ESCO-CERN Symposium on the *Large-Scale Structure of the Universe, Cosmology and Fundamental Physics*, p. 273 (1984); Mössbauer, R.L., 'Neutrino-Ruhemassen und Leptonenzahl-Verletzung', *Phys. Blätter*, 41, p. 391 (1985); Mössbauer, R.L. *et al.*, 'Neutrino Oscillation Experiments at the Gösgen Nuclear Power Plant', *Phys. Rev.*, D34, p. 2621 (1986); Mössbauer, R.L., 'Untersuchung der Protein-Dynamik mittels Mössbauer-Effekt und Röntgenstrukturanalyse' (with Parak, F.), *Physiologie aktuell*, 3, p. 5 (1987); Mössbauer, R.L., 'Quasiparticle Trapping in a Superconductive Detector Exhibiting High Energy and Position Resolution' (with Kraus, H., v. Feilitzsch, F., Jochum, J., Peterreins, Th., Pröbst, F.), *Phys. Lett.*, B 231, p. 195 (1989); Mössbauer, R.L., 'Neutrino Physics at Nuclear Energies', *PINSA*, A64, p. 87 (1998); Mössbauer, R.L., 'Gammastrahlen-Resonanzspektroskopie', *Naturwiss. Rundschau*, 52, p. 171 (1999); Mössbauer, R.L., 'The Discovery of the Mössbauer Effect', *Hyperfine Interactions*, 126, p. 1 (2000); Mössbauer, R.L., Angloher, G. *et al.*, 'Energy Resolution of 12 eV at 5,9 keV from Al-Superconducting Tunnel Junction Detectors', *J. Applied Physics*, 89, p. 1425 (2001).

Rudolf Muradian

Date and place of birth: 19 June 1936, Yerevan, Armenia
Wife and children: Diana; Mira
Appointment to the Academy: 16 Oct. 1994
Scientific discipline: Physics
Academic title: Professor at the Universidade Federal da Bahia and the Byurakan Astrophysical Observatory

Most important awards, prizes and academies Lenin Prize for Physics, 1988. National Academy of Sciences of Armenia, Yerevan (1986); Pontificia Academia Scientiarium (1994).

Summary of scientific research Rudolf Muradian was educated at Moscow University and received his doctoral degree from the Joint Institute for Nuclear Research, Dubna. His work has covered a wide range of topics in elementary particle physics, mathematical physics, and cosmology. For discovering the Dimensional Quark Counting Rules he shared the 1988 Lenin Prize for Physics. The main results of Prof. Muradian's research can be summarized as follows: 1) Description of bound states and scattering amplitudes in the framework of Quantum Field Theory. 2) Construction of the Mandelstam double spectral function for 6th order diagram using the analytical properties of partial wave amplitudes in the complex angular momentum plane. 3) Investigation of the *three nucleon forces* in light nuclei in the framework of Quantum Chromodynamics. 4) Exact solution of the *random walk problem* on a sphere and in the Lobachevsky space. 5) Direct method of constructing irreducible representations for finite rotation groups – tetrahedral, octahedral, and icosahedral – based on the extraction of roots from unit matrices in a definite direction. 6) He is one of the authors of the *Dimensional Quark Counting Rules* for exclusive processes:



This formula provides direct information about the composite quark structure of matter and has a wide application in modern particle and nuclear physics.

7) An important contribution was made by Prof. Muradian to the solution of the old and most difficult problem of cosmogony – the problem of the origin of the rotation of planets, stars and galaxies. Observational data regarding the spin J and mass m of astronomical bodies and their systems he described by a Regge-like law of the form:

$$J \sim \hbar \left(\frac{m}{m_p}\right)^{n}$$

where m_p is the proton mass and $\hbar$ is the Planck constant. The number n in the exponent takes integral values $n = 1, 2, 3$ characterizing the spatial dimensionality (shape) of primeval objects before the fragmentation process. The choice $n = 2$ for galaxies, their clusters and superclusters, and $n = 3$ for asteroids, planets and stars are in excellent agreement with observations, surprising resemblance between the angular momentum and mass connection. Two very important limiting points are revealed:

$$\text{Eddington point} \longrightarrow (m_{\text{Edd}}, J_{\text{Edd}})$$
$$\text{Chandrasekhar point} \longrightarrow (m_{\text{Ch}}, J_{\text{Ch}})$$

Limiting masses and limiting angular momenta for cosmic bodies were expressed as functions of fundamental constants:

$$m_{\text{Edd}} = m_p \left(\frac{\hbar c}{G m_p^2}\right)^{\frac{1}{2}}, \quad J_{\text{Edd}} = \hbar \left(\frac{\hbar c}{G m_p^2}\right)^{1}$$

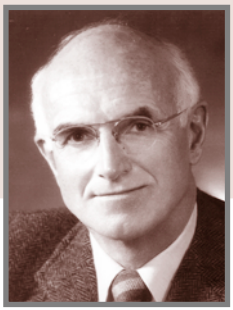
$$m_{\text{Ch}} \sim m_p \left(\frac{\hbar c}{G m_p^2}\right)^{\frac{3}{2}}, \quad J_{\text{Ch}} \sim \hbar \left(\frac{\hbar c}{G m_p^2}\right)^{3}$$

8) By means of *Mathematica*, the computer algebra system, the package *Diana* was designed and implemented for making automatic and quick dimensional analysis of a broad range of problems in physics, engineering, and economics.

Main publications Muradian, R., 'Solution of the "random walk" problem in the space with constant curvature', T*eoreticheskaya i Matematicheskaya Fizika*, 2, pp. 328-332 (1970); Matveev, V., Muradian, R. and Tavkhelidze, A., 'Automodelity in strong interactions', *Lettere al Nuovo Cimento*, 5, pp. 907-912 (1972); Matveev, V., Muradian, R. and Tavkhelidze, A., 'Automodellism in the large-angle elastic scattering and structure of hadrons',

Lettere al Nuovo Cimento, 7, pp. 719-723 (1973); Matveev, V., Muradian, R. and Tavkhelidze, A., 'Automodelity in strong interactions', *Teoreticheskaya i Matematicheskaya Fizika*, 15, pp. 332-338 (1973); Muradian, R., 'On the origin of galaxies rotation in the Ambartsumian cosmogony', *Astrofizika*, 11, pp. 237-248 (1975); Muradian, R., 'Cosmic numbers and rotation of the Metagalaxy', *Astrofizika*, 13, pp. 63-67 (1977); Muradian, R., 'The origin of the magnetic fields and superdense cosmogony', *Astrofizika*, 14, pp. 439-446 (1978); Muradian, R., 'The primeval hadron: origin of stars, galaxies and astronomical universe', *Astrophysics and Space Science*, 69, pp. 325-337 (1980); Muradian, R., 'On the discrete subgroups of the three dimensional rotation group', *Teoreticheskaya i Matematicheskaya Fizika*, 46, pp. 335-347 (1981); Muradian, R., 'Nuclear forces and QCD', *Izvestiya Akademii Nauk Armyanskoy SSR, Seriya Fizika*, 16, pp. 252-261 (1981); Muradian, R., 'On the rotation of astronomical Universe', Preprint, Yerevan Physics Institute, Yerevan, YePI-636 (26) (1983), Muradian, R., 'The primeaval hadron: origin of rotation and magnetic fields in the Universe', Preprint, Yerevan Physics Institute, Yerevan, YePI-701(16) (1984); Muradian, R., 'Cosmological constant and rotation of the Universe', *Astrofizika*, 21, pp. 396-398 (1984); Muradian, R., 'The new form of the Mendeleev table', *Armyanskij Khimicheskij Zhurnal*, 43, pp. 478-481 (1990); Muradian, R., 'Regge in the sky: origin of the cosmic rotation', Preprint, ICTP, Trieste, IC/94/143 (1994); Muradian, R., 'Flare stars and Pascal distribution', Preprint, ICTP, Trieste, IC/94/175 (1994); Muradian, R. and Santana, A., 'Ilopf structure in Nambu-Zie n-algebras', *Theoretical and Mathematical Physics*, 114, pp. 67-72 (1998).

Joseph Edward Murray



Date and place of birth: 1 April 1919, Milford, MA, USA
Wife and children: Virginia Link; Ginny, Rick, Tom, Meg, J. Link, Kathy
Appointment to the Academy: 30 May 1996
Scientific discipline: Surgery (Transplantation and Reconstructive)
Academic title: Professor at the Harvard Medical School

Most important awards, prizes and academies Awards: Francis Amory Prize, American Academy of Arts and Sciences (1962); Lifetime Achievement Award, Massachusetts Medical Society; Nobel Prize in Physiology or Medicine (1990); Medal for Distinguished Service to Surgery, American Surgical Association (1991); Sabin Award, Americans for Medical Progress (1994). Academies: National Academy of Sciences (1993); Hon. Fellow Royal College of Surgeons of England; Hon. Fellow Royal Australasian College of Surgeons; American Surgical Association; American Soc. of Plastic and Reconstructive Surgery.

Summary of scientific research Joseph Murray's career has been devoted to medical surgery and in particular to plastic and reconstructive surgery, and he has been Chief Plastic Surgeon at two major Boston hospitals. He has not only been an active working and practical surgeon, but also a researcher and theoretician. He has thus engaged in debate, research and discussion at an international level, being constantly in the vanguard of new developments and techniques, never hesitating to adopt bold and innovative approaches. Considered one of the pre-eminent experts in his field, the award of the Nobel Prize in medicine in 1990 was a recognition of his many achievements in his field of specialisation.

Main publications Over three hundred articles and essays, including: Murray, J.E., Matson, D.D., Habal, M.B., and Geelhoed, G.W., 'Regional Cranio-Orbital Resection for Recurrent Tumors with Delayed Reconstruction', *Surgery, Gynecology and Obstetrics*, 134, p. 437 (1972); Belfer, M.L., Harrison, A.M., Pillemer, F.C., and Murray, J.E., 'Appearance and Influence of Reconstructive Surgery on Body Image', *Clinics in Plastic Surgery*, 9 (3), p. 307 (1983); Murray, J.E., Kaban, L.B., and Mulliken, J.B., 'Analysis and

Treatment of Hemifacial Microsomia', *Plastic & Reconstructive Surgery*, 74, p. 789 (1984); Murray, J.E., Mulliken, J.B., Kaban, L.B., 'Microtia: A Microfilm of Hemifacial Microsomia', *Plastic Reconstructive Surgery*, vol. 76, n. 2, pp. 859-864 (1985); Murray, J.E., Mulliken, J.B., Kaban, L., Evenas, C.A., and Strand, R.D., 'Facial Skeletal Changes Following Hypertelorbitism Correction', *Plastic and Reconstructive Surgery*, vol. 77, n. 1, pp. 7-15 (1986); Murray, J.E., 'The Many Faces of Surgery: Presidential Address', *Archives of Surgery*, vol. 123, pp. 543-544 (1988); Murray, J.E., 'The First Successful Organ Transplants in Man', Nobel Lecture (December 8, 1990), *Les Prix Nobel*, The Nobel Foundation, 1990/1991; Murray, J.E., 'The Role of Surgeon-Scientists in Medical Progress', *ACS Bulletin*, pp. 23-28 (Feb. 1992); Murray, J.E., 'Reflections on Plastic Surgery', *Plastic and Reconstructive Surgery*, vol. 89, n. 5, pp. 944-948 (1992); Murray, J.E., 'Human Organ Transplantation: Background and Consequences', *Science*, 256, pp. 1411-1416 (1992); Murray, J.E., 'Organ Transplantation and the Revitalization of Immunology', in Callager, R.B., Gilder, J., Nossal, G.J.V. and Salvatore, G., *Immunology: The Making of a Modern Science* (Academic Press, London, 1995); Murray, J.E., 'The Excelsior Surgical Society/Edward D. Churchill Lecture', *Bulletin of the American College of Surgeons*, 80, 8, pp. 14-25, (1995); Murray, J.E., 'Surgery and the Value of Life', *Dolentium Hominum: To Know, Love and Serve,* Proceedings of the Ninth International Conference of the Vatican, November 24-26, 1994, 28:X, 1995; Murray, J.E., Merrill, J.P., and Harrison, J.H., 'Renal Homotransplantation in Identical Twins', (Reprinted from Surgical Forum, VI, p. 432, 1955, with commentaries by Joseph E. Murray and Charles B. Carpenter), *Journal of the American Society of Nephrology*, 12, p. 201, 2001.

Marshall Warren Nirenberg

Date and place of birth: 10 April 1927, New York, NY, USA
Appointment to the Academy: 24 June 1974
Scientific discipline: Biochemistry
Academic title: Chief of the Laboratory of Biochemical Genetics, Rockville Pike, MD, USA

Most important awards, prizes and academies Awards: Modern Medicine Award (1964); Award from the Department of Health, Education, Welfare, 1963; National Medal for Science (1965); Louisa Gross Horwitz Prize (1968); Nobel Prize in Physiology or Medicine for deciphering the genetic code, shared with Gobind Khorana and Robert Holley (1968). Academies: American Society of Biological Chemistry; American Chemical Society; American Neurochemistry Society; Biophysical Society; American Association for the Advancement of Science; European Academy of Sciences and Arts; Society for Developmental Biology; Washington Academy of Sciences; National Academy of Sciences, USA; National Academy of Medicine, USA; American Academy of Arts and Sciences; American Neurological Association; Leopoldina Deutsche Akademie der Naturforscher; European Academy of Sciences and Arts; Pontifical Academy of Sciences.

Summary of scientific research Since 1966 Professor Nirenberg has been Chief of the Laboratory of Biochemical Genetics at the National Heart, Lung, and Blood Institute of the National Institutes of Health in Bethesda, MD. Dr. Nirenberg and his coworkers deciphered the genetic code. First, they determined the base compositions of RNA codons by directing cell free protein synthesis with randomly-ordered synthetic polyribonucleotides; then, they determined the nucleotide sequences of RNA codons by directing the binding of aminoacyl-tRNA ti ribosomes with trinucleotides of known sequence. They also showed that single-stranded RNA, but not double – or triple – stranded RNA, is a template for protein synthesis. Dr. Nirenberg then entered the field of neurobiology and established many clonal lines of mouse neuroblastoma cells. He found that some cell lines synthesized catocholamines, whereas others synthesize acetylcholine. Elevation of cellular cyclic AMP for a number of

days shifted the cells from a relatively undifferentiated state to a differentiated state where many neural properties were expressed. Five cell lines were found that form abundant synapses with cultured striated muscle cells. A neuroblastoma-glioma somatic hybrid cell line was generated that expresses abundant opiate receptors, which was used as a model system to explore the mechanism of opiate dependence. Dual regulation of adenylate cyclase by morphine was shown to account for morphine dependence, tolerance, and withdrawal. The neuroblastoma and somatic hybrid cell lines that were established have been used as model systems to study many properties of neurons. Dr. Nirenberg and his colleagues discovered and characterized *Drosophila* and mouse homeobox genes. He has focused on one of the *Drosophila* homeobox genes, *vnd-NK-2*, which initiates the neural pathway of development in the ventral portion of the neuroectoderm and gives rise to part of the ventral nerve cord. Current studies focus on determining how a pattern of neuroblasts that express the *vnd-NK-2* gene is formed in the central nervous system.

Main publications Nirenberg, M.W. (with Matthaei, J.H.), 'Characteristics and stabilization of DNase sensitive protein synthesis in *E. coli* extracts', *Proc. Natl. Acad. Sci. USA*, 47, pp. 1580-1588 (1961); Nirenberg, M.W. (with Matthaei, J.H.), 'The dependence of cell-free protein synthesis in *E. coli* upon naturally occurring or synthetic polyribonucleotides', *Proc. Natl. Acad. Sci. USA*, 47, pp. 1588-1602 (1961); Nirenberg, M.W. *et al.*, 'An intermediate in the biosynthesis of polyphenylalanine directed by synthetic template RNA', *Proc. Natl. Acad. Sci. USA*, 48, pp. 104-109 (1962); Nirenberg, M.W. (with Jones, O.W., Leder, P., Clark, B.F.C., Sly, W.S. and Pestka, S.), 'On the coding of genetic information', *Cold Spring Harbor Symp. on Quant. Biol.*, 28, pp. 549-557 (1963); Nirenberg, M.W. (with Leder, P.), 'RNA codewords and protein synthesis. I. The effect of trinucleotides upon the binding of sRNA to ribosomes', *Science*, 145, pp. 1399-1407 (1964); Nirenberg, M.W. (with Bernfield, M.R.), 'RNA codewords and protein synthesis. IV. The nucleotide sequences of multiple codewords for phenylalanine, serine, leucine and proline', *Science*, 147, pp. 479-484 (1965); Nirenberg, M.W. *et al.*, 'RNA codewords and protein synthesis. VII. On the general nature of the RNA code', *Proc. Natl. Acad. Sci.*, 53, pp. 1161-1168 (1965); Nirenberg, M.W. (with Marshall, R.E. and Caskey, C.T.), 'RNA codewords and protein synthesis. XII. Fine structure of RNA codewords recognized by bacterial, amphibian, and mammalian transfer RNA', *Science*, 155, pp. 820-826 (1967); Nirenberg, M.W., 'The Genetic Code in Les Prix Nobel en 1968', Nobel Foundation, Stockholm, P.A. Norstedt and Söner, pp. 221-241 (1969);

Nirenberg, M.W. (with Nelson, P. and Ruffner, W.), 'Neuronal tumor cells with excitable membranes grown in vitro', *Proc. Natl. Acad. Sci. USA*, 64, pp. 1004-1010 (1969); Nirenberg, M.W. (with Amano, T. and Richelson, E.), 'Neurotransmitter synthesis by neuroblastoma clones', *Proc. Natl. Acad. Sci. USA*, 69, pp. 258-263 (1972); Nirenberg, M.W. (with Minna, J. and Glazer, D.), 'Genetic dissection of neural properties using somatic cell hybrids', *Nature New Biology*, 235, pp. 225-231 (1972); Nirenberg, M.W. *et al.*, 'Dual regulation of adenylate cyclase accounts for narcotic dependence and tolerance', *Proc. Natl. Acad. Sci. USA*, 72, pp. 3092-3096 (1975); Nirenberg, M.W. *et al.*, 'Synapse formation between clonal neuroblastoma x glioma hybrid cells and striated muscle cells', *Proc. Natl. Acad. Sci. USA*, 73, pp. 123-127 (1976); Nirenberg, M.W. (with Puro, D.G.), 'On the specificity of synapse formation', *Proc. Natl. Acad. Sci. USA*, 73, pp. 3544-3548 (1976); Nirenberg, M.W. *et al.*, 'Synapse turnover: A mechanism for acquiring synaptic specificy', *Proc. Natl. Acad. Sci. USA*, 75, pp. 2281-2285 (1978); Nirenberg, M.W. (with Trisler, G.D. and Schneider, M.D.), 'A topographic gradient of molecules in retina can be used to identify neuron position', *Proc. Natl. Acad. Sci. USA*, 78, pp. 2145-2149 (1981); Nirenberg, M.W. (with Wilson, S., Higbashida, H., Rotter, A., Krueger, K., Busis, N., Ray, R., Kenimer, J.G. and Adler, M.), 'Modulation of Synapse Formation by Cyclic Adenosine Monophosphate', *Science*, 222, pp. 794-799 (1983); Nirenberg, M.W. (with Kim, Y.), 'Drosophila NK-homeobox Genes', *Proc. Natl. Acad. Sci. USA*, 86, pp. 7716-7720 (1989); Nirenberg, M.W. (with Mellerick, D.M.), 'Dorsal-Ventral Patterning Genes Restrict NK-2 Homeobox Gene Expression to the Ventral Half of the Central Nervous System of Drosophila Embryos', *Developmental Biology*, 171, pp. 306-316 (1995); Nirenberg, M.W. (with Gruschus, J.M., Tsao, D.H.H., Wang, L.-H. and Ferretti, J.A.), 'The Three-dimensional Structure of the vnd/NK-2 Homeodomain-DNA Complex by NMR Spectroscopy', *J. Mol. Biol.*, 289, pp. 529-545 (1999).

Sergey Petrovich Novikov

Date and place of birth: 20 March 1938, Gorky, Russia
Wife and children: married; 1 son, 2 daughters
Appointment to the Academy: 25 June 1996
Scientific discipline: Mathematics
Academic title: Professor at the University of Maryland and the Landau Institute for Theoretical Physics

Most important awards, prizes and academies Awards: Fields Medal (1970); Lenin Prize (1967); Lobachevski International Prize (1981). Academies: USSR/Russian Academy of Sciences (1981); Honorary Member, London Math. Society (1987); US National Academy (1994); Accademia Nazionale dei Lincei (1993); Pontifical Academy of Sciences (1996).

Summary of scientific research *Classical Topology of 60s*: 1. Method of classification of manifolds developed 1961-4 [1]. Proof of topological invariance of rational Pontryagin classes [2]. Novikov Conjecture describing all homotopy invariant expressions from the Riemann Curvature Tensor [3]. 2. Calculation of stable homotopy groups of spheres and cobordism rings [4]; new methods of algebraic topology based on the complex cobordisms [5, 6]. 3. Topology of 2-foliations on 3-manifolds (1963-5): proof of the existence of compact leaf on a 3-sphere, braids and classification of analytical 2-foliations in the solid torus, homotopy obstructions for the Anosov systems [7]. *Topological Phenomena in Physics*: 1. Chern numbers of the dispersion relations for the generic 2D Schrodinger operators in magnetic field and lattice found in 1980 before the discovery of the Integral Quantum Hall Effect [8]. 2. Topology of multivalued functions and functionals (closed 1-forms) gas constructed in 1981-2 [9]. Morse theory and fundamental group, representations and von Neumann factors, Novikov-Shubin invariants [10]. 3. Qualitative theory of the Einstein equation for Homogeneous Cosmological Models as a dynamical system near singularity constructed in 1971-3 [23]. 4. Galvanomagnetic phenomena: universal generic asymptotics for the conductivity tensor of the 3D normal metal with complicated Fermi surface in the strong magnetic field (of the order of magnitude about 10-100t) was found [11]. *Solitons and Algebraic Geometry:* 1. Periodic Problem for the

KdV equation: large family of the exact 'finite-gap' solutions found based on the discovery of finite-gap (algebro-geometrical) 1D periodic potentials. Riemann surface, θ-functions [12, 13]. KP hierarchy and Krichever solutions found in 1976 as a basis for the Novikov Conjecture on the solution of Riemann-Schottki Problem for θ-functions. Inverse spectral problem for the 2D Schrodinger operators on a single energy level [13]. Higher rank solutions for the KP hierarchy. Explicit calculation of the commuting higher rank linear OD operators, Krichever-Novikov equation [14]. 2. Special Poisson brackets for the finite-dimensional integrable systems [15]. Dubrovin-Novikov Hydrodynamic Type Poisson brackets based on the Riemannian Geometry discovered in 1983. Numerical and analytical integration of the Whitham systems with singularities, dispersive analog of shock wave [15]. 3. Analog of the Laurent-Fourier decompositions on Riemann surface as a tool for the operator quantization of the bosonic strings for any number of loops [16]. 4. Laplace Chains of the 2D Schrodinger operators, new exactly solvable cases in the magnetic field and lattice, discrete systems [16, 17]. Scattering theory on graphs developed on the basis of Symplectic Geometry 1997-8 [18].

Main publications [1] 'Homotopically equivalent smooth manifolds', I., *Izv. Akad. Nauk SSSR*, 28 (2), pp. 365-474 (1964); [2] 'On manifolds with free Abelian fundamental group and their application', *Izv. Akad. Nauk SSSR*, 30 (1), pp. 207-246 (1966); [3] 'Analogues hermitiens de la K-theorie', *Actes Congr. Intern. Math* (Nice, 1970), Gauthier-Villars, Paris, vol. 2, pp. 39-45 (1971); [4] 'Homotopy properties of Thom complexes', *Mat. Sb.*, 57 (4), pp. 406-442 (1962); [5] 'Methods of algebraic topology from the point of view of cobordism theory', *Izv. Akad. Nauk SSSR*, 31 (4), pp. 885-951 (1967); [6] 'Formal groups and their role in the apparatus of algebraic topology' (*et al.*), *Uspekhi Mat. Nauk*, 26 (2), pp. 131-154 (1971); [7] 'The topology of foliations', *Trudy Moskov. Mat. Obshch*, 14, pp. 248-278 (1965); [8] 'Bloch functions in a magnetic field and vector bundles. Typical dispersion relations and their quantum numbers', *Dokl. Akad. Nauk SSSR*, 257 (3), pp. 538-543 (1981); [9] 'The Hamiltonian formalism and a many-valued analogue of Morse theory', *Uspekhi Mat. Nauk*, 37 (5), pp. 3-49 (1982); [10] 'Morse inequalities and von Neumann 1-factors', *Dokl. Akad. Nauk SSSR*, 289 (2), pp. 289-292 (1986); [11] 'Topological Phenomena in Metals' (with Maltsev, A.), *Uspekhi Phys Nauk*, 168 (3), pp. 249-258 (1998); [12] 'A periodic problem for the Korteweg-de Vries equations', I., *Funktsional Anal. i Prilozhen.*, 8 (3), pp. 54-66 (1974); [13] 'Non-linear equations of Korteweg-de Vries type, finite zone linear operators, and Abelian varieties' (*et al.*), *Uspekhi Mat.*

Nauk, 31 (1), pp. 55-136 (1976); [14] 'Two-dimensional Schrödinger operators: Inverse scattering transform and evolutional equations' (with Veselov, A.P.), *Phys.*, D18, pp. 267-273 (1986); [15] 'Holomorphic bundles over algebraic curves and nonlinear equations' (with Krichever, I.M.), *Uspekhi Mat. Nauk*, 35 (6), pp. 47-68 (1980); [16] 'Poisson brackets and complex tori', *Trudy Mat. Inst. Steklov*, 165, pp. 49-61 (1984); [17] 'Hydrodynamics of the soliton lattices. Differential geometry and Hamiltonian formalism' (with Dubrovin, B.A.), *Uspekhi Mat. Nauk*, 44 (6), pp. 29-98 (1989); [18] 'Riemann surfaces, operator fields, strings. Analogues of the Fourier-Laurent bases' (with Krichever, I.M.), *Physics and Mathematics of Strings*, (L. Brink *et al.*, eds.), World Scientific, Singapore, pp. 356-388 (1990); [19] 'Spectral Symmetries of the Low-dimensional Schrödinger Operators and Laplace Transformations' (with Dynnikov, I.A.), *Russia Math Surveys*, 52 (5), pp. 175-234 (1997); [20] 'Schrödinger Operators on Graphs and Symplectic Geometry', to appear in the Additional Volume of Arnoldfest, Toronto, Fields Institute; [21] *Topology-1. Encyclopedia of Mathematical Sciences*, Springer Verlag, vol. 12, pp. 320 (1996); [22] 'Solitons and Geometry. Fermi lectures 1992', *Scuola Norm. Sup. di Pisa*, (1994); [23] 'Singularities of the cosmological model of the Bianchi IX type according to the qualitative theory of differential equations' (with Bogoyavlenskii, O.I.), *Zh. Eksper. Teoret. Fiz.*, 64 (5), pp. 1475-1494 (1973).

Ryoji Noyori

Date and place of birth: 3 September 1938, Hyogo, Japan
Wife and children: Hiroko; Eiji and Koji
Appointment to the Academy: 1 Oct. 2002
Scientific discipline: Chemistry
Academic title: President at RIKEN (The Institute of Physical and Chemical Research) and Professor at Nagoya University

Most important awards, prizes and academies Awards: Japan Academy Prize (1995); Arthur C. Cope Award, American Chemical Society (1997); King Faisal International Prize for Science, Saudi Arabia (1999); Order of Culture, Japanese Emperor/Government (2000); Wolf Prize in Chemistry, Israel (2001); Roger Adams Award in Organic Chemistry, American Chemical Society (2001); Nobel Prize in Chemistry (2001). Academies: Foreign Honorary Member of the American Academy of Arts and Sciences (2001); Honorary Member of the European Academy of Sciences and Arts (2001); Pontifical Academy of Sciences (2002); Foreign Associate of the National Academy of Sciences, USA (2003); Foreign Member of the Russian Academy of Sciences. Honorary Professorships: Shanghai Institute of Organic Chemistry; Hong Kong Polytechnic University; South China University of Technology. Honorary Degrees: Technische Universität München; University of Rennes; University of Bologna; University of Alicante; Uppsala University; University of Ottawa; University of Chicago.

Summary of scientific research Ryoji Noyori is well known for his initiation (1966) and development of asymmetric catalysis using chiral organometallic compounds. The efficiency of the asymmetric catalysts discovered by Noyori equals or, in certain cases, even exceeds that of enzymes. Applications of his original and versatile chemistry have allowed him and other scientists to achieve truly efficient syntheses of organic molecules of theoretical and practical importance. In particular, chemistry based on the BINAP ligand invented by Noyori in 1980 has been practiced in research laboratories worldwide as well as on an industrial scale. Noyori's major accomplishments include the development of practical asymmetric hydrogenation of functionalized olefins and ketones using chiral Ru-BINAP com-

plexes; Rh catalyzed asymmetric isomerization of geranylamine to citronellal enamine; the demonstration of the general utility of dynamic kinetic resolution in asymmetric catalysis; the invention of chiral Ru catalysts effecting highly selective asymmetric transfer hydrogenation of ketones and imines; the discovery of highly enantioselective addition of dialkylzincs to aldehydes catalyzed by chiral amino alcohols and the elucidation of the molecular mechanism of the chirality amplification phenomenon. These methods have found application in syntheses of numerous important products including menthol, carbapenem antibiotics, anti-bacterial agents and prostaglandins.

Main publications Miyashita, A., Yasuda, A., Takaya, H., Toriumi, K., Ito, T., Souchi, T. and Noyori, R., 'Synthesis of 2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl (BINAP), an Atropisomeric Chiral Bis(triaryl)phosphine, and Its Use in the Rhodium(I)-Catalyzed Asymmetric Hydrogenation of α-(Acylamino)acrylic Acids', *J. Am. Chem. Soc.*, 102, p. 7932 (1980); Noyori, R. and Hayakawa, Y., 'Reductive Dehalogenation Polyhalo Ketones with Low-Valent Metals and Related Reducing Agents', *Org. React.*, 29, p. 163 (1983); Noyori, R. and Suzuki, M., 'Prostaglandin Syntheses by Three-Component Coupling', *Angew. Chem., Int. Ed. Engl.*, 23, p. 847 (1984); Hayakawa, Y., Wakabayashi, S., Kato, H. and Noyori, R., 'The Allylic Protection Method in Solid-Phase Oligonucleotide Synthesis. An Efficient Preparation of Solid-Anchored DNA Oligomers', *J. Am. Chem. Soc.*, 112, p. 1691 (1990); Noyori, R. and Suzuki, M., 'An Organometallic Way to Prostaglandins: The Three-Component Coupling Synthesis', *Chemtracts-Org. Chem.*, 3, p. 173 (1990); Noyori, R., 'Chiral Metal Complexes as Discriminating Molecular Catalysts', *Science*, 248, p. 1194 (1990); Noyori, R. and Takaya, H., 'BINAP: An Efficient Chiral Element for Asymmetric Catalysis', *Acc. Chem. Res.*, 23, p. 345 (1990); Noyori, R. and Kitamura, M., 'Enantioselective Addition of Organometallic Reagents to Carbonyl Compounds: Chirality Transfer, Multiplication, and Amplification', *Angew. Chem., Int. Ed. Engl.*, 30, p. 49 (1991); Noyori, R., *Asymmetric Catalysis in Organic Synthesis*, John Wiley & Sons, New York (1994); Noyori, R., Tokunaga, M. and Kitamura, M., 'Stereoselective Organic Synthesis via Dynamic Kinetic Resolution', *Bull. Chem. Soc. Jpn.*, 68, p. 36 (1995); Jessop, P.G., Ikariya, T. and Noyori, R., 'Homogeneous Catalysis in Supercritical Fluids', *Science*, 269, p. 1065 (1995); Noyori, R. and Hashiguchi, S., 'Asymmetric Transfer Hydrogenation Catalyzed by Chiral Ruthenium Complexes', *Acc. Chem. Res.*, 30, p. 97 (1997); Sato, K., Aoki, M. and Noyori, R., 'A "Green" Route to Adipic Acid: Direct Oxidation of Cyclohexenes with 30% Hydrogen Peroxide', *Science*,

281, p. 1646 (1998); Noyori, R. and Ohkuma, T., 'Asymmetric Catalysis by Architectural and Functional Molecular Engineering: Practical Chemo- and Stereoselective Hydrogenation of Ketones', *Angew. Chem. Int. Ed.*, 40, p. 40 (2001); Noyori, R., Suga, S., Oka, H. and Kitamura, M., 'Self and Nonself Recognition of Chiral Catalysts: The Origin of Nonlinear Effects in the Amino-Alcohol Catalyzed Asymmetric Addition of Diorganozincs to Aldehydes', *Chem. Rec.*, 1, p. 85 (2001); Noyori, R., Yamakawa, M. and Hashiguchi, S., 'Metal-Ligand Bifunctional Catalysis: A Nonclassical Mechanism for Asymmetric Hydrogen Transfer between Alcohols and Carbonyl Compounds', *J. Org. Chem.*, 66, p. 7931 (2001); Noyori, R., 'Asymmetric Catalysis: Science and Opportunities' (Nobel Lecture), *Angew. Chem. Int. Ed.*, 41, p. 2008 (2002).

Czesław Olech

Date and place of birth: 22 May 1931, Pinczów, Poland
Wife and children: Jadwiga; Teresa, Anna, Wanda, Barbara, Janusz
Appointment to the Academy: 9 June 1986
Scientific discipline: Mathematics
Academic title: Professor at the Institute of Mathematics of the Polish Academy of Sciences

Most important awards, prizes and academies Awards: State Prize of Poland; Bernard Bolzano Golden Medal of the Czechoslovak Academy of Sciences; Martin Drinov Golden Medal of the Bulgarian Academy of Sciences; Stefan Banach Medal and Nikołaj Kopernik Medal, both of the Polish Academy of Sciences. Academies: Full member, Polish Academy of Sciences; Pontifical Academy of Sciences; Foreign member, Russian Academy of Sciences; Polish Academy of Arts and Sciences. Honorary doctorate: University of Vilnius.

Summary of scientific research Main fields of research interest: ordinary differential equations and mathematical theory of optimal control. Contributions to O.D.E.: various applications of Ważewski topological method in studying asymptotic behaviour of solutions; exact estimates of exponential growth of solution of linear second order differential equations with bounded coefficients; theorems concerning global asymptotic stability of the autonomous system on the plane with stable Jacobian matrix at each point of the plane, results establishing relation between question of global asymptotic stability of an autonomous system and that of global one-to-oneness of a differentiable map; contribution to the question whether unicity condition implies convergence of successive approximation to solutions of ordinary differential equations. Contribution to control theory: establishing a most general version of the so-called bang-bang principle for linear control problem by detailed study of the integral of set valued map; existence theorems for optimal control problem with unbounded controls and multidimensional cost functions; existence of solution of differential inclusions with nonconvex right-hand side; characterization of controllability of convex processes.

Main publications Olech, C., 'On the asymptotic behaviour of the solutions of a system of ordinary non-linear differential equations', *Bull. Acad. Polon.*

Sci., Cl. III 4, pp. 555-561 (1956); Olech, C., 'Asymptotic behaviour of the solutions of second order differential equations', *Bull. Acad. Polon. Sci., Série des Sci. Math. Astr. et Phys.*, 7, pp. 319-326 (1959); Olech, C., 'Remarks concerning criteria for uniqueness of solutions of ordinary differential equations', *Bull. Acad. Polon. Sci., Série des Sci. Math. Astr. et Phys.*, 8, pp. 661-666 (1960); Olech, C., 'On the global stability of an autonomous system on the plane', *Contr. Diff. Equations*, 1, pp. 389-400 (1963); Olech, C., (with Hartman, P.) 'On global stability of solutions of differential equations', *Trans. Amer. Math. Sci.*, 104, pp. 154-178 (1962); Olech, C., 'Extremal solution of a control system', *Journal of Diff. Eq.*, 2, pp. 74-101 (1966); Olech, C. (with Plis, A.), 'Monotonicity assumption in uniqueness criteria for differential equations', *Coll. Math.*, 18, pp. 43-58 (1967); Olech, C., 'Approximation of set-valued functions by continuous functions', *Coll. Math.*, 19, pp. 285-293 (1968); Olech, C., 'Existence theorems for optimal problems with vector-valued cost function', *Trans. Amer. Math. Soc.*, 136, pp. 159-180 (1969); Olech, C., 'Existence theorems for optimal control problems involving multiple integrals', *Journal of Diff. Eq.*, 6, pp. 512-526 (1969); Olech, C. (with Kaczynski, H.), 'Existence of solutions of orientor fields with nonconvex right-hand side', *Annal. Polon. Math.*, 29, pp. 61-66 (1974); Olech, C. (with Frankowska, H.), 'Boundary solutions of differential inclusion', *Journal of Diff. Eq.*, 44 (1982); Olech, C. (with Meisters, G.), 'Solution of the global asymptotic stability jacobian conjecture for polynomial case', *Analyse mathématique et applications*, pp. 373-381, Gauthier-Villars (Paris, 1988).

Sergio Pagano

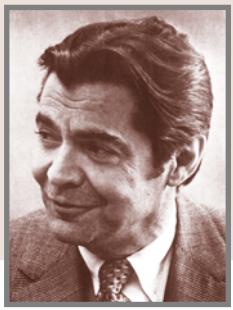
Date and place of birth: 6 November 1948, Genoa, Italy
Appointment to the Academy: 7 Jan. 1997
Scientific discipline: Pontifical Diplomacy
Academic title: Prefect of the Secret Vatican Archives

Summary of scientific research Né à Gênes le 6 novembre 1948, il est entré dans la Congrégation des Barnabites en 1966. Il a étudié la philosophie et la théologie à Rome, où il a été ordonné prêtre en 1978. La même année il obtient la maîtrise en théologie avec spécialisation en Liturgie, le diplôme de Paléographe Archiviste auprès de l'École Vaticane de Paléographie, Diplomatique et Archivistique, puis il est nommé 'Scriptor' des Archives Secrètes Vaticanes. Actuellement, il est professeur de diplomatique pontificale dans cette École. Membre de l'Académie San Carlo de Milan, représentant des Archives Secrètes au Comité International d'Archivistique, consulteur historique de la Congrégation pour les Causes des Saints depuis mai 1985, il est nommé Vice Préfet des Archives Secrètes Vaticanes par Jean-Paul II le 30 janvier 1995. Quelques jours plus tard, il reçoit la charge de Vice Directeur de l'École Vaticane de Paléographie, Diplomatique et Archivistique. Depuis 1989, il est Supérieur du Centre d'Études historiques des Pères Barnabites de Rome. Le 7 janvier 1997, il est nommé Préfet des Archives Secrètes Vaticanes et Directeur de l'École Vaticane de Paléographie, Diplomatique et Archivistique. Il est membre de droit 'perdurante munere' de l'Académie Pontificale des Sciences et du Comité Pontifical des Sciences Historiques. Depuis mars 2000, il est membre correspondant des *Monumenta Germaniae Historica* et depuis juillet 2000, il est membre de la Société Romaine d'Histoire de la Patrie.

Main publications Pagano, S., *Schedario Baumgarten*, vol. III. *Bolle e brevi da Clemente V a Martino V (an. 1305-1431)*, Città del Vaticano, 1983; Pagano, S., *I documenti del processo di Galileo Galilei* (in collaborazione con Luciani, A.G.), Città del Vaticano, 1984 [*Pontificiae Academiae Scientiarum Scripta Varia*, 53; Collectanea Archivi Vaticani, 21]; Pagano, S.,

Schedario Baumgarten, vol. IV. *Bolle e brevi da Eugenio IV a Pio IX (an. 1431-1862)*. Introduzione, indici e indici generali dell'opera, Città del Vaticano, 1986; Pagano, S., *Nuovi documenti su Vittoria Colonna e Reginald Pole* (in collaborazione con Concetta Ranieri), Città del Vaticano, 1989 [Collectanea Archivi Vaticani, 24]; Pagano, S., *Il processo di Endimio Calandra e l'Inquisizione a Mantova nel 1567-1568*, Città del Vaticano, 1991 [Studi e Testi, 339]; Pagano, S., *Il cardinale Uberto Gambara vescovo di Tortona (1489-1549)*, Firenze, Leo S. Olschki, 1995; Pagano, S., *L'epistolario 'vaticano' di Lorenzo Perosi (1867-1956)*, Genova, Marietti, 1997; Pagano, S., *Le ragioni temporali di un vescovo – Maffeo Gambara Vescovo di Tortona e il conflitto giurisdizionale con il senato di Milano 1593-1596*, Roma, Gangemi Editore, 2000; Tomeno Berruti, *Cronaca di Tortona*, edizione a cura di Sergio Pagano, Tortona, Litocoop Srl, 2001; *Novarien. Beatificationis et canonizationis Servi Dei Caroli a Basilica Petri (in saec.: Ioannis Francisci Bascapè) Religiosi professi Congregationis Clericorum Regularium S. Pauli ('Barnabiti') Episcopi Novariensis (1550-1615).* Positio super vita, virtutibus et fama sanctitatis, voll. I-II, Sergius Pagano curavit, Romae, Typis Nova Res, 2003 [Congregatio De Causis Sanctorum, Prot. N. 1311]; Pagano, S., *Paesi infetti. Magia, eresia e faide familiari nel tortonese durante il secolo XVI*, Roma, Gangemi, 2003; *Bibliografia dell'Archivio Vaticano*, nuova versione, IX (1997-1999), direzione redazionale a cura di S. Pagano, Città del Vaticano, 2003.

George Emil Palade



Date and place of birth: 19 November 1912, Jassy, Moldavia, Romania
Wife and children: Marylin G. Farquhar; Georgia van Duzen and Philip Palade
Appointment to the Academy: 2 Dec. 1975
Scientific discipline: Cell Biology
Academic title: Senior Research Scientist in Cell Biology at the University of California

Most important awards, prizes and academies Awards: Lasker Award (1966); Gairdner Special Award (1967); Nobel Prize in Physiology or Medicine (1974); Louisa Gross Horwitz Prize (1970). Academies: National Academy of Sciences, USA; Foreign Member, American Academy of Arts and Sciences; Royal Society; Foreign Member, Leopoldina Academy, Germany; Foreign Member, Romanian Academy; Pontifical Academy of Sciences.

Summary of scientific research My work in cell biology started with a survey at the electron microscope level of the organization of eukaryotic cells and led to the discovery of a number of important structures (or structural details) in mitochondria, endoplasmic reticulum, ribosomes and polysomes. The salient achievement of that period was the discovery of ribosomes. From electron microscopy I moved to cell fractionation (controlled by microscopy) to help define in chemical and functional terms many subcellular components such as ribosomes, polysomes, mitochondria, nuclei and cell membranes. In the process I contributed to the improvement of preparatory procedures in electron microscopy as well as in cell fractionation. From this level of inquiry, I proceeded to the analysis of a complex process, namely, the processing of secretory protein in grandular cells, using an integrated approach based on electron microscopy, cell fractionation and autoradiology. This was, in fact, the work that in my judgement justified the Nobel Prize I received. The results defined kinetically the pathway followed by secretory protein in eukaryotic cells and became the basis for further work in our and many other laboratories. In the next phase of my research activities I concentrated on membrane biogenesis defining again the conditions under which membranes, especially membrane proteins, are synthesized and processed by eukaryotic cells. Finally, in a separate type of investigation, I worked on the structure and func-

tion of the vascular endothelia, concentrating primarily on structures involved in exchanges between the blood plasma and interstitial fluid. This project has obvious implications for normal physiology and important medical problems related to cardiovascular diseases.

Main publications Palade, G.E., 'An electron microscopy study of the mitochondria structure', *J. Histochem. Cytochem.*, 1, p. 188 (1953); Palade, G.E., 'A small particulate component of the cytoplasm', *J. Biophys. Biochem. Cytol.*, 1, pp. 59-68 (1955); Palade, G.E., 'The endoplasmic reticulum', *Biophys. Biochem. Cytol.*, 2, p. 85 (1956); Palade, G.E. and Siekevitz, P., 'Pancreatic microsomes. An integrated morphological and biochemical study', *J. Biophys. Biochem. Cytol.*, 2, p. 671 (1956); Palade, G.E., 'Microsomes and ribonucleoprotein particles', *Microsomal Particles and Protein Synthesis*, (R.B. Roberts, ed.), Washington Acad. Sci., New York: Pergamon Press, p. 36, 1958; Majno, G. and Palade, G.E., 'Studies on inflammation. I. The effect of histamine and serotonin on vascular permeability: an electron microscopic study', *J. Biophys. Biochem. Cytol.*, 11, pp. 571-606 (1961); Farquhar, M.F. and Palade, G.E., 'Junctional complexes in various epithelia', *J. Cell Biol.*, 17, p. 375 (1963); Palade, G.E., 'The organization of living matter', *PNAS*, 52, p. 613 (1964); Redman, G.M., Siekevitz, P. and Palade, G.E., 'Biogenesis of endoplasmic reticulum membranes. I. Structural and chemical differentiation in developing rat hepatocyte', *J. Cell Biol.*, 30, pp. 73-96 (1966); Palade, G.E., 'Structure and function at the cellular level', *JAMA*, 198, p. 815 (1966); Palade, G.E., 'Intracellular aspects of the process of protein secretion', *Science*, 189, p. 347 (1975), (Nobel Prize Lecture); Jamieson, J.D. and Palade, G.E., 'Production of secretory proteins in animal cells', *International Cell Biology – 1976-77*, (B.R. Brinkley and K.R. Porter, eds.) pp. 308-317, 1977; Simionescu, N., Simionescu, M. and Palade, G.E., 'Differentiated microdomains on the luminal surface of the capillary endothelium. I. Preferential distribution of anionic sites', *J. Cell. Biol.*, 90, pp. 603-613 (1981); Palade, G.E., 'Membrane biogenesis: An overview', *Methods in Enzymology*, (S. Fleischer and B. Fleischer, eds.), New York: Academic Press, 96, p. xxix (1983).

Crodowaldo Pavan

Date and place of birth: 1 December 1919, Campinas, São Paulo, Brazil
Wife and children: Maria de Lourdes de Oliveira Pavan (deceased); Octavio Henrique, Ricardo and Luciano
Appointment to the Academy: 17 April 1978
Scientific discipline: Biology
Academic title: Emeritus Professor at the Universidade de São Paulo and Universidade de Campinas-São Paulo

Most important awards, prizes and academies Awards: Brazilian Prize of Genetics (1963); Moinho Santista Prize – Area Biology (1980); Alfred Jurykowski Prize, Brazilian Academy of Medicine (1986). Academies: Pontifical Academy of Sciences; Brazilian Academy of Sciences; Third World Academy of Sciences; Academy of Sciences of Lisbon, Portugal; Academy of Sciences of Chile; Academy of Medicine of São Paulo, Brazil; Istituto Veneto di Scienze, Arti e Lettere; Fisiografica Society of Lund, Sweden; Academy of Letters of São Paulo, Brazil.

Summary of scientific research 1) *Areas of scientific work*. In the past: population genetics on tropical species of *Drosophila*; cytogenetics and chromosomal physiology on different species of Sciarids; biology and the biological control of animal pests; *Cochliomya hominivorax* (screwworms), *Dermatobia hominis* (human bot fly), and *Musca domestica* (housefly). Presently: nitrogen-fixing bacteria of non-legume plants. These are bacteria that live inside the body (endophytic) of the plant, some of them being obligatory endophytic and others facultative. These bacteria are very common on many families of plants in Brazil. The hope is to find or create an association between plant and specific nitrogen-fixing bacteria to substitute the use in agricultural practice of artificial nitrogen fertilizers. More recently the study of endosymbiotic bacteria associated to plant seeds and birds' eggs. 2) *Other areas of activity*. The development of science and technology in Brazil; cooperation in science and technology between countries of the Third World.

Main publications Dreyfus, A., Nonato, E., Breuer, M.E. and Pavan, C., 'Cromossomos politenicos em vários órgãos de Rhynchosciara angelae', *Rev. Brasileira de Biologia*, 2, pp. 435-457 (1951); Pavan, C., Cordeiro, A.R., Dobzhansky, N. & Th., Malagolowkin, C., Spassy, B. and Wedel, M.,

'Concealed genic variability in Brazilian population of Drosophila willistoni', *Genetics*, 36, pp. 13-30 (1951); Breuer, M.E. and Pavan, C., 'Behavior of polytene chromosomes of Rhynchosciara angelae at different stages of larval development', *Chromosoma*, 7, pp. 371-386 (1955); Pavan, C., 'Nucleic acid metabolism in polytene chromosomes and the problem of differentiation', *Brookhaven Symposia in Biology*, 18, pp. 222-239 (1965); Azeredo-Espin, A.M.L. and Pavan, C., 'Karyotypes and possible regions of origin of three species of Calliphoridae (Diptera) recently introduced in Brazil', *Rev. Brasileira de Genética*, 4, pp. 619-638 (1983); Pavan, C., 'Chromosomal changes induced by infective agents Triangle', *Sandoz J. Med. Sci*., 8, pp. 42-48 (1967); Pavan, C., Biesele, J., Riess, R.W. and Wertz, A.V., 'Changes in the ultrastructure of "Rhynochosciara" cells infected by "Microsporidia"', *Studies on Genetics*, VI, p. 7103 (1971, XIII); Pavan, C., Da Cunha, A.B. and Morsoletto, C., 'Virus-chromosome relationships in cells of "Rhynchosciara" (Diptera, Sciaridae)', *Caryologia*, 24, pp. 371-389 (1971); Pavan, C. and Sanders, P.F., 'Heterochromatin in development of normal and infected cells', *Cell Differentiation* (Munrsgaard-Copenhagen, 1972).

William Daniel Phillips

Date and place of birth: 5 November 1948, Wilkes-Barre, PA, USA
Wife and children: Jane; Caitlin, Christine
Appointment to the Academy: 7 April 2004
Scientific discipline: Physics
Academic title: Professor

Most important awards, prizes and academies Awards: Gold Medal, Dept. of Commerce (1993); Michelson Medal, Franklin Institute (1996); Nobel Prize in Physics, shared with Steven Chu of Stanford University and Claude Cohen-Tannoudji of the École Normale Superieure, Paris (1997). Nobel Prize Citation: 'for development of methods to cool and trap atoms with laser light'. Academies: Fellow, American Physical Society; Fellow, Optical Society of America; Fellow, American Academy of Arts and Sciences; Pontifical Academy of Sciences.

Summary of scientific research Recent scientific activities center on the manipulation of matter with light, and its applications. This includes laser cooling of atoms; trapping of atoms in laser, magnetic, and microwave fields; the study of Bose-Einstein condensation of cold atomic gases; the quantum motion of atoms trapped in optical lattices, including the study of interacting, degenerate gases in one, two and three-dimensions; the study of collisions between lasercooled atoms and between atoms in a BEC, including photoassociative spectroscopy and the precision determination of atomic lifetimes and scattering lengths; the use of lasercooled atoms in atomic frequency standards, including atomic fountain clocks; atom optics and atom lasers – the study of coherent atomic deBroglie waves and their use in devices like interferometers; microgravity applications of laser-cooled atoms, including atomic clocks and atomic interferometry; atom lithography – the use of atom optics to write patterns on surfaces; optical tweezers – the use of laser beams to manipulate biological cells and other small objects – for studies of biochemical binding, bioadhesion, and other biochemical and biomedical applications; and quantum information, in which cold atoms are used as qubits.

Main publications Laburthe Tolra, B., O'Hara, K.M., Huckans, J.H., Phillips, W.D., Roiston, S.L. and Porto, J.V., 'Observation of Reduced Three-Body Recombination in a Correlated 1D Degenerate Bose Gas', *Phys. Rev. Lett.*, 92, pp. 190-401 (2004); McKenzie, C., Hecker Denschlag, J., Häffner, H., Browaeys, A., de Araujo, L.E.E., Fatemi, F.K., Jones, K.M., Simsarian, J.E., Cho, D., Simoni, A., Tiesinga, E., Julienne, P.S., Helmerson, K., Lett, P.D., Rolston, S.L. and Phillips, W.D., 'Photoassociation of Sodium in a Bose-Einstein Condensate', *Phys. Rev. Lett.*, 88, pp. 120-403 (2002); Denschlag, J., Simsarian, J.B., Feder, D.L., Clark, C.W., Collins, L.A., Cubizolles, J., Deng, L., Hagley, E.W., Helmerson, K., Reirihardt, W.P., Rolston, S.L., Schneider, B.I. and Phillips, W.D., 'Generating Solitons by Phase Engineering of a Bose-Einstein Condensate', *Science*, 287, p. 97 (2000); Deng, L., Hagley, E.W., Wen, J., Trippenbach, M., Band, Y., Julienne, P.S., Simsarian, J.E., Helmerson, K., Roiston, S.L. and Phillips, W.D., 'Four-wave mixing with matter waves', *Nature*, 398, p. 218 (1999); Hagley, E.W., Deng, L., Kozuma, M., Wen, J., Helmerson, K., Rolston, S.L. and Phillips, W.D., 'A Well-Collimated Quasi-Continuous Atom Laser', *Science*, 283, p. 1706 (1999); Kozuma, M., Den, L., Hagley, E.W., Wen, J., Lutwak, R., Helmerson, K., Rolston, S.L. and Phillips, W.D., 'Coherent Splitting of Bose-Einstein Condensed Atoms with Optically Induced Bragg Diffraction', *Phys. Rev. Lett.*, 82, pp. 871-875 (1999); Phillips, W.D., 'Laser cooling and trapping of neutral atoms', *Rev. Mod. Phys.*, 70, pp. 721-741 (1998)(Nobel Lecture); Kastberg, A., Phillips, W., Rolston, S., Spreeuw, R. and Jessen, P., 'Adiabatic cooling of cesium to 700 nK in an optical lattice', *Phys. Rev. Lett.*, 74, p. 1542 (1995); Lett, P., Watts, R., Westbrook, C., Phillips, W.D., Gould, P. and Metcalf, H., 'Observation of Atoms Laser Cooled Below the Doppler Limit', *Phys. Rev. Let.*, 61, p. 1169 (1988); Alan L. Migdall, John V. Prodan, William D. Phillips, Thomas H. Bergeman, and Harold J. Metcalf, 'First Observation of Magnetically Trapped Neutral Atoms', *Physical Review Letters*, 54, n. 24, pp. 2596-2599 (June 17, 1985); William D. Phillips and Harold Metcalf, 'Laser Deceleration of an Atomic Beam', *Physical Review Letters*, 48, n. 9, pp. 596-599 (1982).

John Charles Polanyi

Date and place of birth: 23 January 1929, Berlin, Germany
Wife and children: Anne Ferrar Davidson; Margaret and Michael
Appointment to the Academy: 9 June 1986
Scientific discipline: Chemistry
Academic title: Professor at the University of Toronto

Most important awards, prizes and academies Awards: Marlow Medal of the Faraday Society, UK (1962); Steacie Prize for the Natural Sciences (1965); Henry Marshall Tory Medal of the Royal Society of Canada (1977); Wolf Prize in Chemistry, shared with G. Pimentel (1982); Nobel laureate in Chemistry (1986). Academies: Fellow, Royal Society of Canada; Fellow, Royal Society of London; Foreign Member, American Academy of Arts and Sciences; Foreign Associate, National Academy of Sciences, USA; Companion of the Order of Canada; Pontifical Academy of Sciences.

Summary of scientific research The past decades have seen the birth of a field of chemical physics termed 'reaction dynamics', the study of the atomic and molecular motions underlying chemical reaction. Starting in 1956, J.C. Polanyi's laboratory at the University of Toronto attempted to detect and measure the extent of vibration and rotation in reaction products from gaseous reaction by recording their emission in the infrared. Ultimately these experiments yielded quantitative data concerning the motions in molecules at the instant of their formation, and also the effect on these product motions of systematic alterations in the corresponding motions in the reagents. From these data it was possible, by means of Monte Carlo trajectory computations performed in this and other laboratories, to obtain some insight into the patterns of motion in the course of transition from reagents into products. More recently Polanyi's laboratory has been involved in an attempt to establish, through theory and experiment, a means of probing the subpicosecond 'transition state' directly, either by recording feeble emission or by laser absorption; this area of research (still in its infancy) constitutes 'transition state spectroscopy'. In a second recent departure this laboratory has turned its attention to the dynamics of simple reactions occurring at sur-

faces. Following adsorption of submonolayers on the surface, reaction is initiated by ultraviolet light. The present indication is that this procedure can result in reaction between coadsorbed species, both held at the surface, with preferred locations and orientations. Most recently his laboratory has been involved in studying photoreaction one molecule at a time, beneath the tip of a Scanning Tunneling Microscope. The hope, therefore, is to exploit this 'surface aligned photochemistry' as a means of improving our understanding, and therefore our control, over microscopic reaction pathways – the molecular choreography of the reactive process.

Main publications Cashion, J.K. and Polanyi, J.C., 'Infrared Chemiluminescence from the Gaseous Reaction Atomic H Plus Cl_a', *J. Chem. Phys.*, 29, p. 455 (1958); Polanyi, J.C., 'Energy Distribution Among Reagents and Products of Atomic Reactions', *J. Chem. Phys.*, 31, p. 1338 (1959); Polanyi, J.C., 'Proposal for an Infrared Maser Dependent on Vibrational Excitation', *J. Chem. Phys.*, 34, p. 347 (1961); Polanyi, J.C., 'The Iraser and Vaser. A Proposal for an Infrared and Visible Analogue of the Maser', *Proc. Roy. Soc. (Canada)*, 54(C), p. 25 (1960); Polanyi, J.C., 'Vibrational-Rotational Population Inversion', *J. Appl. Optics. Chemical Laser Supplement*, pp. 109-127 (1965); Kuntz, P.J., Nemeth, E.M., Polanyi, J.C., Rosner, S.D. and Young, C.E., 'Energy Distribution Among Products of Exothermic Reactions. II. Repulsive, Mixed and Attractive Energy Release', *J. Chem. Phys.*, 44, p. 1168 (1966); Polanyi, J.C. and Wong, W.H., 'Location of Energy Barriers. I. Effect on the Dynamics of Reaction A + BC', *J. Chem. Phys.*, 51, p. 1439 (1969); Mok, M.H. and Polanyi, J.C., 'Location of Energy Barriers. II. Correlation with Barrier Height', *J. Chem. Phys.*, 51, p. 1451 (1969); Ding, A.M.G., Kirsch, L.J., Perry, D.S., Polanyi, J.C. and Schreiber, J.L., 'The Effect of Changing Reagent Energy on Reaction Probability, and Product Energy-Distribution', *Faraday Disc. Chem. Soc.*, 55, p. 252 (1973); Polanyi, J.C. and Schreiber, J.L., 'The Reaction $F + H_2 \rightarrow HF + H$: A Case Study in Reaction Dynamics', *Faraday Disc. Chem. Soc.*, 62, p. 267 (1977); Foth, H.-J., Polanyi, J.C. and Telle, H.H., 'Emission from Molecules and Reaction Intermediates in the Process of Falling Apart', *J. Phys. Chem.*, 86, p. 5027 (1982); Arrowsmith, P., Bly, S.H.P., Charters, P.E. and Polanyi, J.C., 'Spectroscopy of the Transition State. II. $F + Na_2 \rightarrow FNaNa^{+*} \rightarrow NaF + Na^{*}$', *J. Chem. Phys.*, 79, p. 283 (1983); Bourdon, E.B.D., Cowin, J.P., Harrison, I., Polanyi, J.C., Segner, J., Stanners, C.D. and Young, P.A., 'UV Photodissociation and Photodesorption of Adsorbed Molecules. I: CH_2Br on LiF(001)', *J. Phys. Chem.*, 88, p. 6100 (1984); Bourdon, E.B.D., Das, P.,

Harrison, I., Polanyi, J.C., Sognor, J., Stanners, C.D., Williams, R.J. and Young, P.S., 'Photodissociation, Photoreaction and Photodesorption of Adsorbed Species. II. CH_2Br and H_2S on LiF(001)', *Faraday Diac. Chem. Soc.*, 82 (1986); Lu, P.H., Polanyi, J.C. and Rogers, D., 'Photoinduced Localized Atomic Reaction (LAR) of 1,2- and 1,4-dichlorobenzene with Si(111)7x7', *J. Chem. Phys.*, 112, p. 11005 (2000); Jiang, G., Polanyi, J.C., Rogers, D., 'Electron and Photon Irradiation of Benzene and Chlorobenzene on Si(111)7x7', *Surface Science*, 544, p. 147 (2003).

Frank Press

Date and place of birth: 4 December 1924, Brooklyn, New York, NY, USA
Wife and children: Billie Kallick; one son and one daughter
Appointment to the Academy: 3 Sept. 1999
Scientific discipline: Geophysics
Academic title: Formely President of the United States National Academy of Sciences

Most important awards, prizes and academies Awards: Legion of Honour, France (1989); Japan Prize (1993); US National Medal of Science (1994); Cross of Merit, Germany (1993); Lomonosov Gold Medal of Russian Academy of Sciences (1998). Academies: US National Academy of Sciences; Royal Society of London; French Academy of Sciences; Russian Academy of Sciences; American Philosophical Society; Japan Academy of Engineering; American Academy of Arts and Sciences. Honorary Degrees: Princeton, Yale, Columbia, Sorbonne, Notre Dame, others.

Summary of scientific research Research and teaching in earth and planetary sciences with specialization in geophysics and oceanography.

Main publications Press, F. and Ewing, M., 'Propagation on explosive sound in a liquid layer overlying a semi-infinite elastic solid', *Geophysics*, 15, pp. 426-446 (1950); Press, F. and Ewing, M., 'Crustal structure and surface wave dispersion, Part II: Solomon Island earthquake of 29 July 1950', *Bull. Seism. Soc. Am.*, 42, pp. 315-325 (1952); Press, F. and Ewing, M., 'Mantle Rayleigh waves from the Kamchatka earthquake of 4 November, 1952', *Bull. Seism. Soc. Am.*, 44, pp. 471-479 (1954); Press, F., Oliver, J.E., and Ewing, M., 'Crustal structure and surface wave dispersion, Part IV: Atlantic and Pacific Ocean Basins', *Bull. Geol. Soc. Am.*, 66, pp. 913-946 (1953); Press, F. and Ewing, M., 'Rayleigh wave dispersion in the period range 10 – 500 seconds', *Trans. Am. Geophys. Union*, 37, pp. 213-215 (1956); Press, F., 'Determination of crustal structure from phase velocity of Rayleigh waves, Part I: Southern California', *Bull. Geol. Soc. Am.*, 67, pp. 1647-1658 (1956); Press, F., Ewing, M., and Jardetsky, W.S., 'Elastic Waves in Layered Media' (McGraw-Hill Book Co., New York, 1957); Press, F. and Ewing, M., 'Determination of crustal structure from phase velocity of Rayleigh waves, Part

III: The United States', *Bull. Seism. Soc. Am.*, 70, pp. 229-244 (1959); Press, F., Benioff, H. and Smith, S., 'Excitation of the free oscillations of the earth by earthquakes', *J. Geophys. Res.*, 66, pp. 605-619 (1961); Press, F., Ben Menahem, A. and Toksoz, M.N., 'Experimental determination of earthquake fault length and rupture velocity', *J. Geophys. Res.*, 66, pp. 3471-3485 (1961); Press, F. and Harkrinder, D., 'Propagation of acoustic-gravity waves in the atmosphere', *J. Geophys. Res.*, 67, pp. 3889-3908 (1962); Press, F. and Biehler, S., 'Influences on crustal velocities and densities from P-wave delays and gravity anomalies', *J. Geophys. Res.*, 69, pp. 2979-2995 (1964); Press, F., 'Displacements, strains and tilts at teleseismic distances', J. Geophys. Res., 70, pp. 2395-2412 (1965); Press, F., 'Earth models obtained by Monte Carlo inversion', *J. Geophys. Res.*, 73, p. 16 (1968); Press, F., 'Regionalized earth models', *J. Geophys. Res.*, 75, pp. 6575-6581 (1970); Press, F., 'The earth and the moon', *Quarterly J. Roy. Astron. Soc.*, 12, pp. 232-243 (1971); Press, F., 'Science and Technology in the White House, 1977 to 1980: Parts 1 and 2', *Science*, 211, pp. 139-145, pp. 249-256 (1981); Press, F., 'Science: The best and the worst of times', *Science*, 231, pp. 1351-1352 (1986); Press, F., 'Growing up in the golden age of science', *Annual Review of Earth and Planetary Science*, 231, pp. 1351-1352 (1986); Press, F., 'Patterns of seismic release in the Southern Californian region', *J. of Geophys. Res.*, 100, n. B4, pp. 6421-6430 (1995); Press, F., 'The dilemma of the golden age (address to the members of the National Academy of Sciences at the 125th annual meeting)', *Science, Technology, and Human Values*, 13, nos. 3 and 4 (summer and autumn, 1988); Press, F., 'Science and society in the years ahead', 1995 Sigma Xi Forum, *Vannevar Bush II: Science for the 21st Century*, March 2-3 (1995); Press, F. and Siever R., *Understanding Earth*, 4th edn. (W.H. Freeman and company, New York, 2003).

Giampietro Puppi

Date and place of birth: 20 November 1917, Bologna, Italy
Wife and children: Bianca Boccanegra; Giovanna
Appointment to the Academy: 17 April 1978
Scientific discipline: Physics
Academic title: Professor at the University of Bologna

Most important awards, prizes and academies Academies: Accademia Nazionale dei Lincei; Accademia Nazionale delle Scienze; Accademia Nazionale di Agricoltura; Académie Internationale d'Astronautique; Accademia delle Scienze di Bologna; Istituto Veneto di Scienze, Lettere e Arti; Pontificia Accademia delle Scienze.

Summary of scientific research G. Puppi a initié son activité scientifique en 1946, dans le domaine de la physique des rayons cosmiques et en particulier vers l'étude expérimentale, phénoménologique et théorique des différentes composantes dans l'atmosphère et vers l'étude de leurs interactions avec la matière. L'excès positif de la composante pénétrante, la diffusion de la composante nucléonique et le bilan énergétique global ont fait l'objet de ses premiers travaux. Dans l'effort de comprendre l'étrange comportement des mésons dans les phénomènes d'absorption par la matière, il est arrivé à formuler l'existence d'une interaction universelle faible, du type proposé par Fermi pour la désintégration beta des noyaux atomiques, pour toutes les particules élémentaires à spin $^1/_2$. Avec son groupe de recherche à Bologne, et souvent aussi grâce à une vaste collaboration avec plusieurs laboratoires de différents pays, il a participé activement au développement de la physique des hautes énergies avec les accélérateurs. Parmi les résultats obtenus à l'aide des émulsions nucléaires, il faut signaler: l'étude des déphasages dans la diffusion pion-proton, le caractère résonnant de l'interaction, l'interférence entre interaction coulombienne et interaction nucléaire, la valeur de la constante de couplage. Dans le domaine des particules étranges, à l'aide des chambres à boules, une autre série de résultats porte sur les propriétés des hypérons avec la démonstration de la non-conservation de la parité dans la désintégration des hypérons, la détermination de leur vie

moyenne, ainsi que de leurs spins. D'autres travaux encore sont dédiés à l'étude des structures complexes produites comme matérialisation d'énergie dans les collisions entre particules à très haute énergie et à la découverte des états résonnants; c'est dans ce travail que l'on arrive à la découverte du méson rho et à la détermination de son spin et de sa parité. L'activité actuelle de G. Puppi est orientée davantage vers la technologie, l'organisation et la gestion de la recherche dans le milieu industriel. Ses intérêts scientifiques aujourd'hui concernent les sciences de l'environnement.

Main publications Puppi, G., 'Sui mesoni dei raggi cosmici', *Nuovo Cimento*, V, p. 6 (1984) and VI, p. 3 (1949); Puppi, G., 'On positive excess of meson component' (in collaboration), *Phys. Rev.*, 76, p. 854 (1949) and *Nuovo Cimento*, VI, p. 6 (1949) and XI, p. 1354 (1953); Puppi, G., 'Sulla componente nucleonica nell'atmosfera' (in collaboration), *Nuovo Cimento*, VIII, p. 12 (1951); Puppi, G., 'Eccitazione dei nuclei per assorbimento dei mesoni 1° e 2°' (in collaboration), *Nuovo Cimento*, IX, p. 8 (1952) and X, 1704 (1952); Puppi, G., 'Interaction of (π) mesons in photographic plates 1° e 2°' (in collaboration), *Nuovo Cimento*, XI, p. 597 (1954); Puppi, G., *The energy balance of cosmic radiation*, Progress in cosmic rays (North Holland, 1955); Puppi, G., 'Coulomb interference in pion-proton scattering' (in collaboration), *Nuovo Cimento*, X, p. 1238 (1955); Puppi, G., 'Results in pion-proton scattering', *Proc. of the fifth Rochester Conf.* (1955); Puppi, G., 'K+ –p scattering', *Proc. of the sixth Rochester Conf.* (1956); Puppi, G., 'Some considerations on the phase-shifts analysis in p+ –p+ scattering' (in collaboration), *Nuovo Cimento*, X, p. 491 (1956); Puppi, G., 'Determination of the pion-nucleon interaction coupling constant from scattering experiments using dispersion relation' (in collaboration), *Nuovo Cimento*, X, p. 172 (1957); Puppi, G., 'Demonstration of parity non-conservation in hyperons decay' (in collaboration), *Phys. Rev.*, 108, p. 1353 (1957); Puppi, G., 'Experimental determination of Λ° and Σ° spins' (in collaboration), *Nuovo Cimento*, X, p. 222 (1958); Puppi, G., 'Lifetime of Λ° Θ° and Σ' (in collaboration), *Nuovo Cimento*, X, p. 150 (1958); Puppi, G., 'Search for evidence of parity non-conservation in K-He interactions' (in collaboration), *Phys. Rev.*, 120, p. 570 (1960); Puppi, G., 'Helicity of the proton from Σ Decay' (in collaboration), *Phys. Rev. Letters*, 7, p. 264 (1961); Puppi, G., 'Pionic Resonances', *Annual Rev. Nucl. Sciences* (1964); Puppi, G., 'Investigation of resonant π–π interaction in J = I T = I state' (in collaboration), *Nuovo Cimento* (1962); Puppi, G., 'On the deceleration of metagalactic clouds in the galaxy' (in collaboration), *Nuovo Cimento* (1966).

Yves Quéré

Date and place of birth: 29 April 1931, Commercy, France
Wife and children: France Jaulmes (deceased); David, Anne, Emmanuelle
Appointment to the Academy: 20 Oct. 2003
Scientific discipline: Physics
Academic title: Emeritus Professor at the École Polytechnique of Paris

Most important awards, prizes and academies Awards: Officier, Legion d'Honneur. Academic Appointments: Chairman, Department of Physics, École Polytechnique (1987); Chairman, Senate of Professors, École Polytechnique (1989). Academies: Corresponding Member (1980), Member (1991) and Foreign Secretary (1993), Académie des Sciences; Co-Chairman of InterAcademy Panel for International Issues (IAP) (2000, 2003); Pontificia Academia Scientiarum (2003). Honorary Degrees: Polytechnic University, Bucharest (1996); Science Academy of Belarus (2003).

Summary of scientific research Main domains of research, in experimental solid state physics, have been: 1) Determination of properties of point defects (like: vacancies, or interstitials) in metals such as silver, gold, uranium, etc. 2) Observation of radiation damage (neutrons, protons, heavy ions, etc.) in metals and ionic crystals. Study, in particular, of irradiation swelling and growth in nuclear materials. 3) Scientific leadership of a lab devoted to electronic and physical properties of Pu, Np, etc. 4) Study of the interactions between particles and solids, particularly in the case of *Ion Channeling*: first observations and theoretical models of dechanneling by crystal defects.

Main publications Books (in English): *Irradiation effects in fissile materials*, with Jean Leteurtre (North Holland, 1966); *Physics of Materials* (Gordon and Breach, 1998). Main scientific papers: Quéré, Y., Nakache, F., 'Évaluation du volume d'une pointe de fission dans l'uranium', *J. Nat. Nucl.*, 2, p. 203 (1959); Quéré, Y., Pham, F., Blin, J., 'Sur le gonflement exagéré dans les combustibles nucléaires (a theory of "Breakaway Swelling")', *Reactor Science and Techn.*, 17, p. 15 (1963); Quéré, Y., 'Interactions between quenched vacancies and oxygen in silver', *J. Phys. Soc. Japan*, 18 sup. III, p. 91 (1963); Quéré, Y., 'Dechanneling cylinder of dislocations', *Phys. Stat. Solidi*,

30, p. 713 (1968); Quéré, Y., Couve, H., 'Radiography of platinum by means of channeled particles', *J. Appl. Phys.*, 39, p. 4012 (1968); Quéré, Y., 'Dechanneling of fast particles by lattice defects', *J. Mat. Nucl.*, 53, p. 262 (1974); Quéré, Y., Uggerhoj, E., 'The use of accelerators to obtain channeling micrographs of polycrystalline foils', *Phil. Mag.*, 34, p. 1197 (1976); Rullier, F., Quéré, Y., 'An experimental argument – in Nb_3Ge – for the Labbé-Barisic-Friedel theory of superconductivity', *Phys. Letters*, 81 A, p. 232 (1981); Beuneu, B., Quéré, Y., 'Un interstitiel paraélastique dans le molybdène', *J. Physique Lettres*, 42, p. 465 (1981); Boucher, R., Quéré, Y., 'Sources d'énergie au plutonium pour stimulateurs cardiaques (energy sources for pacemakers)', *J. Mat. Nucl.*, 100, p. 132 (1981); Quéré, Y., 'The virtues of a scientific education', *Nucl. Inst. Meth.*, B.164, p. 23 (2000); Beuneu, B., Quéré, Y., 'Paraelasticity in electron irradiated molybdenum', *Yamada Science Found.*, Univ. Tokyo Press, 156 (1982); Gély, M.H., Dunlop, A., Quéré, Y., 'Une paire de Frenkel éphémère dans l'iridium', *J. Physique Lettres*, 44, p. 219 (1983); Quéré, Y., 'Radiation effects in (old and new) superconductors', *Nucl. Instr. Meth.*, B33, p. 906 (1988); Rullier-Albenque, F., Bielska, H., Quéré, Y., Wallner, G., Müller, P., 'Defect production rates in normal and in superconducting states', *J. Nucl. Mater.*, 151, p. 245 (1988); Quéré, Y., Rullier-Albenque, F., 'Point defects in superconductors', *J. Nucl. mater.*, 169, p. 19 (1989); Cohen, C., Dural, J., Gaillard, M.J., Genre, R., Grob, J.J., Hage-Ali, M., Kirsch, R., L'Hoir, A., Mory, J., Poizat, J.C., Quéré, Y., Remillieux, J., Schmaus, D., Toulemonde, M., 'Channeling of 2.4 GeV Ar ions in a germanium crystal', *J. Physique Lettres*, 46, p. 1565 (1985); Same authors, 'Electron-impact ionization and energy loss of 27 Me V u Xe^{35+} incident ions channeled in silicon', *Phys. Rev. Lett.*, 63, p. 1930 (1989); Ganne, J.P., Quéré, Y., 'Intrinsic thermal expansion of point defects in metals', *Yamada Sc. Found.*, Univ. Tokyo Press, 232 (1992); Quéré, Y., 'Science et Droits de l'Homme', *Science et Liberté* (about A. Sakharov), Edition de Physique (1990); Quéré, Y., 'The Jahn-Teller effect: a pedagogical approach', *Acta Phys. Polon.* (1992).

Chintamani Nagesa Ramachandra Rao

Date and place of birth: 30 June 1934, Bangalore, India
Wife and children: Indumati; Suchitra, Sanjay
Appointment to the Academy: 25 June 1990
Scientific discipline: Chemistry
Academic title: Hon. President and Linus Pauling Research Professor of the Jawaharlal Nehru Centre for Advanced Scientific Research

Most important awards, prizes and academies Awards: Marlow Medal, Faraday Society, UK; American Chemical Society Centennial Foreign Fellowship, USA; Medal, Royal Society of Chemistry, London; Hevrovsky Gold Medal, Czechoslovak Academy of Sciences; Sahabdeen International Award for Science, Sri Lanka; TWAS Medal, Italy; Albert Einstein Gold Medal, UNESCO; Centenary Medal and Lectureship, Royal Society of Chemistry, London; Hughes Medal, Royal Society, London; Bhatnagar Award, CSIR; Sir C.V. Raman Award, UGC; S.N. Bose Medal of Indian National Science Academy (INSA); Padma Vibhushan by President of India; Meghnad Saha Medal, INSA; Golden Jubilee Prize, CSIR; Asutosh Mookerjee Memorial Medal; Nehru Award for Science; Millennium Plaque of Honour, Indian Science Congress. Honours: Hon. Fellowship, Royal Society of Chemistry, London; Blackett Lecturer, Royal Society, London; Linnett Visiting Professorship, Univ. of Cambridge; Jawaharlal Nehru Fellowship; Grand Cross of the Order of Scientific Merit, Brazil; Officier Ordre Palmes Académiques, France. Academies: Royal Society, London; National Academy of Sciences, USA; American Academy of Arts and Sciences; Soviet Academy of Sciences; Polish Academy of Sciences; Czechoslovak Academy of Sciences; Slovenian and Serbian Academies of Sciences; Third World Academy of Sciences; American Philosophical Society; Korean Academy of Science and Technology; Pontifical Academy of Sciences; Academia Europaea; Brazilian Academy of Sciences; Japan Academy; Royal Spanish Academy of Sciences; Indian Academy of Sciences, French Academy of Sciences; Indian National Science Academy, National Academy of Sciences. Honorary Doctorates: 34 universities in India and abroad including Bordeaux, Caen, Notre Dame, Novosibirsk, Purdue, RAS (SB), Uppsala, Wales, Wroclaw, Banaras, Bangalore.

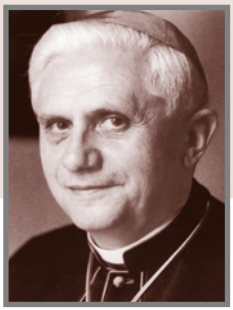
Summary of scientific research During his earlier research career Prof. C.N.R. Rao worked mainly in the area of molecular structure and spectroscopy. He has contributed extensively to various aspects of infrared spectroscopy and electronic spectroscopy of molecules and has investigated the interactions between molecules through hydrogen bonding and charge-transfer type of interactions by employing a variety of techniques. Prof. Rao authored two well-known books in spectroscopy. His book on electronic spectroscopy was the first to employ molecular orbital rotations and has been translated into several languages and has come out in several editions. Prof. Rao developed the area of solid state and materials chemistry as the main area of his research from the early beginnings of the subject itself and has worked on a variety of aspects of this important field. These include tailor-making and designing of new solids, structure-property relations, phase transitions, synthetic strategies and so on. He has contributed extensively to the area of high-temperature superconductivity of copper oxides and worked on the parent cuprate of this family as early as 1971. He has also investigated small metal clusters, fullerenes, nanowires and nanotubes. He has also been working on colossal magnetoresistance of manganese oxides and related problems. Prof. Rao has authored a very well-known monograph on 'Phase Transitions in Solids' and a book entitled *New Directions in Solid State Chemistry*. He is the author of over 1200 research papers and has edited or authored 37 books.

Main publications Rao, C.N.R., *Chemical Applications of Infrared Spectroscopy*, Academic Press (New York, 1963); Rao, C.N.R., *Ultraviolet and Visible Spectroscopy* (3rd edn.), Butterworths (London, 1975); Rao, C.N.R. and Rao, K.J., *Phase Transitions in Solids – An Approach to the Study of the Chemistry and Physics of Solids*, McGraw-Hill (New York, 1978); Rao, C.N.R. and Sarma, D.D., 'Study of Electron States of Solids by Electron Spectroscopy', *J. Solid State Chem.*, 45, p. 1 (1982); Rao, C.N.R. and Thomas, J.M., 'Intergrowth Structures: The Chemistry of Solid-solid Interfaces', *Accounts of Chem. Res.*, 18, p. 113 (1985); Rao, C.N.R. and Gopalakrishnan, J., *New Directions in Solid State Chemistry*, Cambridge University Press (1986), (2nd edn., 1998); Rao, C.N.R. and Yashonath, S., 'Computer Simulation of Transformations in Solids', *J. Solid State Chem.*, 68, p. 153 (1987); Rao, C.N.R., Mohan Ram, R. and Ganguly, P., 'A Comparative Study of the Magnetic and Electrical Properties of Perovskite Oxides and the Corresponding Two-dimensional Oxides of K_2NiF_4 Structure', *J. Solid State Chem.*, 72, p. 14 (1987); Rao, C.N.R., 'Chemical Insights into High-temperature Superconductors', *Phil. Trans. Royal Soc.*

(Lond), A 336, p. 595 (1991); Rao, C.N.R., Vijayakrishnan, V., Kulkarni, G.U. and Aiyer, H.N., 'An Investigation of Well-characterized Small Gold Clusters by Photoelectron Spectroscopy, Tunneling Spectroscopy and Cognate Techniques', *J. Phys. Chem.*, 97, p. 11157 (1993); Rao, C.N.R., *Chemical Approaches to the Synthesis of Inorganic Solids*, John Wiley (1994); Rao, C.N.R., Govindaraj, A., Aiyer, H.N. and Seshadri, R., 'Polymerization and Pressure-induced Amorphization of C_{60} and C_{70}', *J. Phys. Chem.*, 99, p. 16814 (1995); Edwards, P.P., Ramakrishnan, T.V. and Rao, C.N.R., 'The Metal-nonmetal Transition', *J. Phys. Chem.*, 99, p. 5228 (1995); Rao, C.N.R. and Raveau, B., *Transition Metal Oxides*, VCH Publishers (New York, 1995), (2nd edn., 1999); Mahendiran, R., Mahesh, R., Raychaudhuri, A.K. and Rao, C.N.R., 'Structure, Electron Transport Properties and Giant Magnetoresistance of Hole-doped $LaMnO_3$ Systems', *Phys. Rev.*, B53, p. 3348 (1996); Rao, C.N.R., 'Virtues of Marginally Metallic Oxides', *J. Chem. Soc. Chem. Commun.* (1996); Rao, C.N.R., Satish Kumar, B.C., Govindaraj, A. and Nath, M., 'Nanotubes', *Chem. Phys. Chem.*, 2, p. 78 (2001); Rao, C.N.R., 'Charge, spin and orbital ordering in the perovskite manganates', *J. Phys. Chem.*, 104, p. 5877 (2000); Rao, C.N.R., *Understanding Chemistry*, Universities Press, 1999 (Reprinted 2001); Rao, C.N.R., 'Novel materials, materials design and synthetic strategies: Recent advances and new directions', *J. Mater. Chem.*, 9, p. 1 (1999); Rao, C.N.R. *et al.*, 'Afbau principle of complex open framework structures of metal phosphates of different dimensionalities', *Acc. Chem. Res.*, 34, p. 80 (2001); Rao, C.N.R., Kulkarni, G.U., Thomas, P.J. and Edwards, P.P., 'Sizedependent chemistry: Properties of nanocrystals', *Chem. Euro J.*, 8, p. 28 (2002); Rao, C.N.R. and Govindaraj, A., 'Carbon nanotubes from organometallic precursors', *Acc. Chem. Res.*, 35, p. 998 (2002); Choudhury, A., Kumar, U. and Rao, C.N.R., 'Three-dimensional openframework transition metal selenites', *Angew. Chem. Intnl. Ed.*, 41, p. 158 (2002); Neeraj, S., Noy, M.L., Rao, C.N.R. and Cheetham, A.K., 'Sodalite networks formed by metal squarates', *Solid State Sci.*, 4, p. 1231 (2002); Rao, C.N.R., Kulkarni, G.U., Thomas, PA., Agarwal, V.V. and Saravanan, P., 'Films of metal nanocrystals formed at aqueous-organic interfaces', *J. Phys Chem.*, B107, p. 7391 (2003); Ranganathan, A., Kulkarni, G.U. and Rao, C.N.R., 'Understanding the hydrogen bond in terms of the bond critical point and the geometry of the lone pairs', *J. Phys. Chem.*, A107, p. 6073 (2003); Kumar, N. and Rao, C.N.R., 'Stripes and superconductivity in Cuprates: Is there a connection?', *Chem. Phys. Chem.*, 4, p. 439 (2003); Rao, C.N.R. and Nath, M., 'Inorganic nanotubes', *Dalton Trans.*, 1 (2003);

Rao, C.N.R., Deepak, F.L., Gundiah, G. and Govindaraj, A., 'Inorganic Nanowires', *Progr. Solid State Chem.*, 31, p. 5 (2003); Rao, C.N.R. *et al.*, 'Novel properties of a mixed valent iron compound with the kagome lattice', *Phys. Rev.*, B67, p. 134425 (2003); Vaidhyanathan, R., Natarjan, S., and Rao, C.N.R., 'Aliphatic dicarboxylates with 3D metal organic frameworks possessing hydrophobic channels', *Dalton Trans.*, 1459 (2003); Rao, C.N.R., Vanitha, P.V. and Cheetham, A.K., 'Phase separation in metal oxides', *Chem. Euro. J.*, 9, p. 828 (2003).

Joseph Card. Ratzinger



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Appointment to the Academy: 13 Nov. 2000
Scientific discipline: Theology
Academic title: Honorary Professor of Theology and Former Vice-President of the University of Regensburg

Most important awards, prizes and nominations Cardinal Ratzinger was Ordinary Professor at the Universities of Bonn, Münster, Tübingen, and Regensburg. He was Dean of the Faculty of Catholic Theology and Vice-President at Regensburg from February 1976 until March 1977. In November 1981 he was made Prefect of the Congregation for the Doctrine of the Faith, President of the Pontifical Biblical Commission and of the International Theological Commission. Honorary Doctorates: Catholic Universities of Lima, Eichstätt, Lublin, Navarre, and Wroclaw. Awards: Grand Merit Cross with Sash, Germany; Gold Medal of Honour with Sash, Austria; Commandeur de la Légion d'Honneur, France; Augustin Bea Prize; Leopold Kunschak Prize; Capri S. Michele Literature Prize; Premio Nazionale di Cultura Cattolica; Literary Prize of Basilicata. Academies: Corresponding Member, Rhineland-Westphalia Academy of Sciences; Académie des Science Réligieuses; Ordinary Member, European Academy of Arts and Sciences; Foreign Associate Member, Académie des Sciences Morales et Politiques de l'Institut de France.

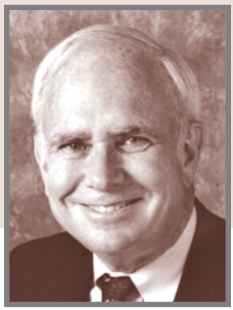
Summary of scientific research Cardinal Ratzinger has centred his scientific research around fundamental theology and systematic theology. His doctorate was on St Augustine (*Volk und Haus Gottes in Augustins Lehre von der Kirche*) and his habilitation thesis was on St Bonaventure (*The Theology of History in St Bonaventure*). One of his first works, which demonstrated his stature as a theologian, was his *Introduction to Christianity*. His brilliant studies led him to be called at an early age to hold professorial chairs at some of the most important German universities. A large number of the Cardinal's publications have been addressed to these two above-mentioned areas; he has also published works on specific concerns of contemporary Christianity.

In the light of such present-day realities as inter-religious dialogue, the structure of the Church, and rapid cultural change, Cardinal Ratzinger has reflected on all the principal aspects of theology, most notably eschatology, the liturgy, the ministries, creation, sin, the Incarnation, and the Trinity. Such a pathway of scholarship prepared the ground for his organisation of the writing and publication of the *Catechism of the Catholic Church* in the post-Vatican II period. Cardinal Ratzinger also has published on subjects such as ecumenism and politics, the Catholic Church and the Jews, and the Church at the end of the millennium. He has also offered an autobiography to the reading public. As Prefect of the Congregation for the Doctrine of the Faith he has never ceased to dedicate his intellectual and moral energies to the promotion and defence of the doctrine of the faith and its customs in the whole of the Catholic world, at the same time favouring studies directed towards a growth in understanding of the faith so that to new problems, produced by the progress of the sciences and civilisation, suitable answers could be given in the light of the Word of God.

Main publications In addition to reviews, smaller writings, and numerous contributions to articles, collections, and lexicons, his major works include the following: Ratzinger, J., *Introduction to Christianity* (London, 1969, 1985[2]). Ratzinger, J., *Das neue Volk Gottes. Entwürfe zur Ekklesiologie* (Düsseldorf, 1969, 1970[2]); Ratzinger, J., *Dogma and Preaching* (Chicago, 1985); Ratzinger, J., *The Ratzinger Report* (San Francisco, 1985, 1986[2]); Ratzinger, J., *The Feast of Faith* (San Francisco, 1986); Ratzinger, J., *Behold the Pierced One* (San Francisco, 1986); Ratzinger, J., *Principles of Catholic Theology* (San Francisco, 1987); Ratzinger, J., *Church, Ecumenism and Politics* (Middlegreen, 1988); Ratzinger, J., *Eschatology, Death and Eternal Life* (Chicago 1988); Ratzinger, J., *Ministers of Your Joy* (English: Slough, 1989; American: Ann Arbor,1989); Ratzinger, J., *'In the beginning...' A Catholic Understanding of the Story of Creation and the Fall* (Huntington, 1990); Ratzinger, J., *To Look on Christ* (New York, 1991); Ratzinger, J., *Conscience and Truth* (New York, 1991); Ratzinger, J., *A Turning Point for Europe?* (San Francisco, 1994); Ratzinger, J., *Introduction to the Catechism of the Catholic Church* [with Christoph Schönborn] (San Francisco, 1994); Ratzinger, J., *Called to Communion* (San Francisco, 1996); Ratzinger, J., *A New Song for the Lord: Faith in Christ and Liturgy Today* (New York, 1996); Ratzinger, J., *Salt of the Earth: The Church at the End of the Millennium* [with Peter Seewald] (San Francisco, 1997) and *Milestones: Memoirs 1927-1977* (San Francisco, 1998); Ratzinger, J., *Many Religions – One Covenant: Israel, the*

Church and the World (San Francisco, 1999); Ratzinger, J., *The Sabbath of History* [with W. Congdon] (Washington, 2000); Ratzinger, J., *The Spirit of the Liturgy* (San Francisco, 2000); Ratzinger, J., *God and the World. A conversation with Peter Seewald* (San Francisco, 2002); Ratzinger, J., *God Is Near Us. The Eucharist, The Heart of Life* (San Francisco, 2003).

Peter Hamilton Raven



Date and place of birth: 13 June 1936, Shanghai, China
Wife and children: Dr. Patricia D. Raven; Mrs. Liz McQuinn, Ms. Alice Raven, Mr. Francis Raven and Ms. Kathryn Raven
Appointment to the Academy: 4 Oct. 1990
Scientific discipline: Biology
Academic title: Director of the Missouri Botanical Garden

Most important awards, prizes and academies Awards: Distinguished Service Award, American Inst. of Biological Studies (1981); Int. Environmental Leadership Medal of UNEP (1982); Int. Prize in Biology, Japanese Government (1986); United States National Medal of Science (2000); International Cosmos Prize (2003). Academies: US National Academy of Sciences (1977); Fellow, American Academy of Arts and Sciences (1977); Foreign Member, Royal Danish Academy of Sciences and Letters (1980); Foreign Member, Royal Swedish Academy of Sciences (1982); Honorary Member, Royal Society of New Zealand (1984); Foreign Member, Academy of Sciences of the USSR (1988-91); Russian Academy of Sciences (1991); Corresponding Member, Australian Academy of Science (1990); Foreign Fellow, National Academy of Sciences of India (1990); Foreign Fellow, Indian National Science Academy (1990); Pontifical Academy of Sciences (1990); Corresponding Member, Academia de Ciencias Exactas, Físicas y Naturales, Argentina (1991); Corresponding Member, Austrian Academy of Sciences (1992); Honorary Member, Academia Chilena de Ciencias (1993); Corresponding Member, Academia Nacional de Ciencias, Córdoba, Argentina (1993); Foreign Member, Academy of Sciences of the Ukraine (1994); Foreign Member, Chinese Academy of Sciences (1994); Honorary Member, Hungarian Academy of Sciences (1998).

Summary of scientific research Dr. Peter Raven is one of the world's leading authorities on plant systematics and evolution, who has published more than 480 books and papers in the fields of taxonomy, population biology, biogeography, reproductive biology, ethnobotany, and conservation biology. His initial work centered around his broad and outstanding investi-

gations of the systematics and evolution of the plant family *Onagraceae*, the evening primrose family. This research, augmented by that of his students and collaborators and embracing morphology, anatomy, cytology, palynology, embryology, ecology, reproductive biology, population genetics, and, most recently, molecular biology, has made this family of plants one of the best known of any size, and a valuable model for evolutionary studies. Working from this center in systematics, Raven pursued wide-ranging studies that encompassed and even helped to define many aspects of evolutionary and population biology. His 1965 paper with Paul Ehrlich on butterflies and plants coined the term co-evolution and helped to refocus much subsequent evolutionary research by its emphasis on the importance of mutual co-adaptation. Another paper with Ehrlich in 1969 challenged the prevailing dogma that species cohesion was maintained primarily by gene flow (the 'biological species concept'), arguing instead that gene flow was highly restricted in natural populations. In these and other papers, Raven helped lay the groundwork for the ongoing reevaluation of the nature and concept of biological species. Early studies of pollination in *Onagraceae* led him in 1972 to propose that the mutualistic interactions between plants and their pollinators could be analyzed in energetic terms. This idea anticipated and stimulated an explosive growth in pollination biology, and led to more rigorous and predictive models about pollinator specificity and floral rewards. Another seminal paper from this period proposed a multiple origin of plastids and mitochondria, based on Raven's perceptive reading of the detailed ultrastructural data emerging from the field of cell biology. Raven was among the first botanists to realize the significance for evolutionary biology of the earlier-discredited concept of continental drift. In 1974 he wrote with Daniel Axelrod a now-classic analysis of angiosperm biogeography by examining the relationship and distributions of major plant groups in the context of the new geological paradigm of plate tectonics. His synthetic analyses have helped to illuminate the early radiation of angiosperms, especially in the Southern Hemisphere. On another front, his collaborative studies in the early 1960s on Mayan folk taxonomy helped to establish this new area of ethnobotany on the interface between biology and anthropology. Since 1971, Raven has developed the Missouri Botanical Garden into the world's pre-eminent center for the study of plant diversity, with exploring and collecting programs throughout North and South America, Africa and Madagascar, and China. At the same time, he has become one of the most influential spokespersons for the importance of understanding and preserving biological diversity. He

has championed the concept of national biological resources surveys in the USA, Taiwan, Mexico, and elsewhere, helping to establish a pattern that will be critical for the preservation of ecosystems and their plants, animals, fungi, and microorganisms throughout the world.

Main publications Raven, P.H., *Papers on Evolution*, Little, Brown & Co., Boston, pp. xii+564 (with Ehrlich, P.R. and Holm, R.W.), 1969; Raven, P.H., *Principles of Tzeltal Plant Classification. An Introduction to the Botanical Ethnography of a Mayan-Speaking People of Highland Chiapas*, Academic Press, New York and London, pp. xxii+660 (with Berlin, B. and Breedlove, D.E.), 1974; Raven, P.H., *Coevolution of Animals and Plants*, University of Texas Press, Austin and London, pp. xiii+246, (L.E. Gilbert and P.H. Raven, eds.), 1975, revised edition, 1981; Raven, P.H., *Topics in Plant Population Biology*, Columbia Univ. Press, New York, pp. xvii+589, (O.T. Solbrig, S. Jain, G.B. Johnson and P.H. Raven, eds.), 1979; Raven, P.H., *Advances in Legume Systematics*, Royal Botanic Gardens, Kew, pp. 1-1049 (2 vols.), (R.M. Polhill and P.H. Raven, eds.), 1981; Raven, P.H., *Biology*, C.V. Mosby Publishers, St. Louis, pp. xxx+1198 (with Johnson, G.B.), 1986; 2nd edn., 1989; 3rd edn., 1992, 4th edn., Wm. C. Brown, 1996, 6th edn., McGraw-Hill, 2002, 7th edn., McGraw-Hill, 2005 (released January 2004); Raven, P.H., *Modern Aspects of Species*, Univ. Tokyo Press, Tokyo, pp. 240, (H. Iwatsuki, P.H. Raven and W.J. Bock, eds.), 1986; Raven, P.H., *Understanding Biology*, C.V. Mosby Publishers, St. Louis, pp. xxx+799 (with Johnson, G.), 1988; 2nd edn., 1991; 3rd edn., Wm. C. Brown, 1995.

Martin John Sir Rees

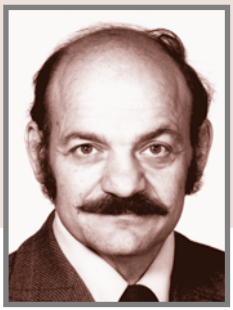
Date and place of birth: 23 June 1942, York, United Kingdom
Wife: Caroline
Appointment to the Academy: 25 June 1990
Scientific discipline: Sciences of the Universe
Academic title: Professor and Master of Trinity College at the University of Cambridge and Astronomer Royal

Most important awards, prizes and academies Awards: Heinemann Prize of Amer. Inst. Phys. (1984); Bappu Medal, Indian Nac. Sci. Acad. (1986); Gold Medal, Royal Astronomical Society (1988); Schwarzschild Medal, Astronomischegesellschaft (1989); Guthrie Prize, Institute of Physics (1989); Balzan International Prize (1989); Robinson Prize for Cosmology (1990); Bruce Medal, Astron. Soc. Pac. (1993); Science writing award, Amer. Inst. Phys. (1996); Bower Prize for Science, Franklin Institute (1998); Rossi Prize, Amer. Astro. Soc. (2000); Gruber Prize for Cosmology (2001); Albert Einstein Award of World Cultural Congress (2003). Academies: Fellow, Royal Society (1979); Foreign Associate, Nat. Acad. Sci. (1982); Foreign Hon. Mem., Amer. Acad. of Arts and Sci. (1975); Foreign Member, Amer. Phil. Soc. (1993). Hon. Member: Indian Nat. Sci. Acad. (1990); Royal Swedish Academy of Sciences (1993); Russian Academy of Sciences (1994); Norwegian Academy of Science (1996); Accademia dei Lincei (1996); Royal Netherlands Academy of Science (1997); Finnish Society of Sciences and Letters (2003). Hon. Degrees: Sussex, Leicester, Uppsala, Keele, Newcastle, Copenhagen, Toronto, Cardiff, Durham, Oxford.

Summary of scientific research Research has been mainly on topics in high energy astrophysics, cosmology and galaxies, and space science. Early work concerned the nature of cosmic radio sources, and interpreting the data that first became available in the 1960s on cosmology and very remote objects at high redshifts. Other topics have included the nature of the compact objects emitting strong x-rays, quasars, pulsars, gravitational waves, background radiation, the formation of galaxies, and physical processes in the early universe. He has also been interested in the interface between cosmology and philosophy. Outside the primarily academic sphere, he has also been involved in international space research, and in projects for education, etc. in developing countries.

Main publications Books: Rees, M.J., *Perspectives in Astrophysical Cosmology*, Cambridge University Press (1995); Rees, M.J., *Gravity's Fatal Attraction: Black Holes in the Universe* (with Begelman, M.C., Freeman, W.H.) (1995); Rees, M.J., *Before the Beginning: Our Universe and Others*, Simon & Schuster (UK); Persons (US) (1997); Rees, M.J., *Just Six Numbers*, Weidenfeld and Nicholson (UK); Basic Books (US) (1999); Rees, M.J., *Our Cosmic Habitat*, Princeton University Press (2001); Rees, M.J., *Our Final Century*, Heinemann (2003). Papers: Approximately 500 research publications, plus many general articles, reviews, etc.

Alexander Rich



Date and place of birth: 15 November 1924, Hartford, CT, USA
Wife and children: Jane Erving; Benjamin E., Josiah D., Rebecca B., Jessica J.
Appointment to the Academy: 17 April 1978
Scientific discipline: Biophysics
Academic title: Professor at the Massachusetts Institute of Technology

Most important awards, prizes and academies Awards: Sigma Xi Proctor Prize, Raleigh, NC (2001); Bower Award and Prize, the Franklin Institute, Philadelphia, PA (2000); National Medal of Science, Washington, DC (1995); Linus Pauling Medal, American Chemical Society, Northwest Sections (1995); Lewis S. Rosenstiel Award in Basic Biomedical Research, Brandeis Univ., Waltham, MA (1983); James R. Killian Faculty Achievement Award, Massachusetts Institute of Technology (1980); Presidential Award, New York Academy of Science, New York, NY (1977); Theodore van Karmen Award for Viking Mars Mission, Washington, DC (1976); Skylab Achievement Award, National Aeronautics and Space Administration, Washington, DC (1974). Academies: Foreign Member, Russian Academy of Sciences, Moscow, Russia (1994); Honorary Member, Japanese Biochemical Society, Tokyo, Japan (1986); Foreign Member, French Academy of Sciences, Paris, France (1984); Honorary Doctorate, Federal University of Rio de Janeiro, Brazil (1981); American Philosophical Society, Philadelphia, PA (1980); Pontifical Academy of Sciences (1978); National Academy of Sciences, Washington, DC (1970); Fellow, American Association for the Advancement of Science, Washington, DC (1965); Fellow, Guggenheim Foundation (1963); Fellow, American Academy of Arts and Sciences, Boston, MA (1959); Fellow, National Research Council, Washington, DC (1949-51).

Summary of scientific research The central thrust of my research has been an attempt to understand the relationship between molecular structure and biological function especially of nucleic acids and proteins. While working as a postdoctoral fellow with Linus Pauling at Caltech, I was strongly impressed with the power of x-ray diffraction analysis in defining structure. Some of my earlier work at the time concerned the then unknown structure and

function of ribonucleic acid. In the mid 50s, I studied the structure of natural and synthetic polynucleotides using fiber x-ray diffraction. A variety of different helical molecules were discovered containing two, three or four strands. These studies were later complemented by using single crystal x-ray diffraction analysis with purine-pyramidine intermolecular complexes. These demonstrated the wide variety of hydrogen bonding interactions of nucleic acid bases. Some of my earlier work concerned the structure of polypeptides. We determined the structure of polyglycine-II, a molecule which contains a unique hydrogen bonding system. This served as a clue for our discovering the structure of collagen, the fibrous protein of skin and connective tissue. In the early 1960s great interest was associated with the role of messenger RNA in protein synthesis. By its length, it seemed apparent to me that messenger RNA was long enough to associate simultaneously with several ribosomes while it was being translated. Out of this we discovered polyribosomes and carried out a series of studies dealing with the nature of the polyribosomal protein synthetic system. This led to a detailed analysis of events in the ribosome and the role of transfer RNA. In the late 60s we discovered we could crystallize pure species of transfer RNA. Solution of its three-dimensional structure by x-ray diffraction would produce information to help understand its mode of action in protein synthesis. Crystals were discovered that diffracted to high resolution and by 1973 we had traced the chain of yeast phenylalanine tRNA. In 1974 at 3 Å resolution we could discern the entire structure. It was an unusual structure, bent so that one end interacts with the messenger RNA during protein synthesis while the other end 75 Å away has the amino acid attached. We continue to address the problem of how this molecule works. In 1979 we solved the structure of a fragment of RNA that was found to be in a novel left-handed form. This conformation of the double helix, called Z-DNA, is a high energy form of the more familiar right-handed helix. For several years we have studied both its chemistry and biology. We now know which forces inside the cell act to stabilize Z-DNA and we understand a great deal about its conformation. A class of proteins were discovered that bind specifically to Z-DNA, many in regulatory regions. Co-crystallization of these proteins with Z-DNA has led to an understanding of how Z-DNA is recognized. In turn, this has led to other biological activities.

Main publications Rich, A. (with Crick, F.H.C.), 'The Structure of Collagen', *Nature*, 176, pp. 915-916 (1955); Rich, A. (with Davies, D.R.), 'A New Two-Stranded Helical Structure: Polyadenylic Acid and Polyuridylic Acid', *J. Amer. Chem. Soc.*, 78, p. 3548 (1956); Rich, A. (with Felsenfeld, G. and Davies,

D.R.), 'Formation of a Three-Stranded Polynucleotide Molecule', *J. Amer. Chem. Soc.*, 79, pp. 2023-2024 (1957); Rich, A., 'A Hybrid Helix Containing Both Deoxyribose and Ribose Polynucleotides and its relation to the Transfer of Information Between the Nucleic Acids', *Proc. Nat. Acad. Sci. USA*, 46, pp. 1044-1053 (1960); Rich, A. (with Davies, D.R., Crick, F.H.C. and Watson, J.D.), 'The Molecular Structure of Polyadenylic Acid', *J. Molec. Bio.*, pp. 71-86 (1961); Rich, A. (with Warner, J.R. and Knopf, P.M.), 'A Multiple Ribosomal Structure in Protein Synthesis', *Proc. Nat. Acad. Sci. USA*, 49, pp. 122-129 (1963); Rich, A. (with Warner, J.R. and Goodman, H.M.), 'The Structure and Function of Polyribosomes', *Cold Spring Harbor Symposium*, 28, pp. 269-285 (1963); Rich, A. (with Kim, S.H., Quigley, G.J., Suddath, F.L., McPherson, A., Sneden, D., Kim, J.J. and Weinzierl, J.), 'Three-Dimensional Structure of Yeast Phenylalanine Transfer RNA: Folding of the Polynucleotide Chain', *Science*, 179, pp. 285-288 (1973); Rich, A. (with Kim, S.H., Suddath, F.L., Quigley, G.J., McPherson, A., Kim, J.J., Sussman, J.L., Wang, A.H.-J. and Seeman, N.C.), 'Three-Dimensional Tertiary Structure of Yeast Phenylalanine Transfer RNA', *Science*, 185, pp. 435-439 (1974); Rich, A. (with Wang, A.H.-J., Quigley, G.J., Kolpak, F.J., Crawford, J.L., van Boom, J.H. and van der Marel, G.), 'Molecular Structure of a Left-Handed Double Helical DNA Fragment at Atomic Resolution', *Nature*, 282, pp. 680-686 (1979); Rich, A. (with Wittig, B., Wölfl, S., Dorbic, T. and Vahrson, W.), 'Transcription of Human c-myc in Permeabilized Nuclei is Associated with Formation of Z-DNA in Three Discrete Regions of the Gene', *Embo J.*, 11, pp. 4653-4663 (1992); Rich, A. (with Su, L., Chan, L., Egli, M. and Berger, J.M.), 'A Minor Groove RNA Triplex in the Crystal Structure of a Viral Pseudoknot Involved in Ribosomal Frameshifting', *Nature Structural Biology*, 6, pp. 285-292 (1999); Rich, A. (with Schwartz, T., Rould, M.A., Lowenhaupt, K. and Herbert, A.), 'Crystal Structure of the Zα Domain of the Human Editing Enzyme ADAR1 Bound to Left-Handed Z-DNA', *Science*, 284, pp. 1841-1845 (1999).

Carlo Enrico di Rovasenda

Date and place of birth: 17 June 1906, Turin, Italy
Appointment to the Academy: 13 Nov. 1986
Scientific discipline: Philosophy and Theology
Academic title: Domenican priest and Director of the Chancellery of the P.A.S. from 1972 to 1986

Summary of scientific research Diplômé Ingénieur Civil à l'École Polytechnique de Turin en 1928, il entra dans l'Ordre de Saint Dominique le 19 mars 1929. Lecteur en Théologie en 1936, licencié en Philosophie à l'Institut Catholique de Paris en 1937; les titres de Prédicateur Général et Maître en Sacrée Théologie lui furent ensuite decernés dans l'Ordre des Frères Prêcheurs. Il enseigna Philosophie Morale et Théologie Morale au Studium Général des Dominicains de Turin, ainsi que l'Éthique Économique et Politique à l'Université Libre d'Études Sociales (Rome) et l'Histoire des Doctrines Politiques à l'Université Saint Thomas d'Aquin (Rome). Au cours de cette période d'enseignement, le Père di Rovasenda a publié les cours polycopiés relatifs à la matière, sans oublier de nombreux livres en collaboration et beaucoup d'articles sur des revues et des journaux. Il est depuis de nombreuses années Assistant Ecclésiastique National du 'Movimento Ecclesiale di Impegno Culturale', qui réunit les intellectuels adhérents à l'Action Catholique Italienne. Le 16 novembre 1972, il fut nommé par le Saint-Père Paul VI Directeur adjoint et successivement le 3 avril 1974 Directeur de la Chancellerie. Le Pape Paul VI le confirma dans cette charge pour quatre ans et Jean-Paul II, une fois encore, pour quatre ans. Le Père di Rovasenda, dans l'exercice de ses fonctions, a su entretenir des rapports réguliers avec le Siège Apostolique; il a développé son action en lien très étroit avec le Président, le Professeur Carlos Chagas, a entretenu des rapports périodiques avec les Académiciens et a organisé, s'assurant de la collaboration intelligente et assidue des membres de la Chancellerie, la réalisation des programmes de travail préparés d'avance par le Président et le Conseil académique. Il a, en outre, participé à diverses réunions internationales, en tant que représentant du Saint Siège et de l'Académie. Il a su, au travers de publications variées et

grâce aux moyens de communications, tels que la radio et la télévision, diffuser l'histoire de l'Académie, ses fonctions et son activité. Le Père di Rovasenda a quitté sa charge le 31 décembre 1986, ayant atteint la limite d'âge. En reconnaissance pour l'activité déployée à l'Académie pendant ces quatorze années, le Saint-Père a voulu le nommer Académicien honoraire.

Main publications He has worked for the journal *Coscienza*, the organ of the MEIC 'Movimento Ecclesiale di Impegno Culturale', since 1980, and through works of a theological, cultural, philosophical, social and spiritual (meditations) nature on questions of contemporary relevance. As an assistant of UCI-Tecnici he has published articles in specialised journals on subjects of a scientific nature. He has also contributed to various publications of Azione Cattolica, including the following: di Rovasenda, E., *Una cultura orientata nella fede*, a cura di Salvatore Accardo, ed. AVE (Roma, 1987); di Rovasenda, E., 'La Pontificia Accademia delle Scienze (1972-1986)', *Stampa e cultura religiosa tra otto e novecento*, Quaderni del Centro studi "C. Trabucco", 16, pp. 71-96 (1991); di Rovasenda, E., *Il mistero cristiano nella vita del credente*, ed. AVE, Collana Proposte, 45 (Roma, 1991); di Rovasenda, E., *Le virtù di contemplazione e azione in Maria SS.*, Meditazioni, Tipografia Grassi (Mantova, 1992); di Rovasenda, E., *Fortezza e temperanza dello Spirito*, Meditazioni, Tipografia Grassi (Mantova, 1993); AA.VV., *Un Padre del nostro tempo. Scritti in onore di P. Enrico di Rovasenda*, ed. AVE (Roma, 1994).

Carlo Rubbia

Date and place of birth: 31 March 1934, Gorizia, Italy
Wife and children: Marisa; Laura and Andrea
Appointment to the Academy: 14 Dec. 1985
Scientific discipline: Particle Physics
Academic title: President of ENEA and Professor at the University of Pavia

Most important awards, prizes and academies Awards: He has been awarded numerous prizes, including the Nobel Prize in Physics (1984). Academies: He is a member of 27 Academies, among which: Accademia Nazionale dei Lincei; Accademia dei XL; American Academy of Arts and Sciences; Pontifical Academy of Sciences; Foreign Member, Polish Academy of Sciences; Foreign Member, Croatian Academy of Sciences and Arts; Foreign Member, Royal Society; Foreign Member, USA National Academy of Sciences; Foreign Member, USSR Academy of Sciences; Third World Academy of Sciences; European Academy of Sciences; Société Européenne de Culture; Ateneo Veneto; Société Française de Physique; Istituto Lombardo; Austrian Academy of Sciences. Honours: Cavaliere di Gran Croce (Knight of the Grand Cross) from the President of the Italian Republic, Sandro Pertini (1985); Officier de la Légion d'Honneur, from the President of the French Republic, François Mitterrand (1989); Polish Order of Merit at the conclusion of his mandate as Director General of CERN (1993). Honorary degrees: University of Geneva, Switzerland (1983); Carnegie Mellon University, USA (1985); University of Genoa, Italy (1985); University of Udine, Italy (1985); University of La Plata, Argentina (1986); Northwestern University, USA (1986); University of Camerino, Italy (1987); University of Chicago, USA (1987); Loyola University, USA (1987); Boston University, USA (1988); University of Sofia, Bulgaria (1990); University of Moscow, USSR (1991); University of Chile, Santiago (1991); Polytechnic University of Madrid, Spain (1992); University of Padua, Italy (1992); Technical University of Rio de Janeiro, Brazil (1993); University of Trieste, Italy (1994); University of Oxford, UK (1994); Catholic University of Lima, Peru (1994); National University of San Antonio Abad of Cusco, Peru (1994); University of Bordeaux, France (1998);

University of Haute Savoie, France (1999); St John's University, USA-Italy (2003); University of Turin, Italy (2004). Lectures: Enrico Fermi Lecturer at the Scuola Normale, Pisa, Italy; Philip-Burton-Moon Lecturer, Birmingham, UK (1984); Bakerian Lecturer, London, UK (1985); Weizmann Lecturer, Rehovot, Israel (1986); Primakoff Lecturer, Pennsylvania, USA (1986); Dirac Lecturer, Sydney, Australia (1989); Heisenberg Lecturer (1992); Max Von Laue Colloquium (1993); Werner Von Siemens Chair (1994); Hitchcock Professorship, Berkeley, USA (1994); Einstein Lecturer, Jerusalem (1998).

Summary of scientific research Soon after his degree on Cosmic Ray Experiments at the Scuola Normale in Pisa, Rubbia spent one and a half years at Columbia University (USA) performing experiments on the decay and the nuclear capture of μ mesons at the Nevis Cyclotron. This was the first of a long series of experiments which Rubbia performed in the field of Weak Interactions and which culminated in the observation of the charged and neutral intermediate vector bosons, believed to be the mediators of such a force. From 1970 to December 1988 Rubbia spent one semester each year at Harvard University (Cambridge, Massachusetts), where he was Higgins Professor of Physics. He performed experiments with different accelerators in the United States (Fermilab, near Batavia, Illinois, and Brookhaven National Laboratory on Long Island, NY) and with the three major accelerators of CERN, the European Laboratory of Particle Physics, near Geneva, Switzerland (the Synchro-Cyclotron, the Proton Synchrotron and the Super Proton Synchrotron). Early in 1983 at CERN, an international team of more than 100 physicists headed by Rubbia, known as the UA1 Collaboration, detected the intermediate vector bosons, a triplet of particles, the W^+, the W^- and the Z^0, which had become a cornerstone of modern theories of elementary particle physics, long before they were observed by Rubbia and collaborators. They are believed to carry the weak force that causes radioactive decay in the atomic nucleus and controls the combustion of the Sun, just as photons, massless particles of light, carry the electromagnetic force which causes most physical and biochemical reactions. To achieve energies high enough to create the intermediate vector bosons (particles roughly one hundred times as heavy as the proton), Rubbia proposed, with David Cline and Peter McIntyre, the use of a beam of protons and a beam of antiprotons, their antimatter twins, counter-rotating and colliding head-on. These revolutionary techniques were developed with Simon van der Meer, with whom Rubbia shared the 1984 Nobel Prize in Physics. Rubbia was one of the leaders in a collaboration effort based deep in the Gran Sasso Laboratory designed to

detect any sign of decay of the proton. The experiment seeks evidence that would disprove the conventional belief whereby matter is stable. The experiment, known as ICARUS and based on a new technique of electronic detection of ionizing events in ultra-pure liquid Argon, is now operational at the University of Pavia, awaiting its transfer to the Gran Sasso Laboratory. More recently he proposed the concept of an Energy Amplifier – a novel and safe way of producing nuclear energy exploiting present-day accelerator technologies, which is actively being studied worldwide in order (1) to incinerate high activity waste from accelerators and (2) to produce energy from natural thorium and depleted uranium. The energy resources which could potentially derive from these fuels will be practically unlimited and comparable to those from fusion. His activities are presently concentrated on the problem of energy supply for the future. Carlo Rubbia is the co-author of 546 scientific publications, of which 245 have been published in major scientific journals. For a complete list please email a request to carlo.rubbia@cern.ch.

Vera C. Rubin

Date and place of birth: 23 July 1928, Philadelphia, PA, USA
Husband and children: Robert Rubin; David, Karl, Allan, Judy Young
Appointment to the Academy: 25 June 1996
Scientific discipline: Astronomer
Academic title: Senior Fellow of the Carnegie Institution of Washington

Most important awards, prizes and academies Awards: US National Medal of Science (1993); Antoinette de Vaucouleurs Medal (1993); Dickson Prize (1994); Russell Prize, American Astronomical Society (1994); Weizmann Women and Science Award (1996); Gold Medal, Royal Astronomical Society (1996); City of Philadelphia John Scott Award (2001); Peter Gruber International Cosmology Prize (2002); Bruce Medal, Astronomical Society of the Pacific (2003); Watson Medal, US National Academy of Sciences (2004). Academies: US National Academy of Sciences (1981); American Academy of Arts and Sciences (1982); American Philosophical Society (1995). Honorary Degrees: Creighton Univ. (1978); Harvard Univ. (1988); Yale Univ. (1990); Williams College (1993); Univ. Michigan (1996); Georgetown Univ. (1997); Ohio State Univ. (1998); Smith College (2001); Grinnell College (2001); Ohio Wesleyan University (2004).

Summary of scientific research Vera C. Rubin has devoted her professional career to the study of motions of stars and gas in galaxies, and galaxies in the universe. Her earliest studies (1951) examined the motions of galaxies to see if they exhibited large scale systematic motions, in addition to the general expansion of the universe. She returned to this subject 25 years later with her long-time collaborator, Dr. W. Kent Ford, Jr., this time obtaining new data on the velocities and the brightnesses of the galaxies. These results indicated a large motion for our Galaxy, and initiated a series of long-term studies still underway today, in an effort by many astronomers to sort out these complex motions. In 1987, she chaired a Vatican Study-Week on Large Scale Motions in the Universe. The major thrust of Dr. Rubin's observations for the past 30 years has been the study of the orbital velocities of stars and gas in galaxies. This work led to the discovery that orbital velocities far

from the centers of galaxies are high, too high to be accounted for by the luminous matter observed in galaxies. Hence these studies played an important role in the realization that most of the matter in the universe is dark. Ultimately, Dr. Rubin and her colleagues produced a systematic study of rotational properties for normal galaxies of different classes. Dr. Rubin has extended her observational studies to rotation motions within galaxies located in dense clusters of galaxies, and to galaxies with peculiar morphologies, in an effort to understand the history and evolution of such objects. In this study, she has discovered curious galaxies, such as NGC 4550, a disk galaxy in which half the stars orbit clockwise, and half the stars orbit counterclockwise. She and her colleagues understand this as a galaxy which acquired a substantial amount of gas, after the initial stellar disk was in place. The new gas later precessed to the principal plane and formed stars, whose reverse orbital sense reflected the angular momentum of the acquired gas. Currently, Dr. Rubin and her collaborators are analyzing the motion of stars in low surface brightness galaxies, and in dwarf irregular galaxies. Little is know about stellar motions in these small, undistinguished stellar agglomerations, which are the most numerous galaxies in the universe. The new, large telescopes make these studies possible.

Main publications Rubin, V.C., 'Rotation of the Metagalaxy', *Astron. J.*, 56, p. 47 (1951); Rubin, V.C. and Burley, J., 'Kinematics of Early-Type Stars. II. The Velocity Field within 2 kiloparsecs of the Sun', *Astron. J.*, 69, p. 92 (1964); Burbidge, E.M., Burbidge, G.R. and Rubin, V.C., 'A Study of the Velocity Field in M82 and its Bearing on Explosive Phenomena in that Galaxy', *Astrophys. J.*, 140, p. 942 (1964); Rubin, V.C., 'Radial Velocities of Distant O B Stars in the Anticenter Region of the Galaxy', *Astrophys. J.*, 142, (Oct. 1965); Rubin, V.C. and Ford, W.K. Jr., 'Rotation of the Andromeda Nebula from a Spectroscopic Survey of Emission Regions', *Astrophys. J.*, 159, p. 379 (1970); Rubin, V.C., Ford, W.K. Jr. and D'Odorico, S., 'Emission-line Intensities and Radial Velocities in the Interacting Galaxies NGC 4038-4039', *Astrophys. J.*, 160, p. 801 (1970); Rubin, V.C., Ford, W.K. Jr., Thonnard, N. and Roberts, M.S., 'Motion of the Galaxy and the Local Group of Galaxies Determined from the Velocity Anisotropy of Distant Sc I Galaxies. II. The Analysis for the Motion', *Astron. J.*, 81, p. 719 (1976); Rubin, V.C., Ford, W.K. Jr. and Oort, J.H., 'New Observations of the NGC 1275 Phenomenon', *Astrophs. J.*, 211, p. 697 (1977); Rubin, V.C., Burstein, D., Ford, W.K. Jr. and Thonnard, N., 'Rotation Velocities of 16 Sa Galaxies and a Comparison of Sa, Sb and Sc Rotation Properties', *Astrophys. J.*, 289,

p. 81 (1985); Rubin, V.C. and Coyne, G.V., S.J., *Large-Scale Motions in the Universe: A Vatican Study Week*, eds. Princeton University Press, 1988; Rubin, V.C., Graham, J.A. and Kenney, J.P.D., 'Cospatial Counterrotating Stellar Disks in the Virgo E7/S0 Galaxy NGC 4550', *Astrophys. J. (Lett.)*, 394, L9-L12 (1992); Rubin, V.C., 'Galaxy Dynamics and the Mass Density of the Universe', *Physical Cosmology*, (D. Schramm, ed.), *Proc. Nat. Ac. Sci*., 90, p. 4814 (1993); Rubin, V.C., 'A Century of Galaxy Spectroscopy', *Astrophys. J.*, 451, p. 419 (1995); Rubin, V.C., Kenney, J.D.P., and Young, J.S., 'Rapidly Rotating Circumnuclear Gas Disks in Virgo Disk Galaxies', *Astron. J.*, 113, p. 1250 (1997); Rubin, V.C., Waterman, A.H., and Kenney, J.P.D., 'Kinematic Disturbances in Optical Rotation Curves among 89 Virgo Disk Galaxies', *Astron. J.*, 118, (1999); Rubin, V.C., 'A Brief History of Dark Matter', *The Dark Universe: Matter, Energy, and Gravity*, (M. Livio, ed.), Cambridge University Press, 1 (2003); Swaters, R.A. and Rubin, V.C., 'Stellar Motions in the Polar Ring Galaxy NGC4650A', *Astrophysical J. (Lett)*, 587, L23-L26 (2003).

Roald Zinnurovich Sagdeev

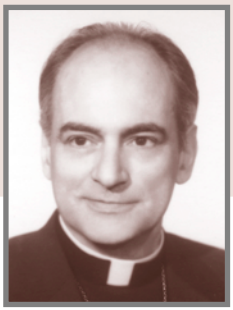
Date and place of birth: 26 December 1932, Moscow, Russia
Wife: Susan Eisenhower
Appointment to the Academy: 4 Oct. 1990
Scientific discipline: Physics
Academic title: Distinguished Professor of Physics, University of Maryland and Director Emeritus, Space Research Institute, Moscow

Most important awards, prizes and academies Awards: Lenin Prize (1984); Hero of Socialist Labour (1986); Tate Medal, American Institute of Physics (1992); Science for Peace, Italy (1994); Leo Scillard Award, American Physical Society (1994); Von Karman Lectureship Award, American Institute of Aeronautics and Astronautics (2001); Hannes Alufen Memorial Lectureship, Sweden (2001); Maxwell Prize, American Physical Society (2001); Order of the October Revolution; Order of the Red Banner. Academies: Russian Academy of Sciences; Council of Dirs. Int. Fund for Survival and Devt. of Mankind; National Academy of Sciences, USA; American Academy of Arts and Sciences, USA; Royal Swedish Academy; Royal Astronomical Society, UK; Max-Planck Society; International Academy of Astronomics; Hungarian Academy of Sciences; Czech Academy of Sciences; Third World Academy; Pontifical Academy of Sciences. Honorary Degrees: UCLA; New York University; University of Michigan; Toulouse University, France; Technical University of Graz, Austria. USSR People's Deputy (1989-91).

Summary of scientific research He began his studies in atomic energy, becoming Head of the Lab. Inst. of Nuclear Physics, Siberian Dept., Academy of Sciences (1961-70). After continuing his interests in nuclear physics he turned increasingly to high temperature physics and space research, becoming Director of the USSR Space Research Institute (1973-88). At a more detailed level he is a specialist in global warming, plasma physics, controllable thermonuclear synthesis, and cosmic ray physics.

Main publications A large number of books and articles in Russia and abroad on his principal areas of scientific research.

Marcelo Bishop Sánchez Sorondo



Date and place of birth: 8 September 1942, Buenos Aires, Argentina
Appointment to the Academy: 5 Oct. 1998
Scientific discipline: Theology and Philosophy
Academic title: Chancellor of the P.A.S. and Professor of the History of Philosophy at LUMSA University, Rome

Most important awards, prizes and academies Academic Appointments: Lecturer in the History of Philosophy (1976-82) and Full Professor (1982-98), Pontifical Lateran University; Dean of the Faculty of Philosophy, Pontifical Lateran University (1987-96); Professor of the History of Philosophy, Libera Università Maria SS. Assunta (1998-). Academies: Pontifical Academy of St Thomas Aquinas (1989) and Secretary Prelate (1999-); Chancellor, Pontifical Academy of Sciences (1998-); Chancellor, Pontifical Academy of Social Sciences (1998-). Ordained Bishop by His Holiness John Paul II on 19 March 2001.

Summary of scientific research My early work centred around an innovative examination of the primary function of the idea of participation in the core theological approach of St Thomas Aquinas, especially with regard to the crucial point of the question of the 'participation (of man) in the divine nature' (2 *Pt* 1, 4). The main and new conclusion was that man, because he is free, i.e. *causa sui*, is his own cause in the order of the re-creation not only of his own growth but also of the communication (κοινωνìα) of divine grace to another human being, to a 'you' who freely wants that grace. As a subsequent follower of the contemporary philosophical current which seeks the 'rehabilitation' of Aristotle, I emphasized that the 'Stagirite' was the first to expound a positive notion of spiritual reality beginning with the human experience of superior activities such as feeling, thinking, wanting and enjoying. Aristotle did this through his meta-categories of power (δύναμις) and energy (ἐνέργεια) which, although they serve initially to explain movement, subsequently allow a metaphysical explanation of the living human subject, of the suffering and acting 'self' – a question discussed in detail by modern philosophy. Drawing upon the most recent developments in critical research into the structure of the thought

of Aristotle (N. Hartman, P. Ricœur and my teacher C. Fabro), I examined the different interpretations of this philosopher, especially those propounded during the medieval period by Thomas Aquinas and during the modern era by Hegel. In his *Encyclopaedia* (§ 482) Hegel rightly observes that no concept has been more subject to misunderstanding than that of freedom, which expresses the essence of the spirit. This was the new anthropological idea that the classical world, including Aristotle, was light years away from. For this reason, I have recently argued, 'realised freedom' or freedom achieved by the truth (John Paul II) became the new criterion for the hermeneutics of history, culture and religions. I also proposed that realised freedom, as a real quality of the human being and not mere potentiality, should be the criterion to be employed in the analysis of Christian history.

Main publications *La Gracia como Participación de la Naturaleza Divina según Santo Tomás de Aquino* (Buenos Aires-Letrán-Salamanca, 1979), pp. 360; *Aristotele e San Tommaso* (Città Nuova, Roma, 1981), pp. 120; *Aristóteles y Hegel* (Herder, Buenos Aires-Rome, 1987), pp. 368; 'La Positività dello Spirito in Aristotele', *Aquinas*, 21, fasc. 1 (Rome, 1978), pp. 126 ff.; 'La Querella Antropológica del Siglo XIII (Sigerio y Santo Tomás)', *Sapientia*, 35, pp. 137-138 (Buenos Aires, 1980), pp. 325-358; 'Aristóteles y Hegel' (N. Hartmann), introduction, translation and notes by M.S.S., *Pensamiento*, 154, vol. 39 (Madrid, 1983), pp. 177-222; 'Partecipazione e Refusione della Grazia', *Essere e Libertà* (studi in onore di C. Fabro, Perugia, 1984), pp. 225-251; 'L'Unità dei Comandamenti', *Coscienza*, 1 (Rome, 1985), pp. 20 ff.; 'La Libertà nella Storia', *Ebraismo, Ellenismo, Cristianesimo*, *Archivio di Filosofia*, 53, 2-3 (Rome, 1985), pp. 89-124; 'L'Evoluzione (*Entwicklung*) Storica della Libertà come Stimolo per la Filosofia Cristiana', *Aquinas*, 30, 1 (Rome, 1988), pp. 30-60; 'Der Weg der Freiheit nach Hegel', *Der Freiheitsgedanke in den Kulturen des Italienischen und Deutschen Sprachraumes* (Akademie Deutsch-Italienischer Studien, Akten der XXI internationalen Tagung, Meran 10-15. April 1989), pp. 457-481; 'L'Energeia Noetica Aristotelica come Nucleo Speculativo del *Geist* Hegeliano', in M.S.S. (ed.), *L'Atto Aristotelico e le sue Ermeneutiche* (Rome, 1990), pp. 179-201; *L'Atto Aristotelico e le sue Ermeneutiche*, 'Introduction' and edited by M.S.S. (Herder, Università Lateranense, Rome, 1990), pp. i-xii-388; *Ragione Pratica, Libertà, Normatività*, 'Introduction' and edited by M.S.S. (Herder, Università Lateranense, Rome, 1991), pp. i-xxiv-474; *Teologia Razionale, Filosofia della Religione, Linguaggio su Dio*, 'Introduction' and edited by M.S.S. (Herder, Università Lateranense, Rome, 1992), pp. i-xvii-500; 'I Valori Culturali dell'America Latina per la Nuova Evangelizzazione', *Euntes*

Docete, 45, 2 (Rome, 1992), pp. 191-204; 'Francisco de Vitoria: Artefice della Nuova Coscienza sull'Uomo', *Vangelo Religioni Cultura* (Turin, 1993), pp. 263-277; *Physica, Naturphilosophie, Nuovi Approcci*, 'Introduction' and edited by M.S.S. (Herder, Università Lateranense, Rome, 1993), pp. i-xxvi-482; 'Del Alma al Espíritu: la Antropología de Tomás de Aquino', *Revista Latinoamericana de Filosofía*, XX, 1 (Buenos Aires, 1994), pp. 20-37; 'Per un Servizio Sapienziale della Filosofia nella Chiesa', *Aquinas*, XXXVII, fasc. 3 (Rome, 1994), pp. 483-500; *περὶ Ψυχῆς*, *De Homine*, *Antropologia*, 'Introduction' and edited by M.S.S. (Herder, Università Lateranense, Rome, 1995), pp. i-xxviii-590; 'Stato, Libertà e Verità', *La Forma Morale dell'Essere* (Rosminiane, Stressa, 1995), pp. 91-133; 'Francis of Vitoria', *Hispanic Philosophy in the Age of Discovery* (The Catholic University of America, Washington, 1995), pp. 250-275; 'La Libertà in C. Fabro', *Studi Cattolici*, September 1995, 415, pp. 529-33; *Tempo e Storia. Per un Approccio Storico e Teoretico*, 'Introduction' and edited by M.S.S. (Herder, Università Lateranense, Rome, 1996), pp. i-xxxvi-442; *La Vita*, 'Introduction' and edited by M.S.S. (Mursia, Università Lateranense, Rome, 1998), pp. i-xxviii-316; 'In che cosa credono quelli che non credono?', *Aquinas*, XLI, fasc. 3 (Rome, 1998), pp. 465-481; 'Aristotele', *Lexicon*, *Dizionario dei Teologhi* (P.M., Casale Monferrato, 1998), pp. 101-104; 'Znaczenie filozofii wiedzy i umiej´tnoÊci jako filozofii czŁowieka', in *CzŁowiek i jego Êwiat na przeŁomie XX/XXI wieku*, (Cz´stochowa, 1998), pp. 37-44, 81-89; 'Hegel: Life between Death and Thought', *Analecta Husserliana*, LIX (Kluwer, Holland, 1999), pp. 189-203; 'Comentario a la Enc. Fides et Ratio', *Cuenta y Razón* (Madrid, April 1999), pp. 7-18; 'Per una Istanza Metafisica Aperta alla Fede', *Per una Lettura dell'Enciclica Fides et Ratio* (Quaderni de *L'Oss. Romano*, Vatican City, 1999), pp. 158-171; 'Globalisation and Humanity: New Perspectives', AA.VV., *A Dialogue on Globalization: Challenges and Opportunities for Countries*, (The Asia Group, Rome 2001), pp. 11-28; 'For a Catholic Vision of the Economy', *Journal of Markets & Morality*, Volume 6, Number 1, (Michigan, 2003), pp. 7-31; 'Il Padre e il Figlio amano se stessi e noi per lo Spirito Santo (*S.Th.*, I, 37, 2)', *Doctor Communis*, fasc. 2, (Vatican City, 2003), pp. 41-57; 'The Truth Is the Goal of the Universe', E. Majorana Center for Scientific Culture, (Erice, Italy, 10-15 May 2003), pp. 191-196; 'Per una cultura aperta alla fede', *La Chiesa a servizio dell'uomo, Giovanni Paolo II XXV anni di Pontificato*, (Roma, 2003), pp. 144-152; 'Il Magistero dei Papi per la Pace e l'Accademia delle Scienze', in G. Prestipino (ed.), *Guerra e Pace* (Napoli, 2004), pp. 83-110; 'Science and Reality', *Analecta Husserliana*, LXXIX (Kluwer, Holland, 1999), pp. 821-833.

Michaël Sela

Date and place of birth: 6 March 1924, Tomaszów, Poland
Wife and children: Sara; Irit, Orlee and Tamar
Appointment to the Academy: 2 Dec. 1975
Scientific discipline: Biology
Academic title: Institute Professor of Immunology at the Weizmann Institute of Science, Israel

Most important awards, prizes and academies Israel Prize in Natural Sciences (1959); Rothschild Prize in Chemistry (1968); Otto Warburg Medal, German Society of Biological Chemistry (1968); Emil von Behring Prize of the Phillips University (1973); Gairdner Foundation International Award, Toronto (1980); Prize of the Institut de la Vie, Fondation Electricité de France (1984); Albert Einstein Golden Medal, UNESCO (1995); Harnack Medal of the Max-Planck Society (1996); Interbrew-Latour Health Prize, Belgium (1997); Wolf Prize in Medicine (1998). Honorary Doctorates: Université de Bordeaux II (1985); National Autonomous University of Mexico (1985); Tufts University, Medford, MA (1989), Colby College, Maine (1989); Université Louis Pasteur, Strasbourg (1990); Hebrew University, Jerusalem (1995); Tel Aviv University (1999); Ben-Gurion University of the Negev (2001). Academies: Israel Academy of Sciences and Humanities; American Academy of Arts and Sciences; Pontifical Academy of Sciences; US National Academy of Sciences; Deutsche Akademie der Naturforscher Leopoldina; Russian Academy of Sciences; French Academy of Sciences; Italian Academy of Sciences; American Philosophical Society; Romanian Academy; Polish Academy of Arts and Sciences. Honours: Commander's Cross of the Order of Merit of the Federal Republic of Germany (1986); Officer de l'Ordre de la Legion d'Honneur, France (1987); Caballero, Order de San Carlos, Colombia.

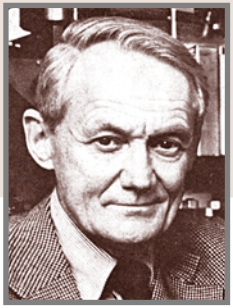
Summary of scientific research 1) The development of synthetic antigens. 2) Their use to elucidate the molecular basis of antigenicity (role of steric conformation, electric charge, shape, size, composition, optical configuration of component building stones, etc.). 3) The establishment, making use of synthetic antigens, of the genetic control of immune response. 4) The development of the notion of synthetic vaccines, including the first synthesis of anti-

gens capable of provoking antibodies that neutralize a virus (MS2 bacteriophage) and bacterial toxins (diphtheria and cholera). 5) The combined use of synthetic antigens and synthetic adjuvants, covalently linked to a synthetic polymer carrier, leading to antigens capable of provoking in aqueous solution protection against a virus and a bacterial toxin. 6) The development of a synthetic amino acid copolymer which serves as a specific drug against multiple sclerosis. 7) Monoclonal antibodies against the ErbB2 receptor, present in high density in breast cancer, either inhibited or enhanced tumor growth. The inhibitory antibodies induced differentiation of human breast cancer into normal milk-producing breast cells. 8) Synthesis of peptide antagonists to the most myasthenogenic T cell epitopes derived from the acetylcholine receptor, in an effort to find drugs against myasthenia gravis.

Main publications ‘Synthesis, characterization and immunogenicity of some multichain and linear polypeptides containing tyrosine’ (with Fuchs, S. and Arnon, R.), *Biochem. J.*, 85, p. 223 (1962); ‘Antibodies to sequential and conformational determinants’ (with Schechter, B., Schechter, I. and Borek, F.), *Cold Spring Harbor Symposia on Quantitative Biology*, 32, p. 537 (1967); ‘Antigenicity: some molecular aspects’, *Science*, 166, p. 1365 (1969); ‘Demonstration of determinant-specific differences in response to synthetic polypeptide antigens in two strains of inbred mice’ (with McDevitt, H.O.), *J. Exp. Med.*, 122, p. 517 (1965); ‘Antibodies Reactive with Native Lysozyme Elicited by a Completely Synthetic Antigen’ (with Arnon, R., Maron, E. and Anfinsen, C.B.), *Proc. Natl. Acad. Sci. USA*, 68, p. 1450 (1971); ‘A pilot trial of Cop 1 in exacerbating-remitting multiple sclerosis’ (with Bornstein, M.B., Miller, A., Slagle, S., Weitzman, M., Crystal, H., Drexler, E., Keilson, M., Merriam, A., Wassertheil-Smoller, S., Spada, V., Weiss, W., Arnon, R., Jacobsohn, I. and Teitelbaum, D.), *The New England Journal of Medicine*, 317, p. 408 (1987); ‘Mechanistic aspects of the opposing effects of monoclonal antibodies to the ErbB2 receptor on tumor growth’ (with Stancovski, I., Hurwitz, E., Leitner, D., Ullrich, A. and Yarden, Y.), *Proc. Natl. Acad. Sci. USA*, 88, p. 8691 (1991); ‘Peptide analogs to pathogenic epitopes of the human acetylcholine receptor □-subunit as potential modulators of myasthenia gravis’ (with Zisman, E., Katz-Levy, Y., Dayan, M., Kirshner, S.L., Paas-Rosner, M., Karni, A., Abramsky, O., Brautbar, C., Fridkin, M. and Mozes, E.), *Proc. Natl. Acad. Sci. USA*, 93, p. 4492 (1996); ‘A synthetic random basic copolymer with promiscuous binding to class II MHC molecules inhibits T-cell proliferative responses to major and minor histo-compatibility antigens in vitro and confers the capacity to prevent murine graft-versus-host

disease in vivo' (with Schlegel, P.G., Aharoni, R., Chen, Y., Chen, J., Teitelbaum, D., Arnon, R., Sela, M. and Chao, N.J.), *Proc. Natl. Acad. Sci. USA*, 93, p. 501 (1996); 'A peptide composed of tandem analogs of two myasthenogenic T cell epitopes interferes with specific autoimmune responses' (with Katz-Levy, Y., Paas-Rozner, M., Kirshner, S., Dayan, M., Zisman, E., Fridkin, M., Wirguin, I., Sela, M. and Mozes, E.), *Proc. Natl. Acad. Sci. USA*, 94, p. 3200 (1997); 'Copolymer 1 induces T-cells of the T helper Type 2 that cross-react with myelin basic protein and suppress experimental autoimmune encephalomyelitis' (with Aharoni, R., Teitelbaum, D. and Arnon, R.), *Proc. Natl. Acad. Sci. USA*, 94, p. 10821 (1997); 'Copolymer 1 acts against the immunodominant epitope 82-100 of myelin basic protein by T cell receptor antagonism in addition to the MHC blocking' (with Aharoni, R., Teitelbaum, D. and Arnon, R.), *Proc. Natl. Acad. Sci. USA*, 96, p. 634 (1999); 'Immunomodulation of experimental autoimmune encephalomyelitis by oral administration of copolymer 1' (with Teitelbaum, D. and Arnon, R.), *Proc. Natl. Acad. Sci. USA*, 96, p. 3842 (1999); 'T-cell immunity to copolymer-1 confers neuroprotection on the damaged optic nerve: possible therapy for optic neuropathies' (with Kipnis, J., Yoles, E., Porat, Z., Cohen, A., Mor, F., Cohen, I.R. and Schwartz, M.), *Proc. Natl. Acad. Sci. USA*, 97, p. 7446 (2000); 'Copolymer 1 inhibits manifestations of graft rejection' (with Aharoni, R., Teitelbaum, D. and Arnon, R.), *Transplantation*, 72, p. 598 (2001); 'Glatiramer acetate specific T-cells in the brain express Th2/3 cytokines as well as brain derived neurotrophic factor (BDNF) in situ' (with Aharoni, R., Kayhan, B., Eilam, R. and Arnon, R.), *Proc Natl. Acad. Sci.*, 100, p. 14157 (2003); 'Therapeutic vaccines – realities of today and hopes for the future' (with Arnon, R. and Schechter, B.), *Drug Discovery Today*, 7, p. 664 (2002); 'From proteins and protein models to their use in immunology and immunotherapy', Reflections, *J. Biol. Chem.*, 278, p. 48507 (2003).

Kai Siegbahn



Date and place of birth: 20 April 1918, Lund, Sweden
Wife and children: Anna-Brita; Per, Hans and Nils
Appointment to the Academy: 14 Dec. 1985
Scientific discipline: Physics
Academic title: Professor at the University of Uppsala

Most important awards, prizes and academies Academies: Royal Swedish Academy of Science; Royal Swedish Academy of Engineering Sciences; Royal Society of Science; Royal Academy of Arts and Sciences of Uppsala; Royal Physiographical Society of Lund; Norwegian Academy of Science; Royal Norwegian Society of Sciences and Letters; National Academy of Sciences; Honorary Member of the American Academy of Arts and Sciences; Honorary Member of Societas Scientiarum Fennica; Comité International des Poids et Mesures, Paris; President of the International Union of Pure and Applied Physics, IUPAP (1981-84); Pontifical Academy of Sciences; European Academy of Arts, Sciences and Humanities; Academia Europaea; Member of the Board of the Ioffe Institute, St Petersburg (1999). Awards: The Lindblom Prize (1945); Björkén Prize (1955, 1977); Celsius Medal (1962); Sixten Heyman Award, University of Gothenburg (1971); Harrison Howe Award, Rochester (1973); Maurice F. Hasler Award, Cleveland (1975); Charles Frederick Chandler Medal, Columbia University, New York (1976); Torbern Bergman Medal (1979); Nobel Prize in Physics (1981); Pittsburgh Award of Spectroscopy (1982); Röntgen Medal (1985). Honorary Degrees: University of Durham (1972); University of Basel (1980); University of Liège (1980); Uppsala College, East Orange, NJ (1982); University of Sussex (1983); Université de la Méditerranée, Aix-Marseille (1998); St Petersburg State Technical University (1999); Honorary Professor at the University of Hefei, China (1991). Founder: International Journal of Nuclear Instruments and Methods in Physics Research and editor (1957-); International Centre for Physics at the University of Uppsala for Countries under Development (1961); University for Science in Nairobi (1966); Member of the Scientific Advisory Board and cofounder of the World Laboratory.

Summary of scientific research The main fields of research cover nuclear physics, atomic and molecular physics, electron spectroscopy and surface science. The early part of the production concerned nuclear physics, mainly α- β- and ϔ-ray spectroscopy of radioactive nuclei. This activity is summarized in the book with the same title. With this background the field of electron spectroscopy for atoms, molecules and condensed matter was developed, beginning during the early fifties. These researches gradually developed in various directions with applications in physics, chemistry and industrial technology, in particular related to surface technology. Photoelectron spectroscopy under the acronym ESCA (Electron Spectroscopy for Chemical Analysis) was described in two books, published in 1967 and 1969 with titles given above. This new spectroscopy can be applied to all states of aggregation of matter and yields detailed information on the atomic and molecular orbitals in chemical compounds in gases, solids or liquids. From a technological point of view, its high surface sensitivity is being utilized in fields like corrosion, surface reactions, catalysis, polymers and solid state electronics. The main emphasis from an instrumental point of view is in particular put on increased spectral resolution and intensity and extension of monochromatic x-ray and UV sources, complemented by synchrotron radiation.

Main publications *Beta- and Gamma-Ray Spectroscopy* (1955); *Alpha-, Beta- and Gamma-Ray Spectroscopy* (1965); *Atomic, Molecular and Solid State Structure Studied by Means of Electron Spectroscopy*, ESCA (Uppsala, 1967); *Applied to Free Molecular*, ESCA (Uppsala, 1969); 'Electron Spectroscopy for Chemical Analysis', *Phil. Trans. Roy. Soc. London A*, pp. 33-57 (1970); 'Perspectives and Problems in Electron Spectroscopy', *Proc. Asilomar Conference* (1971), (D.A. Shirley, ed.)(North Holland, 1972); 'Electron Spectroscopy – A New Way of Looking into Matter', *Endeavor*, 32 (1973); 'Electron Spectroscopy for Chemical Analysis', *Proc. of Conf. on Atomic Physics 3*, Boulder (1972), (S.J. Smith and G.K. Walters, eds.)(Plenum, 1973); 'Electron Spectroscopy for Chemical Analysis' (with Allan, C.J.), *MTP Int. Rev. of Science*, vol. 12, Analytical Chemistry, Part 1, Butterworths (1973); 'Electron Spectroscopy – An Outlook', *Proc. Namur Conference 1974* (Elsevier, 1974); 'Electron Spectroscopy and Molecular Structure', *Pure and Appl. Chem.*, 48, (Pergamon, 1976); 'Electron Spectroscopy for Solids, Surfaces, Liquids and Free Molecules', *Molecular Spectroscopy*, Ch. 15 (Heyden, 1977); 'Electron Spectroscopy for Atoms, Molecules and Condensed Matter', *Les Prix Nobel en 1981*, The Nobel Foundation (1982); *Some Current Problems in Electron Spectroscopy*

(Plenum, 1983); 'Photoelectron Spectroscopy: Retrospects and Prospects', UUIP-1136 (April 1985); 'Electron Spectroscopy for Atoms, Molecules and Condensed Matter – An Overview', *Journ. Electron Spectrosc.*, 36, p. 113 (1985); 'From X-Ray to Electron Spectroscopy and New Trend', *Journ. of Electron Spectroscopy*, 51 (1990); *Charged Particle Spectrometer. Encyclopedia of Physical Science and Technology*, Academic Press 1992 (Also editor of this encyclopedia); *High Resolution Electron Spectroscopy*, UPTEC 96 (1996); *A Study of High Resolution Valence Electron Spectroscopy by Means of Laser Excitation*, UPTEC 96 (1996); *A High Resolution and Large Trasmission Electron Spectrometer*, NIM (1997); *The Medical X-Ray Imaging Project at the ESCA-LASER laboratory*, UPTEC (1999); *Development of Laser Technology Applied to Electronic Structure of Matter in Symbiosis with Electron Spectroscopy*, UPTEC (2000); *Symmetry Analysis of the* ZnSe *(100)/Air Interface by Second Harmonic Generation*, UPTEC (March 2000); *Hyper-Rayleigh Scattering in Solution of Organic Nonlinear Optical Molecules and Measurement of the Hyperpolarisability*, UPTEC (March 2000); *Dot Pattern from Second Harmonic and Some Sum Frequency Generation in Polycrystallic* ZnSe. An extensive monography exists on: 'Electron Spectroscopy and Laser Spectroscopy for Analysis of Solids, Surface, Interfaces and Free Molecules'.

Maxine F. Singer

Date and place of birth: 15 February 1931, New York, NY, USA
Husband and children: Daniel M. Singer; Amy E., Ellen R., David B. and Stephanie F.
Appointment to the Academy: 9 June 1986
Scientific discipline: Biochemistry
Academic title: President Emerita of the Carnegie Institution of Washington

Most important awards, prizes and academies Awards: US Government Senior Executive Service Outstanding Performance Award; National Medal of Sciences (1992); Vanneva-Bush Award (1999); National Academy of Science, USA; American Academy of Arts and Sciences; Institute of Medicine, National Academy of Sciences; American Philosophical Society. Academies: American Society of Biological Chemists; American Association for the Advancement of Science; American Chemical Society; American Society of Microbiologists; American Society for Cell Biology; Pontifical Academy of Sciences. Honorary Degrees: Swarthmore College; Wesleyan University; Harvard University; Yale University.

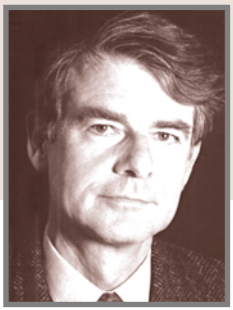
Summary of scientific research Maxine Singer received the Ph.D. degree in Biochemistry in 1957 from Yale University. Her interest in nucleic acids (DNA and RNA) began during her post-doctoral work in Leon Heppel's laboratory at the National Institute of Health. Until 1975, she was a Research Biochemist in the Institute of Arthritis and Metabolic Diseases, NIH. During that period she worked on the synthesis and structure of RNA and applied this experience to the work that elucidated the genetic code. She described and studied enzymes that degraded RNA in bacteria. By 1970 she became interested in animal viruses and took a sabbatical leave in the laboratory of Ernest Winocour (1971-1972) at the Weizmann Institute of Science, Israel. There she began work on aspects of simian virus 40. Moving to the National Cancer Institute in 1975, she continued this work studying defective SV40 viruses whose genomes contain regions of DNA from the host monkey cells. She also carried out investigations on interaction between histone H1 and DNA as it relates to the structure of chromatin. In the same year she served on the organizing committee for the Asilomar Meeting on Recombinant DNA molecules, the

first public discussion of the implication of these new methods. The work on defective SV40 led to an interest in highly repeated DNA sequences in primate, including human genomes. This led, in turn, to the discovery of a transposable element (jumping gene) in human DNA, the topic that was the subject of her most recent research. Looking back, Dr. Singer's scientific interests have evolved from an emphasis on chemistry to an increasing interest in biological phenomena. Her most recent research aimed to elucidate the mechanism whereby the human transposable element replicates and disperses copies to new genomic locations, a process which can be mutagenic. In 1988 she became President of the Carnegie Institution of Washington, retaining her laboratory and the title Scientist Emeritus at the NIH. At Carnegie she renewed her interest in the range of sciences investigated at the Institution's departments: earth science, astronomy, plant and development biology. She also initiated programs designed to improve scientific understanding by the general public including the training of elementary school teachers and a Saturday program for children – First Light. She became President Emerita in 2003. Dr. Singer served as chairman of the Editorial Board of the *Proceedings of the National Academy of Sciences of the USA*. Previously she served on the editorial boards of the *Journal of Biological Chemistry* and *Science* magazine. Dr. Singer was a fellow (trustee) of the Yale Corporation (1975-1990), is a member of the Governing Board of the Weizmann Institute of Science and was co-chairman of its Scientific and Academic Advisory Committee, and was a member of the Board of Johnson & Johnson. She is member of the Board of Perlegen Science, Inc., and chairman of the Board of the Whitehead Institute for Biomedical Research. In 1988, Dr. Singer received the Distinguished Presidential Rank Award, the highest honor given to a civil servant, and in 1992 she received the National Medal of Science, the nation's highest scientific honor bestowed by the President of the United States 'for her outstanding scientific accomplishments and her deep concern for the societal responsibility of the scientist'.

Main publications Singer, M.F., Jones, O.W. and Nirenberg, M.W., 'The effect of secondary structure on the template activity of polyribonucleotides', *Proc. Natl. Acad. Sci. USA*, 29, pp. 392-399 (1963); Leder, P., Singer, M.F. and Brimacombe, R.L.C., 'Synthesis of trinucleoside diphosphates with polynucleotide phosphorylase', *Biochemistry*, 4, pp. 1561-1567 (1965); Nossal, N.G. and Singer, M.F., 'The processive degradation of individual polyribonucleotide chains. I. Escherichia coli ribonuclease' II, *J. Biol. Chem.*, 243, pp. 913-922 (1968); Moses, R.E. and Singer, M.F., 'Polynucleotide phosphorylase of Micrococcus luteus. Studies on the polymerization reaction

catalyzed by primer-dependent and primer-independent enzymes', *J. Biol. Chem.*, 245, pp. 2414-2422 (1970); Singer, D.S. and Singer, M.F., 'Studies on the interaction of H1 histone with superhelical DNA; Characterization of the recognition and binding regions of H1 histone', *Nucleic Acids Res.*, 3, pp. 2531-2547 (1976); Rosenberg, H., Singer, M.F. and Rosenberg, M., 'Highly reiterated sequences of SIMIANSIMIANSIMIANSIMIANSIMIAN', *Science*, 200, pp. 394-402 (1978); Grimaldi, G. and Singer, M.F., 'A monkey Alu-sequence is flanked by 13 base pair direct repeats of an interrupted α-satellite DNA sequence', *Proc. Natl. Acad. Sci. USA*, 79, pp. 1497-1500 (1982); Skowronski, J. and Singer, M.F., 'Expression of a cytoplasmic LINE-1 transcript is regulated in a human teratocarcinoma cell line', *Proc. Natl. Acad. Sci. USA*, 82, pp. 6050-6054 (1985); Skowronski, J., Fanning, T.G. and Singer, M.F., 'Unit length LINE-1 transcripts in human teratocarcinoma cells', *Mol. Cell. Biol.*, 8, pp. 1385-1397 (1988); Singer, M.F. and Berg, P., *Genes and Genomes*, University Science Books (1990); Singer, M.F. and Berg, P., *Dealing with Genes: The Language of Heredity*, University Science Books (1992); Hohjoh, H. and Singer, M.F., 'Sequence specific single-strand RNA-binding protein encoded by the human LINE-1retrotransposon', *EMBO J.*, 16, pp. 6034-6043 (1997); Clements, A.P. and Singer, M.F., 'The human LINE-1 reverse transcriptase: Effects of deletions ouside the common reverse transcriptase domain', *Nucleic Acids Research*, 26, pp. 3528-3535 (1998).

Wolf Joachim Singer



Date and place of birth: 9 March 1943, Munich, Germany
Wife and children: Francine; Nathalie and Tania
Appointment to the Academy: 18 Sept. 1992
Scientific discipline: Neurobiology
Academic title: Professor at the Max-Planck-Institute for Brain Research

Most important awards, prizes and academies Awards: Prize of the IPSEN Foundation (1991); Ernst Jung Prize for Science and Research (1994); Zülch Prize (1994); Hessischer Kulturpreis (1998); Körber Prize for European Sciences (2000); Max Planck Prize for Public Science (2001); La Medaille de la Ville de Paris (2002); Chevalier de la Légion d'Honneur (2002); Ernst Hellmut Vits-Prize (2002); Krieg Cortical Discoverer Award of the Cajal Club (2003); Betty und David Koetser Prize (2002); Communicator Prize (2003); Hans-Berger-Prize (2003). Academies: Academia Europaea (1989); Pontifical Academy of Sciences (1992); Berlin-Brandenburgische Academy of Sciences (1993); Scientific Academy of the Johann Wolfgang Goethe-University Frankfurt (1993); Bavarian Academy of Sciences (1996); Academia Scientiarum et Artium Europaea (1997); Leopoldina (1999); Member of Collegium Europaeum Jenense, Jena (2002).

Summary of scientific research Initially Prof. Wolf Singer's research concentrated on the physiology of thalamic transmission (summarized in *Phys. Rev.*, 1977). Subsequently it turned towards studies of the development and the functional organization of the cerebral cortex using the visual system as a model. This led to a number of discoveries concerning mechanisms of experience-dependent development and synaptic plasticity (summarized in *J. Exp. Biol.*, 1990, and *Science*, 1995). A new line of research began with the discovery that neurons of the neocortex synchronize their responses within and across cortical areas. This finding has been interpreted as support for the hypothesis that the brain might use synchronization of discharges as a mechanism in order to select neuronal responses and to bind them together into functionally coherent assemblies for joint interpretation. Since then numerous experiments have been performed to test the predictions derived from this hypothesis (reviewed in

Singer 1993, Singer and Gray 1995, Singer, Neuron 1999). This work could turn out to be important because its results could provide a solution for the binding problem and hence for a whole class of hitherto unresolved problems in sensory and motor processing. The results support Donald Hebb's postulate that representations of features or constellations of features such as characterize perceptual objects do not solely consist of the responses of individual, highly specialized neurons but in addition of the synchronized responses of assemblies of cooperatively interacting neurons. If true, this could change our view of the nature of representations and engrams. It was also observed that the occurrence of synchronization is frequently associated with an oscillatory patterning of neuronal responses. This established new links between measurements of oscillatory brain activity in humans and micro-electrode investigations in animals. It also stimulated the search for oscillatory phenomena in general and led to numerous discoveries of oscillatory activity in a wide variety of brain structures of different species. The new approach to search for temporal relations among distributed neuronal responses rather than merely their amplitude revealed that cortical and subcortical networks exhibit surprisingly complex dynamics. It encouraged theoreticians in the field of neuronal computation to apply the methods of non-linear dynamics for the analysis of artificial networks and led to experimentation with models which use this putative coding strategy to resolve problems of pattern recognition.

Main publications Singer, W., 'Control of thalamic transmission by cortico-fugal and ascending reticular pathways in the visual system', *Physiol. Rev.*, 57, pp. 386-420 (1977); Rauschecker, J.P. and Singer, W., 'Changes in the circuitry of the kitten visual cortex are gated by postsynaptic activity', *Nature*, 280, pp. 58-60 (1979); Kleinschmidt, A., Bear, M.F. and Singer, W., 'Blockade of NMDA receptors disrupts experience-dependent plasticity of kitten striate cortex', *Science*, 238, pp. 355-358 (1987); Gray, C.M. and Singer, W., 'Stimulus-specific neuronal oscillations in orientation columns of cat visual cortex', *Proc. Natl. Acad. Sci.*, 86, pp. 1698-1702 (1989); Gray, C.M., König, P., Engel, A.K. and Singer, W., 'Oscillatory responses in cat visual cortex exhibit inter-columnar synchronization which reflects global stimulus properties', *Nature*, 338, pp. 334-337 (1989); Singer, W., 'The formation of cooperative cell assemblies in the visual cortex', *J. Exp. Biol.*, 155, pp. 177-197 (1990); Singer, W., 'Search for coherence: a basic principle of cortical self-organization', *Concepts Neurosci.*, 1, pp. 1-26 (1990); Singer, W., 'Synchronization of cortical activity and its putative role in information processing and learning', *Annu. Rev. Physiol.*, 55, pp. 349-374 (1993); Singer, W. and Gray, C.M.,

'Visual feature integration and the temporal correlation hypothesis', *Annu. Rev. Neurosci.*, 18, pp. 555-586 (1995); Singer, W., 'Development and plasticity of cortical processing architectures', *Science*, 270, pp. 758-764 (1995); Neuenschwander, S. and Singer, W., 'Long-range synchronization of oscillatory light responses in the cat retina and lateral geniculate nucleus', *Nature*, 379, pp. 728-733 (1996); Munk, M.H.J., Roelfsema, P.R., König, P., Engel, A.K. and Singer, W., 'Role of reticular activation in the modulation of intracortical synchronization', *Science*, 272, pp. 271-274 (1996); Fries, P., Roelfsema, P.R., Engel, A.K., König, P. and Singer, W., 'Synchronization of oscillatory responses in visual cortex correlates with perception in interocular rivalry', *Proc. Natl. Acad. Sci. USA*, 94, pp. 12699-12704 (1997); Singer, W., 'Neuronal synchrony: a versatile code for the definition of relations?', *Neuron*, 24, pp. 49-65 (1999); Castelo-Branco, M., Goebel R., Neuenschwander S. and Singer, W., 'Neural synchrony correlates with surface segregation rules', *Nature*, 405, pp. 685-689 (2000); Engel, A.K. and Singer, W., 'Temporal binding and the neural correlates of sensory awareness', *Trends in Cognitive Sciences*, 5 (1), pp. 16-25 (2001); Fries, P., Neuenschwander, S., Engel, A.K., Goebel, R. and Singer, W., 'Rapid feature selective neuronal synchronization through correlated latency shifting', *Nature Neuroscience*, 4 (2), pp. 194-200 (2001); Singer, W., 'Consciousness and the binding problem. Marijuán, P.C. Cajal and Consciousness: Scientific Approaches to Consciousness on the Centennial of Ramón y Cajal's Textura', *Annals of the New York Academy of Sciences New York*, 929, pp. 123-146 (2001); Dierks, T., Linden, D.E.J., Jandl, M., Formisano, E., Goebel, R., Lanfermann, H. and Singer, W., 'Activation of Heschl's gyrus during auditory hallucinations', *Neuron*, 22, pp. 615-621 (1999); Singer, W., 'Phenomenal awareness and consciousness from a neurobiological perspective', *Neural Correlates of Consciousness*, (T. Metzinger, ed.), Cambridge, MA, MIT Press, pp. 121-137 (2000); Fries, P., Schröder, J.-H., Roelfsema, P.R., Singer, W. and Engel, A.K., 'Oscillatory neuronal synchronization in primary visual cortex as a correlate of stimulus selection', *J. Neurosci.*, 22, pp. 3739-3754 (2002); Singer, W., 'Synchrony, oscillations, and relational codes', *The Visual Neurosciences*, vol. 2, (L.M. Chalupa and J.S. Werner, eds.), Cambridge, MA, MIT Press, pp. 1665-1668 (2004); Brecht, M., Singer, W. and Engel, A.K., Amplitude and direction of saccadic eye movements depend on the synchronicity of collicular population activity', *J. Neurophysiol.* (in press, 2004).

(Thomas) Richard Edmund Southwood

Date and place of birth: 20 June 1931, Northfleet, Kent, United Kingdom
Wife and children: Alison Langley; Richard Mark Langley, Charles William Langley
Appointment to the Academy: 18 Sept. 1992
Scientific discipline: Zoology
Academic title: Emeritus Professor and Formerly Vice-Chancellor of the University of Oxford

Most important awards, prizes and academies Awards: Scientific Medal; Zoological Society London (1969); Gold Medal, Linnean Society (1988); Croonian Lecturer, Royal Society (1995). Academies: Royal Society (1977); American Academy of Arts and Sciences (1981); Norwegian Academy of Science and Letters (1987); US National Academy of Sciences (1988); Academia Europaea (1989); Pontifical Academy of Sciences (1992); Royal Netherlands Academy of Arts and Sciences (1995); Hungarian Academy of Sciences (1998); Academy of Medical Sciences (1998). Hon. Fellowships: (Royal medical colleges) Physicians (1991); Radiologists (1996). Hon. Degrees (13): UK (1984, 1994); Australia (1983); Sweden (1986); Canada (1988, 1994). Civil Honours: Knight Batchelor, UK (1984); Cavaliere Ufficiale, Order of Merit, Italy (1991); Orden de Merito (II), Portugal (1993); Deputy Lieutenant, Oxfordshire, UK (1993).

Summary of scientific research The main scientific work of Prof. Southwood falls into two related areas: firstly ecology with a strong bias to entomology and secondly environmental sciences and policy. At the International Congress of Entomology in Vienna in 1960 he presented two papers that outlined new general concepts. One demonstrated that migration (and active dispersal) in insects was associated with the occupancy of temporary habitats; it was an evolved adaptation to the changing geographical position of the breeding site and not primarily a mechanism for reducing overcrowding. The underlying analysis was an early example of the comparative method and published in *Biological Reviews* in 1962. Subsequently these ideas on the role of habitat characteristics on the evolution of life history strategies were further developed in a series of comparative and analytical studies culminating in the 1977 paper, his Presidential address to the

British Ecological Society, 'Habitat, the templet for ecological strategies?', now a citation classic. The general concept propounded there, that suites of life history categories may be related to habitat characters described on two axes, disturbance and productivity (or its converse adversity), has now been applied to a wide range of animal and plant groups. Within this field with colleagues he developed a synoptic model of population dynamics, demonstrating the relative roles of different factors under different conditions, which gave guidance on the strategies for pest control. The second 1960 paper addressed the question of the differing number of species of insects living on different species of trees; he proposed that this was a reflection of the extent, in space and time, of the exposure of the tree pool of potential colonists, drawing a parallel with the development in insects of resistance to insecticides. This theory was substantiated by comparative studies on the entomofauna of trees in many countries including Hawaii, Britain and Russia. It was a particular case and forerunner of the now well established island biogeography theory. This strand of work was taken forward in a number of conceptual and field studies. In 1972 he drew attention to the evolutionary hurdles (obstacles) to the herbivory in insects: nutritional, attachment, desiccation and discovery. Much of his field work has been on insects and birds of farmlands (disturbed habitats) and woodlands. In the early 1960s he showed how modern agricultural methods, by reducing the numbers of weeds in cereal fields and hence the populations of insects, was causing a fall in the survival of young partridges and hence a decline in their population. Much detailed work undertaken by others has confirmed this hypothesis and has led to changes in agricultural practice. A substantial study undertaken in 1977-79 involved the census and identification of all macroscopic organisms on three stages in a secondary succession; this work provided a test of templet and successional theories. Working in the field in a variety of situations and through his teaching he compiled and developed an overview of 'Ecological Methods', published in a book of that title in 1966 which is widely used and remains in print. Through his work in agricultural ecology, Prof. Southwood became involved in what may be broadly described as environmental issues and his publications in this area commenced in 1963 and cover topics such as pesticide use, pollution, energy use, radiation, climate change and sustainable development. As an advisor to the UK Government he has played a role in the development of policies on many issues including lead in petrol, acid rain and power station emissions, radiation safety and waste disposal.

Main publications Southwood, R.E., *Ecological Methods*, London: Methuen, 1966, pp. 392; 2nd edn., 1978; 3rd edn. (with Henderson, P.A.), 2000; Southwood, R.E., *Insects on Plants* (with Strong, D.R. and Lawton, J.H.), Oxford: Blackwell Scientific Publications, 1984, pp. 313; Southwood, R.E., 'Species richness and resource availability: A phylogenetic analysis of insects associated with trees' (with Kelly, C.K.), *Proc. Natl. Acad. Sci. USA*, 96, pp. 8013-8016 (1999); Southwood, R.E., 'National communities: structure and dynamics. The Croonian Lecture 1995', *Phil. Trans. R. Soc. Lond. B.*, 351, pp. 1113-1129 (1996); Southwood, R.E., 'Insect-plant relations: overview from the symposium', *Entomologia Experimentalis et Applicata*, 80, pp. 320-324 (1996); Southwood, R.E., 'Ecological Processes and Sustainability', *Int. J. Sustain. Dev. World Ecol.*, 2, pp. 229-239 (1995); Southwood, R.E., 'Risks from radiation: perception and reality. The 1993 Crookshank Lecture of the Royal College of Radiologists', *Clinical Oncology*, 5, pp. 302-308 (1993); Southwood, R.E., 'The Environment: problems and prospects', *Monitoring the Environment*, (B. Cartledge, ed.), pp. 5-41, Oxford: Oxford University Press (1992); Southwood, R.E., 'Surface Waters Acidification Programme: Management Group final report', *Sci. Publ. Affairs*, 5, pp. 74-95 (1990); Southwood, R.E., 'Tactics, strategies and templets', *Oikos*, 52, pp. 3-18 (1988); Southwood, T.R.E., *The Story of Life*, Oxford University Press (2003), pp. xiii+264; Kerr, J.T., Southwood, T.R.E. and Cihlar, J., 'Remotely sensed habitat diversity predicts butterfly species richness and community similarity in Canada', *Proc. Natl. Acad. Sci. USA*, 98, pp. 11365-11370 (2001); Sugihara, G., Bersier, L.-F., Southwood, T.R.E., Pimm, S.L. and May, R.M., 'Predicted correspondence between species abundances and dendrograms of niche similarities', *Proc. Natl. Acad. Sci USA*, 100, pp. 5246-5251 (2003); Southwood, T.R.E., Henderson, P.A. and Woiwod, I.P., 'Stability and change over 67 years – the community of Heteroptera as caught in a light-trap at Rothamsted, UK', *Eur. J. Entomol.*, 100, pp. 557-561 (2003).

Andrzej Szczeklik

Date and place of birth: 29 July 1938, Cracow, Poland
Wife and children: Maria; Michael, Wojciech, Anna
Appointment to the Academy: 16 Oct. 1994
Scientific discipline: Medicine
Academic title: Professor at the Jagiellonian University School of Medicine, Cracow

Most important awards, prizes and academies Awards: Sniadecki Award of the Polish Academy of Sciences (1974); G. Sadoul Award of the European Respiratory Society (1990); Gloria Medicinae Award of the Polish Medical Society (1995); First Prize of *The Lancet* for the paper on genetic polymorphism of leukotriene C4 synthase (1997); First Award of the Polish Science Foundation (1998); a medallion and stand for the Robert Cook Memorial Lectureship, American Academy of Allergy and Immunology (1980). Academies: Polish Academy of Arts and Sciences (1990); Pontificia Academia Scientiarum (1994); Polish Academy of Sciences (1995); Royal College of Physicians, London (1998). Honorary Degrees: University Schools of Medicine, Wrocław (1999); Warsaw (2001); Katowice (2002) and Łódz (2003).

Summary of scientific research Szczeklik's main contributions are in the field of cardio-pulmonary diseases. His early work led to the formation of the hypothesis explaining the mechanism of aspirin-induced asthma, a relatively common clinical syndrome affecting 10% of adult asthmatics. The hypothesis, proved true in the following years, states that aspirin and several other nonsteroidal anti-inflammatory drugs precipitate attacks of asthma in sensitive patients by inhibiting cyclooxygenase (COX-1), the key enzyme in the metabolism of eicosanoids, substances produced from arachidonic acid by most of the cells of our bodies. He then demonstrated a profound overexpression of leukotriene C4 synthase in bronchi of patients with aspirin-induced asthma, and discovered genetic polymorphism of this enzyme, associated with severe type of the disease. This work, awarded first prize by *The Lancet*, stimulated research on the involvement of eicosanoids in pulmonary diseases, and led to the establishment of the European Network on Aspirin-Induced Asthma, which combines 25 university departments from 14 coun-

tries, with Cracow serving as a coordinating center. Interestingly, his recent research unveiled alterations in arachidonic acid metabolism which are common to asthma and urticaria. In 1977 A. Szczeklik injected prostacyclin into himself and his colleagues, a newly discovered local hormone produced by the lining of our blood vessels. He described the powerful actions of prostacyclin in man (vasadilatation, inhibition of blood clotting) and introduced it into the therapy of vascular disorders. Today, analogs of prostacyclin and its close congeners are routinely used for the treatment of peripheral vascular disease, inflammatory diseases of arteries and primary pulmonary hypertension. His most recent research resulted in the discovery of a novel action of aspirin: it inhibits the generation of thrombin in clotting blood. The dampening of the powerful blood clotting mechanism by aspirin may explain, partially at least, its beneficial prophylactic and therapeutic effects in ischemic heart disease and stroke. Interestingly, this action of aspirin is blunted in hypercholesterolemia and also in a common genetic polymorphism of blood platelet glycoproteins. Thus, subjects with high blood cholesterol or the genetic variant of platelets might profit less than others from the antithrombotic effect of the drug. These studies led to a development of a new sensitive model for studying thrombin generation in vivo, demonstration that statins, powerful blood cholesterol lowering drugs, depress the specific reactions of the blood clotting mechanism.

Main publications Szczeklik, A., Gryglewski, R.J., Czerniawska-Mysik, G., 'Relationship of inhibition of prostaglandin biosynthesis by analgesics to asthma attacks in aspirin-sensitive patients', *Br. Med. J.*, 11, 1, pp. 67-69 (1975); Szczeklik, A., Gryglewski, R.J., Czerniawska-Mysik, G., 'Clinical patterns of hypersensitivity to nonsteroidal anti-inflammatory drugs and their pathogenesis', *J. Allergy Clin. Immunol.*, 60, pp. 276-284 (1977); Szczeklik, A., Niżankowski, R., Skawinski, S., Szczeklik, J., Głuszko, P., Gryglewski, R.J., 'Successful therapy of advanced arteriosclerosis obliterans with prostacyclin', *Lancet*, 26, pp. 1111-1114 (1979); Szczeklik, A., Sładek, K., Szczerba, A., Dropinski, J., 'Serum immunoglobulin E response to myocardial infarction', *Circulation*, 77, pp. 1245-1249 (1988); Szczeklik, A., Krzanowski, M., Góra, P., Radwan, J., 'Antiplatelet drugs and generation of thrombin in clotting blood', *Blood*, 80, pp. 2006-2011 (1992); Szczeklik, A., Musiał, J., Undas, A., Swadzba, J., Góra, P., Piwowarska, W., Duplaga, M., 'Inhibition of thrombin generation by aspirin is blunted in hypercholesterolemia', *Arterioscl. Thromb. Vasc. Biol.*, 16, pp. 948-954 (1996); Sanak, M., Simon, H.U., Szczeklik, A., 'Leukotriene C4 synthase promoter polymor-

phism and risk of aspirin-induced asthma', *Lancet*, 350, pp. 1599-1600 (1997); Szczeklik, A., Gryglewski, R.J., Vane, J.R., (eds.), *Eicosanoids, aspirin and asthma*, Marcel Dekker, Inc., New York-Basel-Hong Kong (1988); Cowburn, A.S., Sładek, K., Soja J., Adamek, Ł., Niżankowska, E., Szczeklik, A., Lam, B.K., Penrose, J.F., Austen, F., Holgate, S.T., Sampson, A.P., 'Over-expression of leukotriene C4 synthase in bronchial biopsies from patients with aspirin-intolerant asthma', *J. Clin. Invest.*, 101, pp. 834-846 (1998); Undas, A., Brummel, K., Musiał, J., Mann, K.G., Szczeklik, A., 'PlA(2) polymorphism of beta(3) integrins is associated with enhanced thrombin generation and impaired antithrombotic action of aspirin at the site of microvascular injury', *Circulation*, 27, 104, pp. 2666-2672 (2001); Szczeklik, A., Musiał, J., Undas, A., 'Reasons for resistance to aspirin in cardiovascular disease', *Circulation*, 106, e181-182 (2002); Undas, A., Sydor, W.J., Brummel, K., Musiał, J., Mann, K.G., Szczeklik, A., 'Aspirin alters the cardioprotective effects of the factor XIII Val34Leu polymorphism', *Circulation*, 107, pp. 17-20 (2003); Bochenek, G., Nagraba, K., Niżankowska, E., Szczeklik, A., 'A controlled study of 9alpha,11beta-PGF2 (a prostaglandin D2 metabolite) in plasma and urine of patients with bronchial asthma and healthy controls after aspirin challenge', *J. Allergy Clin. Immunol.*, 111, pp. 743-749 (2003); Szczeklik, A., Stevenson, D.D., 'Aspirin-induced asthma: advances in pathogenesis, diagnosis, and management', *J. Allergy Clin. Immunol.*, 111, pp. 913-921 (2003); Szczeklik, A., Sanak, M., Niżankowska-Mogilnicka, E., Kiełbasa, B., 'Aspirin intolerance and the cyclooxygenase-leukotriene pathways', *Curr. Opin. Pulm. Med.*, 10, pp. 51-56 (2004).

Walter E. Thirring

Date and place of birth: 29 April 1927, Vienna, Austria
Wife and children: Helga; Klaus and Peter
Appointment to the Academy: 9 June 1986
Scientific discipline: Theoretical physics
Academic title: Professor at the University of Vienna

Most important awards, prizes and academies Awards: Max-Planck Medal; Eötvös Medal (1969); Schrödinger Prize of the ÖAW; Prize of the City of Vienna; Henri Poincaré Prize 2000 of the IAMP. Academies: Effective Member, Austrian Academy of Science (1973-); Honorary Member, Eötvös Physics Society; Leopoldina, DDR-Academy of Sciences (1975); Pontifical Academy of Sciences (1986); Honorary Member, Hungarian Academy of Sciences. Honorary Degrees: Comenius University.

Summary of scientific research In my scientific activity I have tried to achieve in the various branches of theoretical physics both intuitive simplicity and mathematical rigor. Although this goal cannot be reached everywhere there are instances where some non-trivial general principles can be deduced from fundamental laws. This applies in particular to our work (with E. Lieb) on the stability of matter and my studies on the thermodynamic behaviour of gravitating systems. I was also fascinated by the geometrical aspects of Einstein's theory of gravity and wanted to find out why and how it is that just this force determines the geometrical structure of the world. One can actually understand that it is the universal nature of gravity which causes its influence on geometry. However, the instances where a more general understanding can be achieved are rare in the life of a scientist and most of it is struggle with details which appear to be not so important once a full understanding is gained.

Main publications Thirring, W.E., 'On the Divergence of Perturbation Theory for Quantized Fields', *Helv. Phys. Acta*, 26, p. 33 (1953); Thirring, W.E., 'Zur freien Weglänge von Neutrinos' (with Houtermans, F.G.), *Helv. Phys. Acta*, 27, p. 81 (1954); Thirring, W.E., 'Use of Causality Conditions in Quantum Theory' (with Gell-Mann, M. and Goldberger, M.), *Phys. Rev.*, 95, p. 1612 (1954); Abstract *ibid*. p. 654; Thirring, W.E., 'A Soluble Relativistic

Field Theory', *Ann. of Phys.*, 3, p. 91 (1958); Thirring, W.E., 'Lorentz-invariante Gravitationstheorien', *Fortschritte d. Physik, Bd.*, (VII) 2, p. 79 (1959); Thirring, W.E., 'Three-Field Theory of Strong Interactions', *Nucl. Phys.*, 14, p. 565 (1959/60); Thirring, W.E., 'Triplet Model of Elementary Particles', *Acta Phys.*, Suppl. III (1966); Thirring, W.E., 'On the Mathematical Structure of the BCS-Model' (with Wehrl, A.), *Commun. Math. Phys.*, 4, p. 303 (1967); Thirring, W.E., 'Systems with Negative Specific Heat', *Z. f. Phys.*, 235, p. 339 (1970); Thirring, W.E., 'Bound for the Kinetic Energy of Fermions Which Proves the Stability of Matter' (with Lieb, E.H.), *Phys. Rev. Lett.*, 35, p. 687 (1975). Books: A Course in Mathematical Physics: vol. 1, *Classical Dynamical Systems*, Springer (New York, Wien, 1978); vol. 2, *Classical Field Theory*, Springer (New York, Wien, 1979, 1986); vol. 3, *Quantum Mechanics of Atoms and Molecules*, Springer (New York, Wien, 1981); vol. 4, *Quantum Mechanics of Large Systems*, Springer (New York, Wien, 1983); *On Science and Religion, Kosmische Impressionen. Gottes Spuren in den Naturgesetzen*, Molden (Wien, 2004).

Charles Hard Townes

Date and place of birth: 28 July 1915, Greenville, SC, USA
Wife and children: Frances; Linda, Ellen, Carla, Holly
Appointment to the Academy: 26 Jan. 1983
Scientific discipline: Physics
Academic title: Professor at the University of California

Most important awards, prizes and academies Awards: Nobel Prize in Physics (1964); Comstock Prize; John J. Carty Medal of the National Academy of Sciences; Rumford Premium of the American Academy of Arts and Sciences; Thomas Young Medal and Prize of the British Physical Society; Medal of Honor of the Institute of Electrical and Electronic Engineers; Mees Medal and Ives Medal of the Optical Society of America; Niels Bohr International Gold Medal; Plyler Prize of the American Physical Society; 2000 Founders' Award of the Nat. Academy of Engineering; Lomonosov Prize of the Russian Academy of Sciences (2001); William Exner Award of Austria; Rabindranath Tagore Birth Centenary; Plaque of the Asiatic Society; Karl Schwarzschild Medal of the Astronomische Gesellschaft. Academies: National Inventors' Hall of Fame of the USA; National Academy of Sciences; Fellow, Institute for Electrical and Electronic Engineers, American Physical Society; Pontifical Academy of Sciences. Foreign Member: Royal Society of London; American Philosophical Society; American Academy of Arts and Sciences. Honorary Member: Optical Society of America; Indian National Science Academy; Russian Academy of Sciences.

Summary of scientific research Townes' principal scientific work has been in microwave spectroscopy, molecular and nuclear structure, quantum electronics, radio astronomy, and infrared astronomy. He was one of the initiators of high resolution microwave spectroscopy and its use in detailed examination of molecular structure and nuclear moments. He and B.P. Dailey developed an explanation of molecular hyperfine effects which allows evaluation of molecular bonding structures and of nuclear quadrupole moments. This in turn led to a systematic study of nuclear quadrupole moments and their dependence on nuclear structure. Townes initiated the field of quantum electronics, building the first maser at Columbia University. He has the fundamental patent

on masers and, with A.L. Schawlow, the basic patent on lasers. This led to work on precise time and distance measurements. His subsequent work in this field included various aspects of non-linear optics, Raman scattering and self-trapping, and the use of lasers for scientific experimentation. Townes' work in radio astronomy was begun in the mid 40s with a theory of free-free emission, included the first application of maser amplifiers to radio astronomy in the 1950s, and the first discovery of complex molecules in interstellar space in the late 1960s. During the following decade, he continued active work on molecular astronomy and the interstellar medium. Since the late 1970s Townes has been occupied primarily with infrared astronomy. Much of this work has involved the invention and construction of sensitive infrared instruments both for very high spectral resolution and for high angular resolution. He has done extensive work on the interstellar medium, dense molecular clouds, and the galactic center. He is presently engaged in observing stars with a mid-infrared spatial interferometer. This instrument has located the formation of dust around stars, discovered that episodic emission of material by stars is common, provided accurate measurements of sizes of older stars, and measured the periodic expansion and contraction of Mira-type stars.

Main publications Townes, C.H., 'The Ammonia Spectrum and Line Shapes Near 1.25 cm Wave-Length', *Phys. Rev.*, 70, p. 665 (1946); Townes, C.H., 'Interpretation of Radio Radiation from the Milky Way', *Astrophys. J.*, 105, p. 235 (1946); Townes, C.H. *et al.*, 'Determination of Electronic Structure of Molecules from Nuclear Quadrupole Effects', *J. Chem. Phys.*, 17, p. 782 (1949); Townes, C.H. *et al.*, 'Nuclear Quadrupole Moments and Nuclear Shell Structure', Phys. Rev., 76, p. 1415 (1949); Townes, C.H. *et al.*, 'The Effects of Electronic Paramagnetism on Nucler Magnetic Resonance Frequencies in Metals', Phys. Rev., 77, p. 852 (1950); Townes, C.H. *et al.*, 'The Maser: New Type of Microwave Amplifier, Frequency Standard, and Spectrometer', Phys. Rev., 99, p. 1264 (1955); Townes, C.H., *Microwave Spectroscopy*, McGraw-Hill (New York, 1955); Townes, C.H. *et al.*, 'Fluctuations in Amplification of Quanta with Application to Amplifiers', *J. Phys. Soc. Japan*, 12, p. 686 (1957); also p. 517 *Collection of Papers Dedicated to Masao Kotani* (Tokyo, 1967); Townes, C.H. *et al.*, 'Infrared and Optical Masers', *Phys. Rev.*, 112, p. 1940 (1958); Townes, C.H. *et al.*, 'Limits on Electromagnetic Amplification Due to Complementarity', p. 233, *Quantum Electronics*, (C.H. Townes, ed.), Columbia Univ. Press (1960); Townes, C.H. *et al.*, 'Coherently Driven Molecular Vibrations and Light Modulation', *Phys. Rev. Letters*, 11, p. 160 (1963); Townes, C.H. *et al.*, 'Simulated Brillouin Scattering and Coherent

Generation of Intense Waves', *Phys. Rev. Letters*, 12, p. 592 (1964); Townes, C.H. *et al.*, 'Detection of NH_3 Molecules in the Interstellar Medium by Their Microwave Emission', *Phys. Rev. Letters*, 21, p. 1701 (1968); Townes, C.H. *et al.*, 'Detection of Water in Interstellar Regions by Its Microwave Radiation', *Nature*, 221, p. 626 (1969); Townes, C.H. *et al.*, 'Observations of the Motion and Distribution of the Ionized Gas in the Central Parsec of the Galaxy', *Ap. J. Lett.*, 227 (1979); Townes, C.H. *et al.*, 'New Evidence on the Mass Distribution in the Galactic Center', *Nature*, 315, p. 767 (1985); Townes, C.H. *et al.*, 'The Nucleus of our Galaxy', *Rep. Prog. Phys.*, 57, p. 417 (1994); Townes, C.H. *et al.*, 'Characteristics of Dust Shells around 13 Late-Type Stars', *Astrom. J.*, 107, 4, p. 1469 (1994); Townes, C.H. *et al.*, 'Non-uniform dust outflow observed around infrared object NML Cygni', *Ap. J.*, 48, p. 420 (1997); Townes, C.H. *et al.*, 'Logic and Uncertainties in Science and Religion', *Scripta Varia*, 99 (Vatican City, 2001), pp. 296-309; Townes, C.H., 'The Berkeley Infrared Spatial Interferometer: A Heterodyne Stellar Interferometer for the Mid-Infrared', *Ap. J.*, 537, pp. 998-1012 (2000); Townes, C.H., 'Interferometry on Mira in the Mid-Infrared: Cyclic Variability of the Continuum Diameter and the Effect of Spectral Lines on Apparent Size', *Ap. J.*, 588, pp. 1064-1071 (2003).

Hans Tuppy

Date and place of birth: 22 July 1924, Vienna, Austria
Wife and children: Erika; Eva, Christine, Claudia
Appointment to the Academy: 10 April 1970
Scientific discipline: Biochemistry
Academic title: Emeritus Professor at the University of Vienna

Most important awards, prizes and academies Academies: Deutsche Akademie der Naturforscher 'Leopoldina'; Österreichische Akademie der Wissenschaften; Pontifical Academy of Sciences. Honorary Degrees: University of Veterinary Medicine and the University of Agriculture, Vienna; Österreichisches Ehrenzeichen für Wissenschaft und Kunst.

Summary of scientific research Investigations on the structure and function of biologically and biomedically important peptides and proteins (insulin, relaxin, oxytocin, cytochrome, interferon), mitochondria, blood-group antigens of the ABO and Lewis systems, and neuraminic acid derivatives.

Main publications Sanger, F. and Tuppy, H., 'The Amino-acid Sequence in the Phenylalanyl Chain of Insulin', *Biochem. J.*, 49, pp. 463-481 (1951); Tuppy, H., 'The Amino-acid Sequence in Oxytocin', *Biochem. Biophys. Acta*, 11, p. 449 (1953); Tuppy, H. and Wintersberger, E., 'Reinigung und Eigenschaften der Serum-Oxytocinase', *Monatshefte f. Chemie*, 91, p. 1001 (1960); Margoliash, E., Smith, E.L., Kreil, G. and Tuppy, H., 'The Complete Amino-acid Sequence of the Horse Heart Cytochrome C', *Nature*, 192, p. 1125 (1961); Schatz, G., Haslbrunner, E. and Tuppy, H., 'Deoxyribonucleic Acid Associated with Yeast Mitocondria', *Biochem. Biophys. Res. Comm.*, 15, p. 127 (1964); Wintersberger, E. and Tuppy, H., 'DNA-Abhängige RNA-Synthese in isolierten Hefe-Mitochondrien', *Biochem. Z.*, 341, p. 399 (1965); Meindl, P. and Tuppy, H., 'Über 2-Deoxy-2, 3-Dehydrosialinsäuren', *Monatshefte f. Chemie*, 100, p. 1295 (1969), *Z. Physiol. Chem.*, 350, p. 1088 (1969); Schenkel-Brunner, H. and Tuppy, H., 'Enzymatic Conversion of Human O into A Erythrocytes and of B into AB Erythrocytes', *Nature*, 233, p. 1272 (1969); Meindl, P., Bodo, G., Palese, P., Shulman, J. and Tuppy, H., 'Inhibition of Neuraminidase Activity by Derivatives of 2-deoxy-2, 3-dehy-

dro-N-acetylneuraminic Acid', *Virology*, 58, p. 457 (1974); Meindl, P., Bono, G. and Tuppy, H., 'Synthetische niedermolekulare Induktoren von Interferon', *Arzneimittelforschung*, 26, p. 303 (1976); Prohaska, R., Schenkel-Brunner, H. and Tuppy, H., 'Enzymatic Synthesis of Blood-group Lewis-Specific Glycolipids', *Eur. J. Biochem.*, 84, p. 161 (1978).

Rafael Vicuña

Date and place of birth: 12 September 1949, Santiago, Chile
Wife and children: María Isabel Undurraga; Isabel, Rafael, Angélica, Magdalena, Tomás, Sofía, Fernanda
Appointment to the Academy: 11 Oct. 2000
Scientific discipline: Biochemistry, Molecular Biology
Academic title: Professor at the Pontificia Universidad Católica de Chile

Most important awards, prizes and academies Honours: Fulbright Foundation, travel fellowship (1974, 1978); Albert Einstein College of Medicine, NY, fellowship for Ph.D. studies (1974-78); International Union of Biochemistry, travel fellowship (1979); John Simon Guggenheim Memorial Foundation fellowship (1986); officially invited by the Chinese Government (mainland) to visit academic institutions (1989); officially invited by the DFG to visit academic institutions in Germany (1998). Academies: Chilean Society of Biology (1973); Chilean Society of Biochemistry and Molecular Biology (1973, President 1997-99); American Society for Microbiology (1974); Association for Politics and the Life Sciences, USA (1987); Technical Association of the Pulp and Paper Industry, TAPPI, USA (1988); Third World Academy of Sciences (1993); Chilean Society of Microbiology (1996); International Academy of Wood Science (1996); Chilean Academy of Sciences (1999, Vice-President 2001-03); Pontifical Academy of Sciences (2000).

Summary of scientific research Major accomplishments in the field of biochemistry of nucleic acids: the identification and characterization of two protein factors that selectively inhibit viral DNA from fX174 phage from using the replication machinery of other single stranded DNA phages; the isolation and thorough characterization of the restriction-modification system of the extremely thermophilic bacterium *Thermus thermophilus*; the purification and characterization of DNA polymerase from *T. thermophilus*, an enzyme that is widely used today in PCR experiments. On the other hand, some achievements in the field of microbial degradation of lignin are: the isolation, identification and characterization of natural bacterial strains able to metabolize lignin model compounds; the elucidation of metabolic pathways involving novel catabolic intermediates; the discovery of the new enzyme benzalde-

hyde lyase, a proposition for its reaction mechanism and cloning and sequencing of the corresponding gene; finding that the ligninolytic system of the basidiomycete *Ceriporiopsis subvermispora* is composed of a manganese-dependent peroxidase (MnP) and the copper containing phenol oxidase called laccase. Both enzymes are produced as a family of isoforms, with isoelectrofocusing patterns that differ according to the growth conditions of the fungus. Isolation and sequencing of three genes coding for MnP with the corresponding alleles and of one gene coding for laccase. The expression of the latter is regulated by copper. Another significant contribution has been the proposition of a novel mechanism for the production of the extracellular hydrogen peroxide required as a substrate by MnP.

Main publications Vicuña, R., Hurwitz, J., Wallace, S., Girard, M., 'Selective inhibition of *in vitro* DNA synthesis dependent on fX174 compared with fd DNA. I. Protein requirements for selective inhibition'. *J. Biol. Chem.*, 252, pp. 2524-2533 (1977); Vicuña, R., Valdés, F., Medina, M.A., Yudelevich, A., 'Deoxyribonucleic acid polymerase from the marine *Pseudomonas* BAL-31', *J. Bacteriol.*, 142, pp. 249-253 (1980); Vicuña, R., Cori, O., 'Biochemistry in Chile', *Trends in Biochemical Sciences*, 6 (9), pp. iii-iv (1981); Venegas, A., Motles, M., Vásquez, C., Vicuña, R., 'Conditions affecting DNA cleavage by TthI at a TthI endonuclease-dam methylase overlapping sequence', *FEBS Lett.*, 130, pp. 272-274 (1981); González, B., Vásquez, C., Bull, P., Vicuña, R., 'Electron microscopy mapping of *E. coli* RNA polymerase binding sites on plasmids from thermophilic bacteria', *DNA*, 3, pp. 251-257 (1984); Krauskopf, M., Pessot, R., Vicuña, R., 'Science in Latin America. How much and along what lines', *Scientometrics*, 10, pp. 189-206 (1986); Vicuña, R., González, B., Mozuch, M.D., Kirk, K., 'Metabolism of lignin model compounds of the arylglycerol-b-aryl ether type by *Pseudomonas acidovorans* D_3', *Appl. Environ. Microbiol.*, 53, pp. 2605-2609 (1987); Vicuña, R., 'Bacterial degradation of lignin', *Enz. Microb. Technol.*, 10, pp. 646-655 (1988); González, B., Vicuña, R., 'Benzaldehyde lyase from *Pseudomonas fluorescens* biovar. I. A novel thiamine pyrophosphate-requiring enzyme', *J. Bacteriol.*, 171, pp. 2401-2405 (1989); Ruttimann-Johnson, C., Salas, L., Vicuña, R., Kirk, T.K., 'Extracellular enzyme production and synthetic lignin mineralization by *Ceriporiopsis subvermispora*', *Appl. Environ. Microbiol.*, 59, pp. 1792-1797 (1993); Vicuña, R., 'Biotechnology in Chile', *Biological Research*, 27, pp. 11-14 (1994); Urzúa, U., Larrondo, L.F., Lobos, S., Larraín, J., Vicuña, R., 'Oxidation reactions catalyzed by manganese peroxidase isoenzymes from *Ceriporiopsis subvermispora*', *FEBS Lett.*, 371, pp.

132-136 (1995); Vicuña R., 'Science and society', *Bol. Soc. Chil. Quim.*, 41, pp. 205-208 (1996) (in Spanish); Urzúa, U., Kersten, P., Vicuña, R., 'Manganese peroxidase-dependent oxidation of glyoxylic and oxalic acids synthesized by *Ceriporiopsis subvermispora* produces extracellular hydrogen peroxide', *Appl. Environ. Microbiol.*, 64, pp. 68-73 (1998); Urzúa, U., Kersten, P., Vicuña, R., 'Kinetics of Mn^{3+}-oxalate in reactions catalyzed by manganese peroxidase of *Ceriporiopsis subvermispora*', *Arch. Biochem. Biophys.*, 360, pp. 215-222 (1998); Karahanian, E., Corsini, G., Lobos, S., Vicuña, R., 'Structure and expression of a laccase gene from the ligninolytic basidiomycete *Ceriporiopsis subvermispora*', *Biochim. Biophys. Acta*, 1443, pp. 65-74 (1998); Tello, M., Corsini, G., Larrondo, L.F., Salas, L., Lobos, S., Vicuña, R., 'Characterization of three new manganese peroxidase genes from the ligninolytic basidiomycete *Ceriporiopsis subvermispora*', *Biochim. Biophys. Acta*, 1490, pp. 137-144 (2000); Larrondo, L., Lobos, S., Stewart, P., Cullen, D., Vicuña, R., 'Isoenzyme multiplicity and characterization of recombinant manganese peroxidases (rMnPs) from *Ceriporiopsis subvermispora* and *Phanerochaete chrysosporium*', *Appl. Environ. Microbiol.*, 67, pp. 2070-2075 (2001); Polanco, R., Lobos, S., Vicuña, R., 'Binding of nuclear proteins to the promoter region of the laccase gene Cs-lcs1 from the basidiomycete *Ceriporiopsis subvermispora*', *Enzyme Microb. Technol.*, 30, pp. 525-528 (2002); Vicuña, R., 'Natural sciences collaborate with theology', *Teología y Vida*, XLIII, pp. 53-73 (2002) (in Spanish); Larrondo, L., Salas, L., Melo, F., Vicuña, R., Cullen, D., 'A novel extracellular multicopper oxidase with ferroxidase activity in *Phanerochaete chrysosporium*', *Appl. Environ. Microbiol.*, 69, pp. 6257-6263 (2003); Vicuña, R., 'Science never ends: a new paradigm is being born in biology', *Scripta Varia*, 105 (Vatican City, 2003), pp. 267-277.

Robert Joseph White

Date and place of birth: 21 January 1926, Duluth, MN, USA
Wife and children: Patricia; Robert, Christopher, Patricia, Michael, Daniel, Pamela, James, Richard, Marguerite, Ruth
Appointment to the Academy: 29 March 1994
Scientific discipline: Neurosciences, Brain Surgery
Academic title: Chairman, Emeritus, of Neurosurgery and the Brain Research Laboratory, Case Western Reserve University

Most important awards, prizes and academies Academic Background: Bachelor of Science, University of Minnesota (1951); Medical Degree (cum laude), Harvard University Medical School (1953); Surgical Residency, Peter Bent Brigham Hospital, Harvard (1953-55); Neurosurgical Fellowship, The Mayo Clinic, Mayo Foundation (1955-58); Staff, The Mayo Clinic (1958-61); Doctor of Philosophy Degree, University of Minnesota (1962). Awards, Honours, Citations: Mayo Clinic Research Award; Sir William Osler Lectureship; Ohio State Governor's Award (1985); Freeman Award and Medal, National Paraplegia Foundation; Distinguished Membership, the Academy of Medicine; Catholic Man of the Year, Knights of Malta (1994); Knight of Columbus; Knight of the Equestrian Order of the Holy Sepulchre of Jerusalem; National Health Professional of the Year (1988); Alumni Centennial Fellow in Natural Science, University of Saint Thomas; Svien Memorial Lectureship, Mayo Clinic; Medical Mutual Honor Award and Medal. Biographical citations: Modern Neurosurgical Giants, Who's Who in the World, American Men of Science; Distinguished Alumni Mayo Clinic Foundation (1998); Humanitarian Award of the American Association of Neurological Surgeons (1997); Golden Center Award for Accomplishments in Medicine (1999). Honorary Degrees: Doctor of Science, John Carroll University (1979); Doctor of Science, Cleveland State University (1980); Doctor of Humane Letters, Walsh University (1996); Doctor of Sciences, University of St Thomas (1998). Honoured Lecturer: Hospitals for Nervous Diseases, Queens Square, London (1958); Cleveland Clinic Foundation (1999); Harvard University (2000); Hastings College (2000). Academies: Society of University Surgeons; Society of University Neurosurgeons; Transplantation Society; American Physiological Society; American Society of Anatomists; American Federal for Clinical Research;

Society for Experimental Biology; Russian Society of Neurosurgery; Ukrainian Neurosurgical Society; Latvian Neurosurgical Society; Faculty appointment to the Burdenkov Institute of Neurosurgery, Moscow; Faculty appointment to the Polenov Institute of Neurosurgery, Saint Petersburg; Faculty appointment to the Ukrainian Neurosurgical Institute, Kiev; American Society of Cryobiology; Russian and Ukranian Academies of Medical Sciences; President, Academy of Medicine (1979-1980); President, Allen Memorial Library (1985); American Society of Artificial Organs; Transplant Society; International Society of Cybernetic Medicine; New York Academy of Medicine.

Summary of scientific research Doctor White's group was the first to accomplish the total isolation of the brain in the experimental animal and maintain its viability through the use of extracorporeal systems. They were also the first to successfully transplant and hypothermically store the mammalian brain with survival for extended periods of time. This research documented, for the first time, the immunologically privileged state of the whole brain organ and demonstrated the unique neuro-chemistry of cerebral tissue at extremely low temperatures. As a result of these investigations, an entirely new understanding of cerebral physiology and bio-chemistry at extremely low temperatures has been established emphasizing the marked suppression of the energy requirements of brain tissue. These results have brought about an understanding of why the brain is protected during periods of circulatory reduction or arrest under hypothermic conditions. These studies have brought about the introduction of a number of new techniques in operative neurosurgery, including the utilization of low temperature states for the treatment of acute spinal cord trauma and the protection of the brain during and following intracranial surgery. These investigations have also extended the employment of hypothermia to the management of severe head injuries and acute cerebral vascular disease.

Main publications White, R.J., Albin, M.S. and Verdura, J., 'Isolation of the Monkey Brain: *In Vitro* Preparation and Maintenance', *Science*, 141, pp. 1060-1061 (1963); White, R.J., Albin, M.S. and Verdura, J., 'Preservation of the Isolated Monkey Brain Utilizing a Mechanical Extracorporeal Circulation', *Nature*, 202, pp. 1082-1083 (1964); White, R.J., Verdura, J., Albin, M.S. and Bowen, H., 'Hypothermia Brain Storage With Electrical and Metabolic Recovery', *Physiologist*, 7, p. 283 (1964); White, R.J., Albin, M.S., Locke, G.E. and Davidson, E., 'Brain Transplantation: Prolonged Survival of Brain After Carotid-Jugular Interposition', *Science*, 150, pp. 779-781 (1965); Albin, M.S., White, R.J., Locke, G.E. and Kretchmer, H.E., 'Spinal

Cord Hypothermia by Localized Perfusion Cooling', *Nature*, 210, pp. 1059-1060 (1966); White, R.J., Albin, M.S. and Verdura, J. and Locke, G.E., 'Prolonged Whole-Brain Refrigeration With Electrical and Metabolic Recovery', *Nature*, 209, pp. 1320-1322 (1966); White, R.J., Albin, M.S., Yashon, D. and Davidson, E., 'Metabolic Characteristics of the Isolated Primate Brain at Profound Hypothermic Levels', *J. Cryobiol.*, 3, pp. 374-375 (1967); White, R.J., 'Experimental Transplantation of the Brain', *Human Transplantation*, (F.T. Rapaport and J. Dausset, eds.), Grune and Stratton, Inc. (New York, 1968), pp. 692-709; White, R.J., 'Preparation and Mechanical Perfusion of the Isolated Monkey Brain', *Karolinska Symposia on Research Methods in Reproduction Endocrinology*, 4th Symposium: Perfusion Techniques, October 11-13, 1971, (E. Diczfalusy, ed.), Karolinska Institute, pp. 200-216; White, R.J., 'Brain', Chapter 23 in *Organ Preservation for Transplantation*, (A.M. Karow, ed.), Little, Brown and Co. (Boston, 1974), pp. 395-407; White, R.J., Albin, M.S. and Verdura, J., Takaoka, Y., Massopust, L.C., Wolin, L.R., Locke, G.E., Taslitz, N. and Yashon, D., 'The Isolation and Transplantation of the Brain: An Historical Perspective Emphasizing the Surgical Solutions to the Design of These Classical Models', *Neurological Research*, 18, pp. 194-203 (1996); White, R.J., Angstwurm, H. and Carrasco de Paula, I., *The Determination of Brain Death and its Relationship to Human Death*, Pontificia Academia Scientiarum, Vatican City, 1989.

Chen Ning Yang

Date and place of birth: 22 September 1922, Anhui, China
Wife and children: Chih Li Yang; three children
Appointment to the Academy: 10 Feb. 1997
Scientific discipline: Theoretical Physics
Academic title: Professor at the State University of New York and at the Chinese University of Hong Kong

Most important awards, prizes and academies Awards: Nobel Prize in Physics (1957); US National Medal of Science (1986). Academies: US National Academy of Science; Russian Academy of Sciences; National Academy of the PRC; Academia Sinica; Royal Society of London.

Summary of scientific research Yang's work in theoretical physics extends over several areas. In elementary particle theory he introduced in the early 1950s effective use of the concept of symmetry in analyzing phenomena related to the new particles. This line of research included the work he did in 1957 with T.D. Lee on parity non-conservation which won them the Nobel Prize. A few years before that in 1954 working with R.L. Mills, Yang greatly extended the use of symmetry by proposing a non-Abelian gauge theory. This theory, some 20 years later, was recognized as being of fundamental importance and is the foundation on which the present theory of elementary particles is built. Yang is also active in statistical mechanics in which he clarified with T.D. Lee the theory of phase transitions. His later work in the 1960s in this field led to the famous Yang-Baxter equation.

Main publications Yang, C.N., 'Field Theory. Most Important Paper being the one with R.L. Mills', *Phys. Rev.*, 96, p. 191 (1954), (establishing the Yang-Mills theory); Yang, C.N., 'High Energy Phenomenology. Most Important Paper being the one with T.D. Lee', *Phys. Rev.*, 104, p. 254 (1956), (proposing non-conservation of parity in weak interactions); Yang, C.N., 'Statistical Mechanics. Most Important Paper being *Phys. Rev. Letters*, 19', p. 1312 (1967), (giving the Yang-Baxter equation); Yang, C.N., 'Condensed Matter Theory. Most important paper being *Rev. Mods. Physics*, 34', p. 694 (1962), (on the concept of ODLRO). Over 250 papers in scientific journals; Selected Papers with Commentary, published by Freeman Co. in 1983.

Ahmed Hassan Zewail

Date and place of birth: 26 February 1946, Damanhour, Egypt
Wife and children: Dema; Maha, Amani, Nabeel, Hani
Appointment to the Academy: 3 Sept. 1999
Scientific discipline: Chemistry
Academic title: Professor at the California Institute of Technology

Most important awards, prizes and academies Awards: King Faisal International Prize in Science (1989); First Linus Pauling Chair, Caltech (1990); Wolf Prize in Chemistry (1993); Robert A. Welch Award in Chemistry (1997); Benjamin Franklin Medal, The Franklin Institute, USA (1998); Egypt Postage Stamps, with Portrait (1998); 'The Fourth Pyramid' (1999); Nobel Prize in Chemistry (1999); Order of the Grand Collar of the Nile, Highest Honor of Egypt, conferred by President Mubarak (1999); Ahmed Zewail Fellowships, University of Pennsylvania, USA (2000-); Ahmed Zewail Prize, American University in Cairo (2001-); Postage Stamp, issued by the country of Ghana (2002). Academies: Ahmed Zewail Center for FemtoScience & Technology, Korea (2002); Fellow, American Physical Society (1982); National Academy of Sciences, USA (1989); Third World Academy of Sciences, Italy (1989); St Catherine's College, Fellow, Oxford, UK (1991); Sigma Xi Society (1992); American Academy of Arts and Sciences (1993); Académie Européenne des Sciences, des Arts et des Lettres, France (1994); American Philosophical Society (1998); Pontifical Academy of Sciences (1999); American Academy of Achievement (1999); Royal Danish Academy of Sciences & Letters (2000); Fellow, American Association for the Advancement of Science, AAAS (2000); Honorary Fellow, Chemical Society of India (2001); Indian Academy of Sciences, Bangalore, India (2001); Foreign Member, Royal Society of London, UK (2001); Honorary Fellow, Sydney Sussex College, Cambridge, UK (2002); Foreign Fellow, Indian National Science Academy, New Delhi, India (2002); Honorary Foreign Member, Korean Academy of Science and Technology (2002); Honorary Fellow, African Academy of Sciences, Nairobi, Kenya (2002); Honorary Fellow, Royal Society of Chemistry, UK (2003); Foreign Member, Russian Academy of Sciences (2003); Foreign Member, Royal

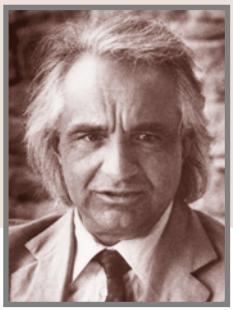
Swedish Academy of Sciences, Stockholm (2003); Foreign Member, Royal Academy of Belgium, Brussels (2003).

Summary of scientific research Current research is devoted to dynamical chemistry and biology, with a focus on the physics of elementary processes in complex systems. In the Laboratory for Molecular Sciences (LMS) Center, collaborative multidisciplinary research has been established to address the role of complexity in the primary function of real systems including enzyme catalysis, protein-RNA transcription, electron transport in DNA, and the role of water in protein and DNA recognitions. A major research frontier at LMS is the new development of ultrafast diffraction techniques that make possible the imaging of transient structures in space and time with atomic-scale resolution. A significant effort is also devoted to giving public lectures to enhance awareness of the value of knowledge gained from fundamental research, and helping the population of developing countries through the promotion of science and technology for the betterment of society.

Main publications Physics & Chemistry – Ultrafast Electron Diffraction: Thee, H., Lobastov, V., Gomez, U., Goodson, B., Srinivasan, R., Ruan, C.-Y. and Zewail, A.H., 'Direct Imaging of Transient Molecular Structures with Ultrafast Diffraction', *Science*, 291, p. 385 (2001); Thee, H., Cao, J. and Zewail, A.H., 'Ultrafast Electron Diffraction of Transient Fe(CO)4: Determination of Molecular Structure and Reaction Pathway', *Angew. Chem., Int. Ed. Engl.*, 40/8, p. 1532 (2001); Ruan, C.-Y., Lobastov, V.A., Srinivasan, R., Goodson, B.M., Thee, H. and Zewail, A.H., 'Ultrafast Diffraction and Structural Dynamics – The Nature of Complex Molecules Far from Equilibrium', *Proc. Natl. Acad. Sci.*, 98, p. 7117 (2001); Lobostov, V.A., Srinivasan, R., Goodson, B.M., Ruan, C.-Y., Feenstra, J.S. and Zewail, A.H., 'Ultrafast Diffraction of Transient Molecular Structures in Radiationless Transitions', *J. Phys. Chem. A*, 105, p. 11159 (2001); Zewail, A.H., 'The Uncertainty Paradox – The Fog That Was Not', *Nature*, 412, p. 279 (2001); Thee, H., Goodson, B.M., Srinivasan, R., Lobastov, V.A. and Zewail, A.H., 'Ultrafast Electron Diffraction and Structural Dynamics: Transient Intermediates in the Elimination Reaction of $C_2F_4I_2$ ', *J. Phys. Chem. A*, 106, p. 4087 (2002); Goodson, B.M., Ruan, C.-Y., Lobastov, V.A., Srinivasan, R. and Zewail, A.H., 'Complex Landscapes of Molecular Structures Imaged by Ultrafast Electron Diffraction: Thermal and Light-Mediated Reactions', *Chem. Phys. Lett* (2003); Srinivasan, R., Lobastov, V.A., Ruan, C.-Y. and Zewail, A.H., 'Ultrafast Electron Diffraction, (UED) A New Development for the 4D Determination of Transient Molecular Structures', Review Article, *Helvetica*

Chimica Acta, June Special Issue, 1 (2003). Biology – Protein and DNA Ultrafast Dynamics: Wan, C., Fiebig, T., Schiemann, O., Barton, J.K. and Zewail, A.H., 'Femtosecond Direct Observation of Charge Transfer between Bases in DNA', *Proc. Natl. Acad. Sci.*, 97, p. 14052 (2000); Qu, X., Wan, C., Becker, H.-C., Zhong, D. and Zewail, A.H., 'The Anticancer Drug-DNA Complex: Femtosecond Primary Dynamics for Anthracycline Antibiotics Function', *Proc. Natl. Acad. Sci.*, 98, p. 14212 (2001); Pal, S.K., Peon, J. and Zewail, A.H., 'Ultrafast Surface Hydration Dynamics and Expression of Protein Functionality: α-Chymotrypsin', *Proc. Natl. Acad. Sci.*, 99, p. 15297 (2002); Pal, S.K., Peon, J. and Zewail, A.H., 'Hydration at the Surface of the Protein Monellin: Dynamics with Femtosecond Resolution', *Proc. Natl. Acad. Sci.*, 99, p. 10964 (2002); Fiebig, T., Wan, C. and Zewail, A.H., 'Femtosecond Charge Transfer Dynamics of a Modified DNA Base: 2-Aminopurine in Complexes with Nucleotides', *J. Phys. Chem.*, 3, pp. 781-788 (2002); Yu, H.-Z., Baskin, J.S. and Zewail, A.H., 'Ultrafast Dynamics of Porphyrins in the Condensed Phase. II. Zinc Tetraphenylporphyrin', *J. Phys. Chem.* A, 106, p. 9845 (2002); Pal, S.K., Peon, J., Bagchi, B. and Zewail, A.H., (feature article), 'Biological Water: Femtosecond Dynamics of Macromolecular Hydration', J. Phys. Chem. B, 106, p. 12376 (2002). World Affairs – Science, Public Education & Aiding the Third World: Zewail, A.H., 'The New World Dis-Order – Can Science Aid the Have-Nots?', Proceedings of the Jubilee Plenary Session of the Pontifical Academy of Sciences, *Science and the Future of Mankind*, 99 (2000); Zewail, A.H., 'Science for the Have-Nots', *Nature*, 410, p. 741 (2001); Zewail, A.H., 'Dialogue of Civilizations: Making History Through New World Vision', *SSQ2/Journal*, Routledge Press (Paris, France, 2002), adapted from a public address at UNESCO, April 20, 2002; Zewail, A.H., 'Dilemma of Science in the Developing World: Personal Reflections', *Third World Academy of Sciences Publication*, 2003, based on *Keynote Speech at the General Assembly of TWAS*, New Delhi, October 22, 2002; Zewail, A.H., *Voyage Through Time – Walks of Life to the Nobel Prize*, American University Press (2002), two new editions and seven translations into other languages; Zewail, A.H., 'Femtochemistry – Atomic-Scale Dynamics of the Chemical Bond using Ultrafast Lasers' (Nobel Paper), *Angewandte Chemie*, Invited, International Edition, 39, pp. 2586-2631 (2000), German Edition, 112, pp. 2688-2738 (2000) Nobel Paper.

Antonino Zichichi



Date and place of birth: 15 October 1929, Trapani, Italy
Wife and children: Maria Ludovica Bernardini; Cosimo, Fabrizio, Lorenzo
Appointment to the Academy: 12 June 2000
Scientific discipline: Physics
Academic title: Professor of Advanced Physics at the University of Bologna and President of the WFS (World Federation of Scientists)

Most important awards, prizes and academies Many honours and awards have been conferred upon Antonino Zichichi for his outstanding discoveries and inventions and for his contributions to the promotion of Science and Scientific Culture in Italy and abroad. He is the recipient of over 60 prizes and honorary awards among which: Doctor Honoris Causa in the Universities of Beijing, Buenos Aires, Malta, Bucharest, Arizona. Academies: Academy of Sciences of the Ukrainian Republic; Academy of Sciences of Georgia; Bologna Academy of Sciences; Pontifical Academy of Sciences. Honours: Order of Merit of the Republic of Poland; Order of Merit of the Federal Republic of Germany; Order of Merit of the Italian Republic; Gold Medal for Science and Culture of the President of the Italian Republic. For his discovery of Nuclear Antimatter the Italian Physical Society awarded him, in 2001, the *Enrico Fermi Prize*, established to celebrate the centennial anniversary of the birth of the great Italian physicist. He founded and directs the Ettore Majorana Centre for Scientific Culture, the first example of the University for the Third Millennium, making Erice famous world-wide. He is past President of the INFN (Italian National Institute for Nuclear Physics), of the EPS (European Physical Society) and of the NATO Science Committee for Disarmament Technology (nuclear, chemical, bacteriological and conventional). Today he is President of the Enrico Fermi Center, Rome.

Summary of scientific research Antonino Zichichi is the author of studies and research into the structure of the elementary building blocks and of the fundamental forces of Nature. He has published over 500 scientific papers, some of which have opened new avenues in Subnuclear Physics at High Energies, and has to his credit: the discovery of Nuclear Antimatter [1]; the conjecture of the existence of a Third Lepton [2] and the invention of new

technologies [3-4] which led to the discovery of the Third Family in the structure of the fundamental particles [5]; the first direct measurements of the mixing angles in pseudoscalar [6] and vector mesons [7] [8]; the discovery of the 'time-like' electromagnetic structure of the proton [9]; the discovery – in the forces which act between quarks and gluons – of the Effective Energy [10]; the proof that, despite its complex structure, it is impossible to break the proton [11], the ultimate heavy building-block of the Universe; the phenomenological discovery of the EGM effect which lowers by three orders of magnitude the supersymmetry breaking threshold energy [12]. At the present time he is engaged in a series of new experiments [13]; at CERN (Geneva), he directs the LAA project [14] and the TOF project of the ALICE experiment for LHC; at DESY (Hamburg), he takes part in the HERA ZEUS experiment; at Gran Sasso, he directs the LVD experiment.

Main publications [1] Massam, T., Muller, Th., Righini, B., Schneegans, M. and Zichichi, A., 'Experimental Observation of Antideuteron Production', *Nuovo Cimento*, 39, p. 10 (1965). [2] Zichichi, A. *et al.*, 'A Proposal to Search for Leptonic Quarks and Heavy Leptons Produced by ADONE', *INFN/AE*-67/3, 20 March 1967; Zichichi, A. *et al.*, 'Limits on the Electromagnetic Production of Heavy Leptons', *Lettere al Nuovo Cimento*, 4, p. 1156 (1970); Zichichi, A. *et al.*, 'Limits on the Mass of Heavy Leptons', *Nuovo Cimento*, 17A, p. 383 (1973). [3] Massam, T., Muller, Th. and Zichichi, A., 'A Telescope to Identify Electrons in the Presence of Pion Background', *CERN Report* 63-25, 27 June 1963 and *Nuovo Cimento*, 39, p. 464 (1965); Zichichi, A. *et al.*, 'Un Grand Détecteur E.M. à Haute Réjection des Pions', *Revue de Physique Appliquée*, 4, p. 108 (1969); Zichichi, A. *et al.*, 'A Large Electromagnetic Shower Detector with High Rejection Power Against Pions', *Nuclear Instruments and Methods*, 101, p. 433 (1972). [4] Zichichi, A. *et al.*, 'Range Measurements for Muons in the GeV Region', *CERN Report* 64-31, 24 June 1964 and *Nuovo Cimento*, 35, p. 759 (1965). [5] Wu, C.S., Lee, T.D., Cabibbo, N., Weisskopf, V.F., Ting, S.C.C., Villi, C., Conversi, M., Petermann, A., Wiik, B.H. and Wolf, G., *The Origin of the Third Family*, (C.S. Wu, ed.), a joint publication by University and Academy of Sciences of Bologna, INFN, SIF (1997), World Scientific (1998). [6] Zichichi, A. *et al.*, 'Evidence for a New Decay Mode of the X^0-Meson: $X^0 \to 2\gamma$', *Nuovo Cimento*, 58A, p. 289 (1968). [7] Zichichi, A. *et al.*, Observation of the Rare Decay Mode of the ϕ-Meson: $\phi \to e^+e^-$', *Nuovo Cimento*, 56A, p. 1173 (1968); Zichichi, A. *et al.*, 'The Decay Mode $\omega \to e^+e^-$ and a Direct Determination of the $\omega - \phi$ Mixing Angle', *Nuovo Cimento*, 57A,

p. 404 (1968); Zichichi, A. *et al.*, 'Evidence for the New Decay Mode $\phi \rightarrow \eta\gamma$ ', *Proceedings of the International Conference on Meson Resonances and Related Electromagnetic Phenomena*, Bologna, Italy, 14-16 April 1971 (Editrice Compositori, Bologna, 1972), p. 265. [8] Zichichi, A., 'An Apparatus of the NBC Type and the Physics Results Obtained'*, Annals of Physics*, 66, p. 405 (1971). [9] Conversi, M., Massam, T., Muller, Th. and Zichichi, A., 'Search for the Time-Like Structure of the Proton', *Phys. Lett.*, 5, p. 195 (1963); Conversi, M., Massam, T., Muller, Th. and Zichichi, A., 'The Leptonic Annihilation Modes of the Proton-Antiproton System at 6.8 $(GeV/c)^2$ Timelike Four-Momentum Transfer', *Nuovo Cimento*, 40, p. 690 (1965). [10] Zichichi, A. *et al.*, 'Evidence of the Same Multiparticle Production Mechanism in p-p Collisions as in e^+e^- Annihilation', *Physics Letters*, 92B, p. 67 (1980). [11] Massam, T. and Zichichi, A., *Quark Search at the ISR*, CERN (preprint), Geneva, Switzerland, June 1968; Zichichi, A. *et al.*, 'Search for Fractionally Charged Particles Produced in Proton-Proton Collisions at the Highest ISR Energy', *Nuovo Cimento*, 40A, p. 41 (1997); Zichichi, A. *et al.*, 'Search for Quarks in Proton-Proton Interactions at $\sqrt{s}$ = 52.5 GeV ', *Nuovo Cimento*, 45A, p. 171 (1978); Zichichi, A. *et al.*, 'A Search for Quarks in the CERN SPS Neutrino Beam', *Nuovo Cimento*, 45A, p. 281 (1978). [12] Anselmo, F., Cifarelli, L., Peterman, A. and Zichichi, A., 'The Simultaneous Evolution of Masses and Couplings: Consequence on Supersymmetry Spectra and Thresholds', *Nuovo Cimento*, 105 A, p. 1179, (1992). [13] *John Bell and the Ten Challenges of Subnuclear Physics*, Presented at the symposium *'Quantum [Un]Speakables',* Erwin Schrödinger Institute, Vienna, 10 November 2000. [14] Zichichi, A. *et al.*, 'The Main Achievements of the LAA Project', *Report No. 7*, CERN/LAA/91-1, 1 March 1991. Books: Zichichi, A., *L'Infinito,* (Rizzoli-Bur, Milano 1988; Pratiche Editrice, Milano 1998); Zichichi, A., *Scienza ed Emergenze Planetarie* (Rizzoli, Milano, 1993[1], 1994[3], Supersaggi Rizzoli, 1996[1], 1999[7]); Zichichi, A., *Creativity in Science* (World Scientific, London, 1996-1998); Zichichi, A., *Subnuclear Physics: the First Fifty Years* (Academy of Science and University of Bologna, Bologna, 1998; World Scientific, London, 2000); Zichichi, A., *Perché io credo in Colui che ha fatto il mondo* (Il Saggiatore, Milano, 1999); Zichichi, A., *L'irresistibile fascino del tempo* (Il Saggiatore, Milano, 2000); Zichichi, A., *Galileo Galilei, divin uomo* (Il Saggiatore, Milano, 2001).

DECEASED ACADEMICIANS*

ABDERHALDEN Emil (28-10-1936), Professor of Physiology, University of Zurich, Switzerland.
9-3-1877, † 5-8-1950.

ALBAREDA Card. Anselmo Maria, O.S.B. (5-10-1962), Prefect, Apostolic Vatican Library, Vatican City; Academician 'Perdurante Munere' from 28-10-1936 to 19-3-1962 (Honorary Academician).
16-2-1892, † 20-7-1966.

ALBAREDA HERRERA Rev. José Maria (29-5-1948), Rector, Catholic University of Pamplona and Director, Instituto Español de Edafología y Fisiología vegetal, University of Madrid, Spain.
15-4-1902, † 27-3-1966.

de ALMEIDA Antonio (3-5-1961), Professor of Anthropology, University of Lisbon, Portugal.
21-8-1900, † 17-11-1984.

AMALDI Ugo (28-10-1936), Professor of Algebric and Infinitesimal Mathematical Analysis, University of Rome, Italy.
18-4-1875, † 11-11-1957.

ANFINSEN Christian Boehmer (12-5-1981), Professor of Biology, Johns Hopkins University, Baltimore, MD, USA. Nobel laureate in Chemistry, 1972.
26-3-1916, † 14-5-1995.

APPLETON Sir Edward Victor (29-5-1948), Vice-Chancellor and Principal, University of Edinburgh, UK. Nobel laureate in Physics, 1947.
6-9-1892, † 21-4-1965.

ARMELLINI Giuseppe (28-10-1936), Professor of Astronomy, University of Rome and Director, Astronomy Observatory, Rome, Italy.
24-10-1887, † 16-7-1958.

BARROIS Charles Eugéne (28-10-1936), Professor of Geology, University of Lille, France.
21-4-1851, † 8-11-1939.

BEST Charles Herbert (5-4-1955), Director, C.H. Best Institute, Toronto, Canada.
27-2-1899, † 31-3-1978.

BIANCHI Emilio (28-10-1936), Professor of Astronomy and Geodesic Science, University of Milan and Director, Astronomy Observatory, Milan, Italy.
26-9-1875, † 11-9-1941.

*The date in brackets refers to the date of appointment to the Academy.

BIRKHOFF George David (28-10-1936), Professor of Mathematics, University of Harvard, Cambridge, MA, USA.
21-3-1884, † 12-11-1944.

BISLETI Card. Gaetano (28-10-1936), Prefect, Holy Congregation for Seminaries and Educational Institutions, Vatican City (Honorary Academician).
21-3-1856, † 30-8-1937.

BJERKNES Wilhelm Frimann Koren (28-10-1936), Professor of Mechanics and Mathematical Physics, University of Oslo, Norway.
14-3-1862, † 7-4-1951.

BLANC-LAPIERRE André Joseph (17-4-1978), Professor of Physics, University of Paris-Sud Orsay and Former President, Académie des Sciences, Paris, France.
7-7-1915, † 14-12-2001.

BOHR Niels (28-10-1936), Professor of Physics, University of Copenhagen, Denmark. Nobel laureate in Physics, 1922.
7-10-1885, † 18-11-1962.

BOLDRINI Marcello (28-10-1936), Professor of Statistics, University of Rome, Italy.
9-2-1890, † 5-3-1969.

BONINO Giovanni Battista (23-5-1942), Professor of Chemical Physics, University of Bologna, Italy.
3-5-1899, † 11-12-1985.

BORSUK Karol (14-1-1982), Director of the Mathematical Department, University of Warsaw, Poland.
8-5-1905, † 24-1-1982.

BOTTAZZI Filippo (28-10-1936), Professor of Physiology, University of Naples, Italy.
23-12-1867, † 19-9-1941.

BOYLE Rev. Leonard E., O.P. (24-5-1984), Prefect, Apostolic Vatican Library, Vatican City, until 23-5-1997; Academician 'Perdurante Munere'.
13-11-1923, † 25-10-1999.

BRANLY Edouard (28-10-1936), Professor of Physics, École Supérieure des Sciences de l'Institut Catholique, Paris, France.
23-10-1844, † 24-3-1940.

de BROGLIE Louis (5-4-1955), Honorary Professor of Physics, Faculté des Sciences de Paris, France; Honorary Perpetual Secretary, Académie des Sciences, Paris, France.
15-8-1892, † 19-3-1987.

BRÜCK Hermann Alexander (5-4-1955), Professor of Astronomy, University of Edinburgh, UK.
15-8-1905, † 4-3-2000.
BULLEN Keith Edward (22-4-1968), Professor of Applied Mathematics, University of Sydney, Australia.
29-6-1906, † 23-9-1976.
BUYTENDIJK Fredrik Jacobus Johannes (28-10-1936), Professor of Physiology, University of Utrecht, Netherlands.
29-4-1887, † 21-10-1974.
CARATHEODORY Constantin (28-10-1936), Professor of Mathematics, University of Munich, Germany.
13-9-1873, † 2-2-1950.
CARDOSO FONTES Antonio (1-9-1941), Director, Instituto Oswaldo Cruz, Rio de Janeiro, Brazil.
6-10-1879, † 28-3-1943.
CARREL Alexis (28-10-1936), Professor of Biology, Rockefeller Institute for Medical Research, New York, NY, USA. Nobel laureate in Physiology or Medicine, 1912.
28-6-1873, † 5-10-1944.
CASTELLANI Sir Aldo (28-10-1936), Professor of Tropical and Subtropical Medicine, London School of Tropical Medicine, London, UK.
8-9-1877, † 3-10-1971.
CHADWICK Sir James (3-5-1961), Professor of Physics, University of Cambridge, UK. Nobel laureate in Physics, 1935.
20-10-1891, † 24-7-1974.
CHAGAS Carlos (11-8-1961), Professor of Biology and Biophysics, Universidade Federal do Rio de Janeiro, Brazil.
12-9-1910, † 16-2-2000.
CHAUDRON Georges (10-4-1970), Professor of Applied Chemistry and Director Emeritus, École Nationale Supérieure, Paris, France.
29-4-1891, † 14-3-1976.
CHIGI ALBANI DELLA ROVERE Prince Don Ludovico (28-10-1936), Grand Master of the Sovereign Military Order of Malta, Rome, Italy (Honorary Academician).
10-7-1866, † 14-11-1951.
CICOGNANI Card. Amleto Giovanni (24-10-1961), Secretary of State to His Holiness Pope Paul VI, Vatican City (Honorary Academician).
24-2-1883, † 17-12-1973.

COLOMBO Giuseppe (17-4-1978), Professor of Mechanics, University of Padua, Italy.
2-10-1920, † 21-2-1984.

COLONNETTI Gustavo (28-10-1936), Professor of Construction Science and Analytical and Graphical Mechanics, Istituto Superiore di Ingegneria, Turin, Italy.
11-8-1886, † 20-3-1968.

CONWAY Arthur William (18-1-1939), Chairman of the Board of Theoretical Physics, Dublin Institute of Advanced Studies, Dublin, Ireland.
2-10-1875, † 11-7-1950.

CONWAY Edward Joseph (11-8-1961), Professor of Biochemistry and Pharmacology, University of Dublin, Ireland.
3-7-1894, † 20-12-1968.

CREUTZFELDT Otto Detlev (4-10-1990), Professor of Neurobiology, Max-Planck-Institut for Biophysical Chemistry, Göttingen, Germany.
1-4-1927, † 23-1-1992.

CROCCO Gaetano Arturo (28-10-1936), Professor of General Aeronautics, University of Rome, Italy.
26-10-1877, † 19-1-1968.

CROMBIE Alistair Cameron (16-10-1994), Professor of History and Philosophy of Science, University of Oxford, UK.
4-11-1915, † 9-2-1996.

CRUZ-COKE Eduardo (29-5-1948), Professor of Physiological Chemistry, School of Medicine, University of Santiago de Chile, Chile.
1899, † 18-3-1974.

CUNEOT Lucien (28-10-1936), Professor of Zoology, University of Nancy, France.
21-10-1866, † 7-1-1951.

DAINELLI Giotto (5-4-1940), Professor Emeritus of Geology and Physical Geography, University of Florence, Italy.
19-5-1878, † 16-12-1968.

DAL PIAZ Giorgio (28-10-1936), Professor of Geology, University of Padua, Italy.
29-3-1872, † 20-4-1962.

DALLAPORTA Nicola (5-10-1989), Professor of Astronomy, University of Padua, Italy (Honorary Academician).
28-10-1910, † 23-10-2003.

DARDOZZI Renato (1-7-1997), Professor of Philosophy and Theology, Former Chancellor, Vatican City (Honorary Academician).
5-4-1922, † 3-6-2003.

DE BLASI Dante (23-5-1942), Professor of Hygiene, University of Rome, Italy.
25-10-1873, † 10-7-1956.

DE CASTRO Aloysio (29-5-1948), Director, School of Medicine, University of Rio de Janeiro, Brazil.
1881, † 7-10-1959.

DE FILIPPI Filippo (28-10-1936), Member, National Geography Committee, National Research Council, Rome, Italy.
6-4-1869, † 23-9-1938.

DE GIORGI Ennio (12-5-1981), Professor of Mathematical Analysis, Scuola Normale Superiore, Pisa, Italy.
8-2-1928, † 25-10-1996.

DE SANCTIS Pietro (28-10-1936), Former Secretary, Pontificia Academia Novorum Lynceorum, Vatican City (Honorary Academician).
3-2-1867, † 15-1-1957.

DEBYE Pieter Josef William (28-10-1936), Chairman, Department of Chemistry, Cornell University, Ithaca, NY, USA. Nobel laureate in Chemistry, 1936.
24-3-1884, † 2-11-1966.

DIRAC Paul Adrian Maurice (11-8-1961), Professor of Mathematics, State University of Florida at Tallahassee, USA. Nobel laureate in Physics, 1933.
8-8-1902, † 20-10-1984.

DÖBEREINER Johanna (17-4-1978), Professor of Soil Microbiology, Centro Nacional de Pequisa de Agrobiología (CNPAB), Seropédica, Brazil.
28-11-1924, † 5-10-2000.

DOISY Edward Adelbert (29-5-1948), Professor of Biochemistry, St. Louis University, MO, USA. Nobel laureate in Physiology or Medicine, 1943.
13-11-1893, † 23-10-1986.

ECCLES Sir John Carew (3-5-1961), Professor of Neurophysiology, State University of New York at Buffalo, NY, USA. Nobel laureate in Physiology or Medicine, 1963.
27-1-1903, † 2-5-1997.

FAUVEL Pierre (28-10-1936), Professor of Zoology, Université Catholique de l'Ouest, Angers, France.
8-10-1866, † 12-12-1958.

FEIGL Fritz (10-4-1970), Director Emeritus of the Microchemical Laboratory of the Ministry of Agriculture, Rio de Janeiro, Brazil.
15-5-1891, † 26-1-1971.

FISHER Sir Ronald Aylmer (3-5-1961), Professor of Genetics, University of Cambridge and Honorary Member, Division of Mathematical Statistics, Commonwealth Scientific and Industrial Research Organization at Adelaide University (C.S.I.R.O.), Adelaide, Australia.
17-2-1890, † 29-7-1962.

FLEMING Sir Alexander (7-3-1946), Professor of Bacteriology, University of London, UK. Nobel laureate in Physiology or Medicine, 1945.
6-8-1881, † 11-3-1955.

FUKUI Kenichi (14-12-1985), Professor of Chemistry, Institute for Fundamental Chemistry, Kyoto, Japan. Nobel laureate in Chemistry, 1981.
4-10-1918, † 9-1-1998.

GALEAZZI-LISI Riccardo (3-12-1949), Pontifical Physician, Vatican City (Honorary Academician).
1891, † 16-11-1968.

GARCIA OTERO Julio César (5-4-1955), Professor of Medical Pathology, University of Montevideo, Uruguay.
24-9-1895, † 28-4-1966.

GARCIA SIÑERIZ José (23-5-1942), Vicepresident, Consejo Superior de Investigaciones Científicas, Madrid, Spain.
11-5-1886, † 18-1-1974.

GARNHAM Percy Cyril Claude (4-10-1970), Professor of Medical Protozoology, Imperial College, Silkwood Park, UK.
15-1-1901, † 25-12-1994.

GATTERER Rev. Fr. Aloys, S.J. (28-10-1936), Prefect, Astrophysical Laboratory, Vatican Observatory, Vatican City; Academician 'Perdurante Munere'.
28-1-1866, † 17-2-1953.

GEMELLI Rev. Fr. Agostino, O.F.M. (28-10-1936), Professor of Applied Psychology, Università Cattolica del Sacro Cuore, Milan, Italy.
18-1-1878, † 15-7-1959.

GENTNER Wolfgang (10-4-1970), Professor of Physics, Max-Planck-Institut, Heidelberg, Germany.
23-7-1906, † 4-9-1980.

GHERZI Rev. P. Ernesto, S.J. (28-10-1936), Director, Meteorological and Seismological Observatory, Zi-ka-wei, Shanghai, China; Director of Research, Geophysical Observatory, Collège Jean de Brébeuf, Montréal, Canada.
8-8-1886, † 6-12-1973.

GHIGI Alessandro (28-10-1936), Professor of General Zoology, University of Bologna, Italy.
9-2-1875, † 20-11-1970.

GIACOMELLO Giordano (3-5-1961), Professor of Pharmaceutical Chemistry and Director, Istituto di Chimica farmaceutica e tossicologica, University of Rome, Italy.
26-7-1910, † 23-6-1968.

GILSON Gustave (28-10-1936), Professor of Zoology, Université Catholique, Louvain, Belgium.
17-7-1859, † 1-1-1945.

GIORDANI Francesco (28-10-1936), President, National Research Council, Rome, Italy; Professor of General Chemistry, University of Naples, Italy.
5-7-1896, † 24-1-1961.

GIORGI Giovanni (28-10-1936), Professor of Electrical Communications, University of Rome, Italy.
27-11-1871, † 19-8-1950.

GIUSTI Rev. Fr. Martino (4-1-1956), Prefect, Vatican Secret Archive, Vatican City, until 25-6-1983; Academician 'Perdurante Munere'.
15-10-1905, † 1-12-1987.

GODLEWSKI Emil (28-10-1936), Professor of Embriology and Biology, University of Cracow, Poland.
15-8-1875, † 25-4-1944.

GOLA Giuseppe (28-10-1936), Professor of Botany, University of Padua, Italy.
26-2-1877, † 25-7-1956.

GREGOIRE Rev. Fr. Victor (28-10-1936), Professor of Botany, Université Catholique, Louvain, Belgium.
5-12-1870, † 12-12-1938.

GUIDI Camillo (28-10-1936), Professor of Construction Science and Theory of Bridges, Istituto Superiore di Ingegneria, Turin, Italy.
24-7-1853, † 30-10-1941.

GUTHNICK Paul (28-10-1936), Professor of Astronomy and Director, University of Sternwarte, Berlin-Neubabelsberg, Germany.
12-1-1879, † 6-9-1947.

HAHN Otto (5-4-1955), Professor of Chemistry and Honorary President, Max-Planck-Gesellschaft zur Förderung der Wissenschaften, Göttingen, Germany. Nobel laureate in Chemistry, 1944.
8-3-1879, † 28-7-1968.

HEISENBERG Werner Carl (5-4-1955), Professor of Theoretical Physics and Director, Max-Planck Institut für Physik und Astrophysik, Munich, Germany. Nobel laureate in Physics, 1932.
5-12-1901, † 1-2-1976.

HEISKANEN Veikko Aleksanteri (24-9-1964), Former Director, Department of Geodetic Science, Photogrammetry and Mapping, Ohio State University, Columbus, OH, USA; Director, Finnish Geodetic Institute, Helsinki, Finland.
23-7-1895, † 23-10-1971.

HERZBERG Gerhard (24-9-1964), Distinguished Research Scientist, National Research Council Canada, Ottawa, Canada. Nobel laureate in Chemistry, 1971.
25-12-1904, † 3-3-1999.

HESS Victor Francis (3-5-1961), Professor of Physics, Fordham University, New York, NY, USA. Nobel laureate in Physics, 1936.
24-6-1883, † 17-12-1964.

HESS Walter Rudolf (5-4-1955), Former Professor of Physiology, University of Zurich, Switzerland. Nobel laureate in Physiology or Medicine, 1949.
17-3-1881, † 12-8-1973.

de HEVESY George Charles (3-5-1961), Professor of Biochemistry, University of Stockholm, Sweden. Nobel laureate in Chemistry, 1943.
1-8-1885, † 12-8-1966.

HEYMANS Corneille Jean François (23-5-1942), Professor of Pharmacology, University of Gand, Belgium. Nobel laureate in Physiology or Medicine, 1938.
28-3-1892, † 20-7-1968.

HINSHELWOOD Sir Cyril Norman (3-5-1961), Professor of Chemistry, University of Oxford, UK. Nobel laureate in Chemistry, 1956.
19-6-1897, † 12-10-1967.

HODGKIN Alan Lloyd (22-4-1968), Professor of Physiology, University of Cambridge, UK.
5-2-1914, † 20-12-1998.

HÖRSTADIUS Sven (11-8-1961), Professor of Zoology, University of Uppsala, Sweden.
18-2-1898, † 16-6-1996.

HOUSSAY Bernardo Alberto (28-10-1936), Professor of Physiology, University of Buenos Aires, Argentina. Nobel laureate in Physiology or Medicine, 1947.
10-4-1887, † 21-9-1971.
HURTADO Alberto (11-8-1961), Professor of Medicine, Instituto de Investigación de la Altura, Lima, Peru.
29-8-1901, † 1-11-1983.
JANSSEN Paul Adriaan Jan (25-6-1990), Professor of Pharmacology and Chairman, Janssen Research Foundation, Beerse, Belgium.
12-9-1926, † 11-11-2003.
JOACHIMOGLU Georges (10-4-1970), Professor of Pharmacology, University of Athens, Greece.
28-12-1887, † 28-11-1979.
JULIA Gaston Maurice (5-4-1955), Professor of Mathematical Analysis, Sorbonne, Paris, France.
3-2-1893, † 19-3-1978.
JUNKES Rev. Fr. Joseph, S.J. (31-3-1953), Prefect, Astrophysical Laboratory, Vatican Observatory, Vatican City; Academician 'Perdurante Munere'.
28-9-1900, † 28-4-1984.
von KARMAN Theodore (5-4-1955), Director, Guggenheim Aeronautical Laboratory, California Institute of Technology, Pasadena, CA, USA.
11-5-1881, † 7-5-1963.
KEESOM Wilhelmus Hendrikus (28-10-1936), Professor of Physics, University of Leiden, Netherlands.
21-6-1876, † 3-3-1956.
LANGFELD Herbert Sidney (29-5-1948), Professor of Psychology and Director, Psychological Laboratory, University of Princeton, NJ, USA.
24-7-1879, † 25-2-1958.
von LAUE Max Theodor Felix (5-4-1955), Professor of Theoretical Physics and Director, Fritz-Institut, Max-Planck-Gesellschaft, Berlin-Dahlem, Germany. Nobel laureate in Physics, 1914.
9-10-1879, † 24-4-1960.
LECOMTE Jean (24-9-1964), First Senior Researcher, Centre National de la Recherche scientifique, Paris, France.
5-8-1898, † 28-3-1979.
LEJEUNE Jérôme Jean Louis Marie (24-6-1974), Professor of Human Genetics, Institute de Progenèse, Paris, France.
13-6-1926, † 3-4-1994.

LELOIR Luis Federico (22-4-1968), Professor of Biochemistry, Instituto de Investigaciones Bioquimicas 'Fundación Campomar', Buenos Aires, Argentina. Nobel laureate in Chemistry, 1970.
6-9-1906, † 2-12-1987.

LEMAÎTRE Rev. Msgr. Georges (28-10-1936), Professor of Mechanics and Mathematical Methodology, Université Catholique, Louvain, Belgium.
17-7-1894, † 20-6-1966.

LÉPINE Pierre Raphaël (24-9-1964), Professor of Biology and Cytology, Institut Pasteur, Paris, France.
15-8-1901, † 30-3-1989.

LEPRI Giuseppe (28-10-1936), Professor of Zoology, University of Rome, and Director, Museo Civico di Zoologia, Rome, Italy.
2-6-1870, † 30-4-1952.

LEPRINCE-RINGUET Louis (11-8-1961), Professor of Elementary Particle Physics, École Polytechnique, Paris, France.
27-3-1901, † 23-12-2000.

LEVI-CIVITA Tullio (28-10-1936), Professor of Rational Mechanics, University of Rome, Italy.
29-3-1873, † 29-12-1941.

LICHNEROWICZ André (12-5-1981), Professor of Mathematical Physics, Collège de France, Paris, France.
21-1-1915, † 11-12-1998.

LILEY Albert William (17-4-1978), Professor of Prenatal Physiology, University of Auckland, Australia.
12-3-1929, † 15-6-1983.

LIONS Jacques-Louis (4-10-1990), Former President, Academy of Sciences and Professor of Mechanical Sciences, Collège de France and École Polytechnique, Paris, France.
2-5-1928, † 17-5-2001.

ŁOJASIEWICZ Stanisław (27-1-1983), Professor of Mathematics, Jagiellonian University, Cracow, Poland.
9-10-1926, † 13-11-2002.

LOMBARDI Luigi (28-10-1936), Professor of Electrotechnology, University of Rome, Italy.
21-8-1867, † 7-2-1958.

LORA TAMAYO Manuel (24-9-1964), Professor of Organic Chemistry, Centro de Química Orgánica 'Manuel Lora Tamayo', Madrid, Spain.
26-1-1904, † 22-8-2002.

LUIGIONI Paolo (28-10-1936), Curator, Museo Civico di Zoologia, Rome, Italy.
9-2-1873, † 6-5-1937.

LYNEN Feodor (17-4-1978), Director, Max-Planck-Institut für Biokemie, Martinsried, Germany. Nobel laureate in Physiology or Medicine, 1964.
6-4-1911, † 6-8-1979.

MAGLIONE Card. Luigi (15-6-1939), Secretary of State to His Holiness Pope Pius XII, Vatican City (Honorary Academician).
2-3-1877, † 22-8-1944.

MARCHETTI SELVAGGIANI Card. Francesco (28-10-1936), Vicar General of His Holiness Pope Pius Pio XII, Vatican City (Honorary Academician).
19-10-1871, † 13-1-1951.

MARCONI Guglielmo (28-10-1936), Professor of Electromagnetic Waves, University of Rome, Italy. Nobel laureate in Physics, 1909.
25-4-1874, † 20-7-1937.

MARINI-BETTÒLO Giovanni Battista (22-4-1968), Professor of Chemistry, University of Rome, Italy.
27-6-1915, † 22-7-1996.

MAROTTA Domenico (3-5-1961), Professor of General Chemistry, University of Rome, Italy.
28-7-1886, † 20-3-1974.

McCONNELL Rev. Msgr. James Robert (25-6-1990), Professor of Theoretical Physics, Dublin Institute for Advanced Studies, Dublin, Ireland.
25-2-1915, † 13-2-1999.

MENDES CORRÊA Antonio Augusto Esteves (28-10-1936), Professor of Anthropology, University of Porto, Portugal.
4-4-1888, † 7-1-1960.

MERCATI Rev. Msgr. Angelo (28-10-1936), Prefect, Vatican Secret Archive, Vatican City; Academician 'Perdurante Munere'.
6-10-1870, † 3-10-1955.

MICHOTTE van den BERCK Baron Albert Edouard (28-10-1936), Professor of Experimental Psychology, Université Catholique, Louvain, Belgium.
13-10-1881, † 2-6-1965.

MILLIKAN Robert Andrews (28-10-1936), Director, Norman Bridge Laboratory of Physics, California Institute of Tecnology, Pasadena, CA, USA. Nobel laureate in Physics, 1923.
22-3-1868, † 19-12-1953.

MIZUSHIMA Sanichiro (11-8-1961), Professor of Physical Chemistry, Tokyo, Japan.
21-3-1899, † 3-8-1983.

MORGAN Thomas Hunt (28-10-1936), Chairman, Division of Biology and Director, William G. Kerckhoff Laboratory of the Biological Sciences, California Institute of Technology, Pasadena, CA, USA. Nobel laureate in Physiology or Medicine, 1933.
25-9-1866, † 4-12-1945.

MORGAN William Wilson (24-9-1964), Professor of Astronomy, University of Chicago, IL, USA.
3-1-1906, † 21-6-1994.

MORUZZI Giuseppe (17-4-1978), Professor of Biology, University of Pisa, Italy.
30-7-1910, † 11-3-1986.

NIEHANS Paul (5-4-1955), Director, Endocrinology Clinic, Clarens, Switzerland.
21-11-1882, † 1-9-1971.

NOBILE Umberto (28-10-1936), Professor of Aeronautical Construction, University of Naples, Italy.
21-1-1885, † 30-7-1978.

NOYONS Adriaan Karel Marie (28-10-1936), Professor of Physiology, University of Utrecht, Netherlands.
7-1-1878, † 1-6-1941.

OCHOA Severo (24-6-1974), Professor of Biology, Universidad Autónoma, Madrid, Spain. Nobel laureate in Physiology or Medicine, 1959.
24-9-1905, † 1-11-1993.

O'CONNELL Rev. Fr. Daniel Joseph Kelly, S.J. (24-9-1964), Director, Vatican Observatory, Vatican City.
25-7-1896, † 15-10-1982.

ODA Minoru (18-9-1992), Professor of Astrophysics, Tokyo University of Information Sciences, Japan.
24-2-1923, † 1-3-2001.

ODHIAMBO Thomas Risley (12-5-1981), Professor of Insect Physiology and Honorary President, African Academy of Sciences, Nairobi, Kenya.
4-2-1931, † 27-5-2003.

OORT Jan Hendrik (18-8-1961), Professor of Astronomy, Sterrewacht, University of Leiden, Belgium.
28-4-1900, † 5-11-1992.

PACELLI Card. Eugenio (28-10-1936), Secretary of State to His Holiness Pope Pius XI, Vatican City (Honorary Academician). Elected Supreme Pontiff as Pius XII on 2 March 1939.
2-3-1876, † 9-10-1958.

PANETTI Modesto (28-10-1936), Professor of Mechanics Applied to Machines and Aeronautical Construction, Polytechnic of Turin, Italy.
9-2-1875, † 29-3-1957.

PARRAVANO Nicola (28-10-1936), Professor of General Chemistry, University of Rome, Italy.
21-7-1883, † 10-8-1938.

PASCHINI Rev. Msgr. Pio (13-8-1957), Perpetual Rector Magnificus Honoris Causa, Pontifical Lateran University, Vatican City (Honorary Academician).
2-3-1878, † 14-12-1962.

PENSA Antonio (28-10-1936), Professor of Human Anatomy and Histology, University of Pavia, Italy.
15-9-1874, † 17-8-1970.

PERUTZ Max Ferdinand (12-5-1981), Professor of Cellular and Molecular Biology, Medical Research Council Laboratory of Molecular Biology, Cambridge, UK.
19-5-1914, † 6-2-2002.

PETRITSCH Ernst Felix (28-10-1936), Professor of Telecommunications Engineering, Technischen Hochschule, Vienna, Austria.
21-5-1878, † 18-12-1951.

PICARD Emile (28-10-1936), Perpetual Secretary, Académie des Sciences de l'Institut de France, Paris, France.
24-7-1856, † 11-12-1941.

PICONE Mauro (10-4-1970), Professor of Mathematical Analysis, University of Rome, Italy.
2-5-1885, † 11-4-1977.

PIERANTONI Umberto (5-4-1940), Professor of Zoology, University of Naples, Italy.
25-9-1876, † 16-11-1959.

PIETRANGELI Carlo (5-10-1989), Professor of Archaeology and Director, Vatican Museums, Vatican City (Honorary Academician).
20-10-1912, † 23-6-1995.

PISTOLESI Enrico (28-10-1936), Professor of Mechanics Applied to Machines and Aeronautical Construction, University of Pisa, Italy.
2-12-1889, † 29-2-1968.

PIZZARDO Card. Giuseppe (15-6-1939), Prefect, Holy Congregation for Seminaries and Educational Institutions, Vatican City (Honorary Academician).
13-7-1877, † 1-8-1970.

PLANCK Max (28-10-1936), Professor of Theoretical Physics, University of Berlin, Germany. Nobel laureate in Physics, 1918.
23-4-1858, † 4-10-1947.

PONNAMPERUMA Cyril Andrew (16-10-1994), Professor of Chemistry, University of Maryland, College Park, USA.
16-10-1923, † 20-12-1994.

PORTER Baron George (24-6-1974), Professor of Chemistry, Royal Institution of Great Britain, London, UK.
6-12-1920, † 31-8-2002.

PRELOG Vladimir (14-12-1985). Professor of Organic Chemistry, Swiss Federal Institute of Technology, Zurich, Switzerland. Nobel laureate in Chemistry, 1975.
23-7-1906, † 7-1-1998.

PULLMAN Bernard (12-5-1981), Professor of Quantum Biochemistry and Biophysics, Institut de Biologie Physico-Chimique, Paris, France.
19-3-1919, † 9-6-1996.

QUAGLIARIELLO Gaetano (23-5-1942), Professor of Biological Chemistry, University of Naples, Italy.
19-12-1883, † 2-6-1957.

RAES Rev. Fr. Alfons, S.J. (23-3-1962), Prefect, Apostolic Vatican Library, Vatican City; Academician 'Perdurante Munere'.
14-8-1896, † 25-6-1983.

RAMAN Sir Chandrasekhara Venkata (11-8-1961), Director, Raman Research Institute, Bangalore, India. Nobel laureate in Physics, 1930.
7-11-1888, † 21-11-1970.

RANZI Silvio (12-5-1981), Professor of Zoology, University of Milan, Italy (Honorary Academician).
16-10-1902, † 16-4-1996.

RASETTI Franco (28-10-1936), Professor of Physics, Johns Hopkins University, Baltimore, MD, USA.
10-8-1901, † 5-12-2001.

ROCHE Marcel (10-4-1970), Professor of Biomedicine and Sociology of Science, Instituto Venezolano de Investigaciones Científicas, Caracas, Venezuela.
15-8-1920, † 3-5-2003.

RONDONI Pietro (28-10-1936), Professor of General and Experimental Pathology, University of Milan, Italy.
2-10-1882, † 4-11-1956.
RUNCORN Stanley Keith (12-9-1981), Professor of Physics, Imperial College of Science, London, UK.
19-11-1922, † 5-12-1995.
RUTHERFORD of NELSON Lord Ernest (28-10-1936), Professor of Experimental Physics, University of Cambridge, UK. Nobel laureate in Chemistry, 1908.
30-8-1871, † 19-10-1937.
RUZICKA Leopold (5-12-1942), Professor of Organic Chemistry, Polytechnique de Zürich, Zurich, Switzerland. Nobel laureate in Chemistry, 1939.
13-9-1887, † 26-9-1976.
RYLE Martin (2-12-1975), Professor of Radioastronomy, University of Cambridge, UK. Nobel laureate in Physics, 1974.
27-9-1918, † 14-10-1984.
SALAM Abdus (12-5-1981), Professor of Physics, International Centre for Theoretical Physics, Trieste, Italy. Nobel laureate in Physics, 1979.
29-1-1926, † 21-11-1996.
SALVIUCCI Pietro (18-11-1982), Former Chancellor, Pontifical Academy of Sciences, Vatican City (Honorary Academician).
18-10-1899, † 29-1-1984.
SANDOVAL VALLARTA Manuel (11-8-1961), Professor of Theoretical Physics, University of Mexico City, Mexico.
11-2-1899, † 1-5-1977.
SCHMIDT Rev. Fr. Wilhelm, S.V.D. (28-10-1936), Scientific Director, Pontificio Museo Missionario Etnologico del Laterano, Vatican City; Academician 'Perdurante Munere'.
16-2-1868, † 10-2-1954.
SCHRÖDINGER Erwin (28-10-1936), Professor of Theoretical Physics, University of Vienna, Austria. Nobel laureate in Physics, 1933.
12-8-1887, † 4-1-1961.
SCHULIEN Rev. Fr. Michael, S.V.D. (10-2-1954), Scientific Director, Pontificio Museo Missionario Etnologico del Laterano, Vatican City; Academician 'Perdurante Munere'.
21-5-1888, † 4-4-1968.

SEGRE Beniamino (2-12-1975), Professor of Mathematical Analysis, University of Rome, Italy.
16-2-1903, † 2-10-1977.

SEVERI Francesco (5-4-1940), President, Istituto Nazionale di Alta Matematica and Professor of Higher Geometry, University of Rome, Italy.
13-4-1879, † 8-12-1961.

SHERRINGTON Charles Scott (28-10-1936), Professor of Physiology, University of Oxford, UK. Nobel laureate in Physiology or Medicine, 1932.
29-11-1858, † 4-3-1952.

SIDDIQUI Salimuzzaman (24-9-1964), Professor of Organic Chemistry, University of Karachi, Pakistan.
19-10-1897, † 14-4-1994.

SIERPINSKI Wacław Franciszek (22-4-1968), Professor of Mathematics, University of Warsaw, Poland.
14-3-1882, † 21-10-1969.

SILVESTRI Filippo (28-10-1936), Professor of General Zoology and Agricultural Science, Istituto Superiore Agrario and Director, Zoology Laboratory, Naples, Italy.
22-6-1873, † 2-6-1949.

SOMIGLIANA Carlo (18-1-1939), Professor of Mathematical Physics, University of Turin, Italy.
20-9-1860, † 20-6-1955.

SPERI-SPERTI George (28-10-1936), Professor of Physics, St Thomas Institute, Cincinnati, OH, USA.
17-1-1900, † 29-4-1991.

SPERRY Roger Wolcott (17-4-1978), Professor of Psychobiology, California Institute of Technology, Pasadena, USA. Nobel laureate in Physiology or Medicine, 1981.
20-8-1913, † 17-4-1994.

STEIN Rev. Fr. Johan Willem Jakob Antoon, S.J. (28-10-1936), Director, Vatican Observatory, Vatican City; Academician 'Perdurante Munere'.
27-2-1871, † 27-12-1951.

STONELEY Robert (10-4-1970), Professor of Theoretical Geophysics, University of Cambridge, UK.
14-5-1894, † 2-2-1976.

STRÖMGREN Bengt (2-12-1975), Professor Emeritus of Astronomy and Director, NORDITA, Copenhagen, Denmark.
21-1-1908, † 4-7-1987.

SZENT-GYÖRGYI Albert (10-4-1970), Professor of Biochemistry, National Foundation for Cancer Research, Woods Hole, MA, USA. Nobel laureate in Physiology or Medicine, 1937.
16-8-1893, † 22-10-1986.

SZENTÁGOTHAI János (12-5-1981), Professor of Anatomy, Semmelweis University, Budapest, Hungary.
31-10-1912, † 8-9-1994.

TARDINI Card. Domenico (19-3-1960), Secretary of State to His Holiness Pope John XXIII, Vatican City (Honorary Academician).
29-2-1888, † 30-7-1961.

TAYLOR Sir Hugh Stott (28-10-1936), Professor of Chemistry, University of Princeton, NJ, USA.
6-2-1890, † 17-4-1974.

TISELIUS Arne Wilhelm Kaurin (5-4-1955), Professor of Biochemistry, University of Uppsala, Sweden. Nobel laureate in Chemistry, 1948.
10-8-1901, † 29-10-1971.

TISSERANT Card. Eugène (19-3-1960), Librarian and Archivist of the Holy See and Dean of the College of Cardinals (Honorary Academician).
24-3-1884, † 21-2-1972.

TONELLI Leonida (23-5-1942), Professor of Mathematical Analysis, University of Pisa, Italy.
19-4-1885, † 11-3-1946.

TONIOLO Renato Antonio (28-10-1936), Professor of General Geography, University of Bologna, Italy.
7-4-1881, † 9-5-1955.

TREANOR Rev. Fr. Patrick, S.J. (11-9-1970), Director, Vatican Observatory, Vatican City; Academician 'Perdurante Munere'.
15-3-1920, † 18-2-1978.

TSCHERMAK-SEYSENEGG Armin (28-10-1936), Professor of Physiology, Philosophisch-Theologische Hochschule, Regensburg, Germany.
21-9-1870, † 9-10-1952.

UBBELOHDE Alfred René (22-4-1968), Professor of Thermodynamics, Imperial College, London, UK.
14-12-1907, † 7-1-1988.

UMEZAWA Hamao (26-9-1983), Professor of Biochemistry, Institute of Microbial Chemistry, Tokyo, Japan.
1-10-1914, † 25-12-1986.

URSPRUNG Alfred (25-6-1941), Professor of Botany, University of Fribourg, Germany.
22-12-1876, † 21-4-1952.

VALLAURI Giancarlo (28-10-1936), Professor of Electrotechnology, Istituto Superiore di Ingegneria, Turin, Italy.
19-10-1882, † -5-1957.

de la VALLÉE POUSSIN Baron Charles Jean (28-10-1936), Professor of Mathematics, Université Catholique, Louvain, Belgium.
14-8-1866, † 2-3-1962.

VALLETTA Vittorio (31-8-1956), Engineer, Turin, Italy (Honorary Academican).
28-7-1883, † 10-8-1967.

VENING MEINSZ Felix Andries (24-9-1964), University Professor of Geophysics, Professor of Geodetic Science, Technische Hogesschool of Delft and Head Director, Royal Dutch Meteorological Institute, De Bilt, Utrecht, Netherlands.
30-7-1887, † 12-8-1966.

VERCELLI Francesco (28-10-1936), Director, Istituto Talassografico and Osservatorio Geofisico, Trieste, Italy.
22-10-1883, † 24-11-1952.

VIRTANEN Artturi Ilmari (5-4-1955), Professor of Biochemistry and President, Finnish Academy, Helsinki, Finland. Nobel laureate in Chemistry, 1945.
15-1-1895, † 11-12-1973.

VOLTERRA Vito (28-10-1936), Professor of Mathematical Physics and Celestial Mechanics, University of Rome, Italy.
3-5-1860, † 11-10-1940.

WEISSKOPF Victor Frederick (2-12-1975), Professor of Physics, Massachusetts Institute of Technology, Cambridge, MA, USA.
19-9-1908, † 21-4-2002.

WEYL Hermann (5-4-1955), Professor of Mathematics, University of Zurich, Switzerland.
9-11-1885, † 9-12-1955.

WHITTAKER Sir Edmund Taylor (28-10-1936), Professor of Mathematics, University of Edinburgh, UK.
24-10-1873, † 24-4-1956.

WIESNER Karel Frantisek (17-4-1978), Professor of Chemistry, University of New Brunswick, Fredericton, Canada.
25-11-1919, † 28-11-1986.

YUKAWA Hideki (3-5-1961), Director, Research Institute for Fundamental Physics, Kyoto, Japan. Nobel laureate in Physics, 1949.
23-1-1907, † 8-9-1981.

ZEEMAN Pieter (28-10-1936), Professor of Physics, University of Amsterdam, Netherlands. Nobel laureate in Physics, 1902.
25-5-1865, † 9-10-1943.

STATISTICAL TABLES

1. LIST OF DISCIPLINES

1. Astronomy
2. Chemistry
3. Earth and Environmental Sciences
4. Life Sciences
    - 4.1. Botany
    - 4.2. Agronomy
    - 4.3. Zoology
    - 4.4. Genetics
    - 4.5. Molecular Biology
    - 4.6. Biochemistry
    - 4.7. Neuroscience
    - 4.8. Surgery
5. Mathematics
6. Applications of Science
7. Philosophy and History of Science (Epistemology); Foundations of Science
8. Physics
9. Other Disciplines

2. ACADEMICIANS IN ALPHABETICAL ORDER

	Name	Birth	App.	Residence	Disc.*
1	ARBER W. (Nobel)	1929	1981	SWITZERLAND	4.4
2	ASHOKA P. (formerly LAMBO)	1923	1974	NEPAL	6
3	BALTIMORE D. (Nobel)	1938	1978	USA	4.5
4	BATTRO A.M.	1936	2002	ARGENTINA	4.7
5	BECKER G.S. (Nobel)	1930	1997	USA	9
6	BEKOE D.A.	1928	1983	GHANA	2
7	BERG P. (Nobel)	1926	1996	USA	4.6
8	BERGSTRÖM S. (Nobel)	1916	1985	SWEDEN	4.6
9	BERTI E.	1935	2001	ITALY	7
10	BLOBEL G. (Nobel)	1936	2001	USA	4.5
11	BOHR A. (Nobel)	1922	1978	DENMARK	8
12	BOON-FALLEUR T.	1944	2002	BELGIUM	4.5
13	CABIBBO N.	1935	1986	ITALY	8
14	CAFFARELLI L.A.	1948	1994	USA	5
15	CAVALLI-SFORZA L.L.	1922	1994	USA	4.4
16	CHANG T.-T.	1927	1997	CHINA (Rep. of)	4.4
17	COHEN-TANNOUDJI C. (Nobel)	1933	1999	FRANCE	8
18	COLOMBO B.M.	1919	1992	ITALY	9
19	CORY S.	1942	2004	AUSTRALIA	4.5
20	COTTIER G.M.M.	1922	1992	VATICAN CITY	9
21	COYNE G.V.	1933	1978	VATICAN CITY	1
22	CROXATTO H.R.	1908	1975	CHILE	4.6
23	CRUTZEN P.J. (Nobel)	1933	1996	GERMANY	3
24	DE DUVE C. (Nobel)	1917	1970	BELGIUM	4.6
25	EIGEN M. (Nobel)	1927	1981	GERMANY	2
26	ESCHENMOSER A.	1925	1986	SWITZERLAND	2
27	FARINA R.	1933	1997	VATICAN CITY	9
28	GARCÍA-BELLIDO A.	1936	2003	SPAIN	4.5
29	GERMAIN P.	1920	1986	FRANCE	5
30	HAWKING S.W.	1942	1986	UK	8
31	HELLER M.	1936	1990	POLAND	7

* The numeration of these disciplines is referred to in the statistical tables.

	Name	Birth	App.	Residence	Disc.
32	HIDE R.	1929	1996	UK	3
33	JAKI S.L.	1924	1990	USA	7
34	KAFATOS F.C.	1940	2003	GERMANY	4.5
35	KEILIS-BOROK V.I.	1921	1994	USA	3
36	KHORANA H.G. (Nobel)	1922	1978	USA	4.6
37	LE DOUARIN N.M.	1930	1999	FRANCE	4.5
38	LEDERBERG J. (Nobel)	1925	1996	USA	4.4
39	LEE T.-D. (Nobel)	1926	2003	USA	8
40	LEHN J.-M. (Nobel)	1939	1996	FRANCE	2
41	LÉNA P.J.	1937	2001	FRANCE	1
42	LEVI-MONTALCINI R. (Nobel)	1909	1974	ITALY	4.7
43	MALDAMÉ J.-M.	1939	1997	FRANCE	7
44	MALU F.W.K.	1936	1983	CONGO (D.R.)	6
45	MANIN Y.I.	1937	1996	GERMANY	5
46	MARTINI C.M.	1927	2000	ITALY	9
47	MENON M.G.K.	1928	1981	INDIA	8
48	MINTZ B.	1921	1986	USA	4.4
49	MITTELSTRASS J.	1936	2002	GERMANY	7
50	MOLINA M.J. (Nobel)	1943	2000	USA	2
51	MOSHINSKY M.	1921	1986	MEXICO	8
52	MÖSSBAUER R.L. (Nobel)	1929	1970	GERMANY	8
53	MURADIAN R.	1936	1994	BRAZIL	1
54	MURRAY J.E. (Nobel)	1919	1996	USA	4.8
55	NIRENBERG M.W. (Nobel)	1927	1974	USA	4.4
56	NOVIKOV S.P.	1938	1996	RUSSIA	5
57	NOYORI R. (Nobel)	1938	2002	JAPAN	2
58	OLECH C.	1931	1986	POLAND	5
59	PAGANO S.	1948	1997	VATICAN CITY	9
60	PALADE G.E. (Nobel)	1912	1975	USA	4.5
61	PAVAN C.	1919	1978	BRAZIL	4.4
62	PHILLIPS W.D. (Nobel)	1948	2004	USA	8
63	POLANYI J.C. (Nobel)	1929	1986	CANADA	2
64	PRESS F.	1924	1999	USA	3

	Name	Birth	App.	Residence	Disc.
65	PUPPI G.	1917	1978	ITALY	8
66	QUÉRÉ Y.	1931	2003	FRANCE	8
67	RAO C.N.R.	1934	1990	INDIA	2
68	RATZINGER J.	1927	2000	VATICAN CITY	9
69	RAVEN P.H.	1936	1990	USA	4.1
70	REES M.J.	1942	1990	UK	1
71	RICH A.	1924	1978	USA	4.5
72	DI ROVASENDA C.E.	1906	1986	ITALY	9
73	RUBBIA C. (Nobel)	1934	1985	ITALY	8
74	RUBIN V.C.	1928	1996	USA	1
75	SAGDEEV R.Z.	1932	1990	USA	8
76	SÁNCHEZ SORONDO M.	1942	1998	ITALY	7
77	SELA M.	1924	1975	ISRAEL	4.6
78	SIEGBAHN K. (Nobel)	1918	1985	SWEDEN	8
79	SINGER M.F.	1931	1986	USA	4.6
80	SINGER W.J.	1943	1992	GERMANY	4.7
81	SOUTHWOOD R.	1931	1992	UK	4.3
82	SZCZEKLIK A.	1938	1994	POLAND	4.5
83	THIRRING W.E.	1927	1986	AUSTRIA	5
84	TOWNES C.H. (Nobel)	1915	1983	USA	8
85	TUPPY H.	1924	1970	AUSTRIA	4.6
86	VICUÑA R.	1949	2000	CHILE	4.6
87	WHITE R.J.	1926	1994	USA	4.7
88	YANG C.N. (Nobel)	1922	1997	USA	8
89	ZEWAIL A.H. (Nobel)	1946	1999	USA	2
90	ZICHICHI A.	1929	2000	ITALY	8

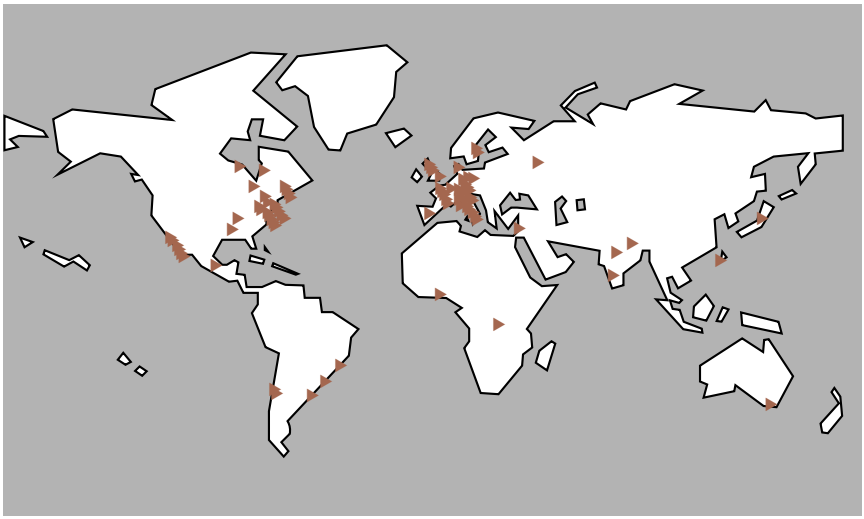
3. NATION OF BIRTH AND RESIDENCE

Nation	Birth	Residence
ALGERIA	COHEN-TANNOUDJI C. MALDAMÉ J.-M.	
ARGENTINA	BATTRO A.M. CAFFARELLI L.A. SÁNCHEZ SORONDO M.	BATTRO A.M.
ARMENIA	MURADIAN R.	
AUSTRALIA	CORY S.	CORY S.
AUSTRIA	THIRRING W.E. TUPPY H.	THIRRING W.E. TUPPY H.
BELGIUM	BOON-FALLEUR T.	BOON-FALLEUR T. DE DUVE C.
BRAZIL	PAVAN C.	MURADIAN R. PAVAN C.
CANADA		POLANYI J.C.
CHILE	CROXATTO H.R. VICUÑA R.	CROXATTO H.R. VICUÑA R.
CHINA (D.R.)	CHANG T.-T. LEE T.-D. RAVEN P.H. YANG C.N.	
CHINA (Rep. of)		CHANG T.-T.
CONGO (D.R.)	MALU F.W.K.	MALU F.W.K.
DENMARK	BOHR A.	BOHR A.
EGYPT	ZEWAIL A.H.	
FRANCE	GERMAIN P. LE DOUARIN N.M. LEHN J.-M. LÉNA P.J. QUÉRÉ Y.	COHEN-TANNOUDJI C. GERMAIN P. LE DOUARIN N.M. LEHN J.-M. LÉNA P.J. MALDAMÉ J.-M. QUÉRÉ Y.

Nation	Birth	Residence
GERMANY	BLOBEL G. EIGEN M. MITTELSTRASS J. MÖSSBAUER R.L. POLANYI J.C. RATZINGER J. SINGER W.J.	CRUTZEN P.J. EIGEN M. KAFATOS F.C. MANIN Y.I. MITTELSTRASS J. MÖSSBAUER R.L. SINGER W.J.
GHANA	BEKOE D.A.	BEKOE D.A.
GREECE	KAFATOS F.C.	
HOLLAND	CRUTZEN P.J.	
HUNGARY	JAKI S.L.	
INDIA	KHORANA H.G. MENON M.G.K. RAO C.N.R.	MENON M.G.K. RAO C.N.R.
ISRAEL		SELA M.
ITALY	BERTI E. CABIBBO N. CAVALLI-SFORZA L.L. COLOMBO B.M. FARINA R. LEVI-MONTALCINI R. MARTINI C.M. PAGANO S. PUPPI G. DI ROVASENDA C.E. RUBBIA C. ZICHICHI A.	BERTI E. CABIBBO N. COLOMBO B.M. LEVI-MONTALCINI R. MARTINI C.M. PUPPI G. DI ROVASENDA C.E. RUBBIA C. SÁNCHEZ SORONDO M. ZICHICHI A.
JAPAN	NOYORI R.	NOYORI R.
MEXICO	MOLINA M.J.	MOSHINSKY M.
NEPAL		ASHOKA P. (formerly LAMBO)
NIGERIA	ASHOKA P. (formerly LAMBO)	
POLAND	HELLER M. OLECH C.	HELLER M. OLECH C.

Nation	Birth	Residence
POLAND	SELA M. SZCZEKLIK A.	SZCZEKLIK A.
ROMANIA	PALADE G.	
RUSSIA	KEILIS-BOROK V.I. MANIN Y.I. MOSHINSKY M. NOVIKOV S.P. SAGDEEV R.Z.	NOVIKOV S.P.
SPAIN	GARCÍA-BELLIDO A.	GARCÍA-BELLIDO A.
SWEDEN	BERGSTRÖM S. SIEGBAHN K.	BERGSTRÖM S. SIEGBAHN K.
SWITZERLAND	ARBER W. COTTIER G.M.M. ESCHENMOSER A.	ARBER W. ESCHENMOSER A.
UK	DE DUVE C. HAWKING S.W. HIDE R. REES M.J. SOUTHWOOD R.	HAWKING S.W. HIDE R. REES M.J. SOUTHWOOD R.
USA	BALTIMORE D. BECKER G.S. BERG P. COYNE G.V. LEDERBERG J. MINTZ B. MURRAY J. NIRENBERG M.W. PHILLIPS W.D. PRESS F. RICH A. RUBIN V.C. SINGER M.F. TOWNES C.H. WHITE R.J.	BALTIMORE D. BECKER G.S. BERG P. BLOBEL G. CAFFARELLI L.A. CAVALLI-SFORZA L.L. JAKI S.L. KEILIS-BOROK V.I. KHORANA H.G. LEDERBERG J. LEE T.-D. MINTZ B. MOLINA M.J. MURRAY J. NIRENBERG M.W.

Nation	Birth	Residence
USA		PALADE G. PHILLIPS W.D. PRESS F. RAVEN P.H. RICH A. RUBIN V.C. SAGDEEV R.Z. SINGER M.F. TOWNES C.H. WHITE R.J. YANG C.N. ZEWAIL A.H.
VATICAN CITY		COTTIER G.M.M. COYNE G.V. FARINA R. PAGANO S. RATZINGER J.



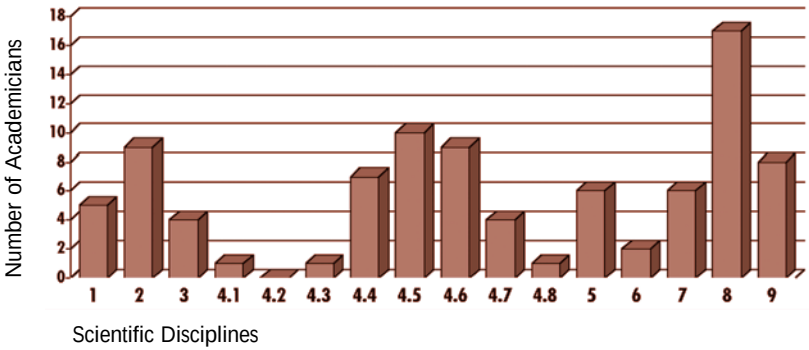
Approximate distribution of Academicians' places of residence.

4. SCIENTIFIC DISCIPLINES

1. ASTRONOMY	COYNE George V. LÉNA Pierre J. MURADIAN Rudolf REES Martin J. RUBIN Vera C.
2. CHEMISTRY	BEKOE Daniel A. EIGEN Manfred ESCHENMOSER Albert LEHN Jean-Marie MOLINA Mario J. NOYORI Ryoji POLANYI John C. RAO Chintamani N.R. ZEWAIL Ahmed H.
3. EARTH SCIENCES	CRUTZEN Paul J. HIDE Raymond KEILIS-BOROK Vladimir I. PRESS Frank
4. LIFE SCIENCES	
4.1. BOTANY	RAVEN Peter H.
4.2. AGRONOMY	
4.3. ZOOLOGY	SOUTHWOOD Richard
4.4. GENETICS	ARBER Werner CAVALLI-SFORZA Luigi L. CHANG Te-Tzu LEDERBERG Joshua MINTZ Beatrice NIRENBERG Marshall W. PAVAN Crodowaldo
4.5. MOLECULAR BIOLOGY	BALTIMORE David BLOBEL Günter BOON-FALLEUR Thierry CORY Suzanne

4.5. MOLECULAR BIOLOGY	GARCÍA-BELLIDO Antonio KAFATOS Fotis C. LE DOUARIN Nicole M. PALADE George E. RICH Alexander SZCZEKLIK Andrzej
4.6. BIOCHEMISTRY	BERG Paul BERGSTRÖM Sune CROXATTO Héctor R. DE DUVE Christian KHORANA Har Gobind SELA Michael SINGER Maxine F. TUPPY Hans VICUÑA Rafael
4.7. NEUROSCIENCE	BATTRO Antonio M. LEVI-MONTALCINI Rita SINGER Wolf J. WHITE Robert J.
4.8. SURGERY	MURRAY Joseph E.
5. MATHEMATICS	CAFFARELLI Luis A. GERMAIN Paul MANIN Yuri I. NOVIKOV Serguey P. OLECH Czesław THIRRING Walter E.
6. APPLICATIONS OF SCIENCE	ASHOKA Prasad (formerly LAMBO) MALU Félix Wa Kalenga
7. PHILOSOPHY AND HISTORY OF SCIENCE (EPISTEMOLOGY): FOUNDATIONS OF SCIENCE	BERTI Enrico HELLER Michael JAKI Stanley L. MALDAMÉ Jean-Michel MITTELSTRASS Jürgen SÁNCHEZ SORONDO Marcelo

8. PHYSICS	BOHR Aage CABIBBO Nicola COHEN-TANNOUDJI Claude HAWKING Stephen W. LEE Tsung-Dao MENON M. Govind Kumar MOSHINSKY Marcos MÖSSBAUER Rudolf L. PHILLIPS William Daniel PUPPI Giampietro QUÉRÉ Yves RUBBIA Carlo SAGDEEV Roald Z. SIEGBAHN Kai TOWNES Charles H. YANG Chen Ning ZICHICHI Antonino
9. OTHER DISCIPLINES	BECKER Gary S. COLOMBO Bernardo M. COTTIER Georges M.M. FARINA Raffaele MARTINI Carlo M. PAGANO Sergio RATZINGER Joseph DI ROVASENDA Carlo E.

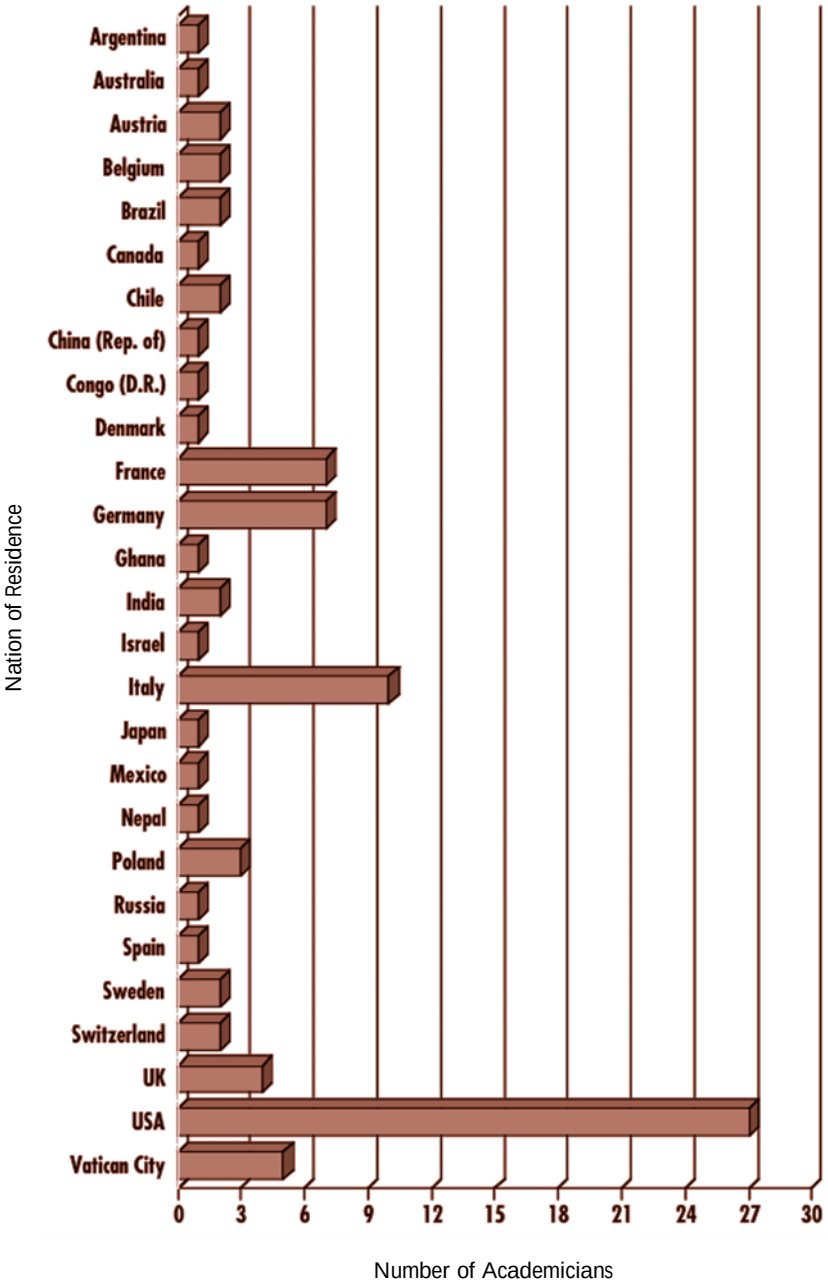


5. NATION OF RESIDENCE AND DISCIPLINE

Nation	Name	Discipline
ARGENTINA	BATTRO A.M.	LIFE SCIENCES (Neuroscience)
AUSTRALIA	CORY S.	LIFE SCIENCES (Molec. Biol.)
AUSTRIA	THIRRING W.E. TUPPY H.	MATHEMATICS LIFE SCIENCES (Biochemistry)
BELGIUM	BOON-FALLEUR T. DE DUVE C.	LIFE SCIENCES (Molec. Biol.) LIFE SCIENCES (Molec. Biol.)
BRAZIL	MURADIAN R. PAVAN C.	ASTRONOMY LIFE SCIENCES (Genetics)
CANADA	POLANYI J.C.	CHEMISTRY
CHILE	CROXATTO H.R. VICUÑA R.	LIFE SCIENCES (Biochemistry) LIFE SCIENCES (Biochemistry)
CHINA (Rep. of)	CHANG T.-T.	LIFE SCIENCES (Genetics)
CONGO (D.R.)	MALU F.W.K.	APPLICATIONS OF SCIENCE
DENMARK	BOHR A.	PHYSICS
FRANCE	COHEN-TANNOUDJI C. GERMAIN P. LE DOUARIN N.M. LEHN J.-M. LÉNA P. MALDAMÉ J.-M. QUÉRÉ Y.	PHYSICS MATHEMATICS LIFE SCIENCES (Molec. Biol.) CHEMISTRY ASTRONOMY FOUNDATIONS OF SCIENCE PHYSICS
GERMANY	CRUTZEN P.J. EIGEN M. KAFATOS F.C. MANIN Y.I. MITTELSTRASS J. MÖSSBAUER R.L. SINGER W.J.	EARTH SCIENCES CHEMISTRY LIFE SCIENCES (Molec. Biol.) MATHEMATICS FOUNDATIONS OF SCIENCE PHYSICS LIFE SCIENCES (Neuroscience)
GHANA	BEKOE D.A.	CHEMISTRY
INDIA	MENON M.G.K. RAO C.N.R.	PHYSICS CHEMISTRY

Nation	Name	Discipline
ISRAEL	SELA M.	LIFE SCIENCES (Biochemistry)
ITALY	BERTI E. CABIBBO N. COLOMBO B.M. LEVI-MONTALCINI R. MARTINI C.M. PUPPI G. DI ROVASENDA C.E. RUBBIA C. SÁNCHEZ SORONDO M. ZICHICHI A.	FOUNDATIONS OF SCIENCE PHYSICS OTHER DISCIPLINES LIFE SCIENCES (Neuroscience) OTHER DISCIPLINES PHYSICS OTHER DISCIPLINES PHYSICS FOUNDATIONS OF SCIENCE PHYSICS
JAPAN	NOYORI R.	CHEMISTRY
MEXICO	MOSHINSKY M.	PHYSICS
NEPAL	ASHOKA P. (formerly LAMBO)	APPLICATIONS OF SCIENCE
POLAND	HELLER M. OLECH C. SZCZKELIK A.	FOUNDATIONS OF SCIENCE MATHEMATICS LIFE SCIENCES (Molec. Biol.)
RUSSIA	NOVIKOV S.P.	MATHEMATICS
SPAIN	GARCÍA-BELLIDO A.	LIFE SCIENCES (Molec. Biol.)
SWEDEN	BERGSTRÖM S. SIEGBAHN K.	LIFE SCIENCES (Biochemistry) PHYSICS
SWITZERLAND	ARBER W. ESCHENMOSER A.	LIFE SCIENCES (Genetics) CHEMISTRY
UK	HAWKING S.W. HIDE R. REES M.J. SOUTHWOOD R.	PHYSICS EARTH SCIENCES ASTRONOMY LIFE SCIENCES (Zoology)
USA	BALTIMORE D. BECKER G.S. BERG P. BLOBEL G. CAFFARELLI L.A. CAVALLI-SFORZA L.L.	LIFE SCIENCES (Molec. Biol.) OTHER DISCIPLINES LIFE SCIENCES (Biochemistry) LIFE SCIENCES (Molec. Biol.) MATHEMATICS LIFE SCIENCES (Genetics)

Nation	Name	Discipline
USA	JAKI S.L.	FOUNDATIONS OF SCIENCE
	KEILIS-BOROK V.I.	EARTH SCIENCES
	KHORANA H.G.	LIFE SCIENCES (Biochemistry)
	LEDERBERG J.	LIFE SCIENCES (Genetics)
	LEE T.-D.	PHYSICS
	MINTZ B.	LIFE SCIENCES (Genetics)
	MOLINA M.J.	CHEMISTRY
	MURRAY J.E.	LIFE SCIENCES (Chemistry)
	NIRENBERG M.W.	LIFE SCIENCES (Genetics)
	PALADE G.	LIFE SCIENCES (Molec. Biol.)
	PHILLIPS W.D.	PHYSICS
	PRESS F.	EARTH SCIENCES
	RAVEN P.H.	LIFE SCIENCES (Botany)
	RICH A.	LIFE SCIENCES (Molec. Biol.)
	RUBIN V.C.	ASTRONOMY
	SAGDEEV R.Z.	PHYSICS
	SINGER M.F.	LIFE SCIENCES (Biochemistry)
	TOWNES C.H.	PHYSICS
	WHITE R.J.	LIFE SCIENCES (Neuroscience)
	YANG C.N.	PHYSICS
	ZEWAIL A.H.	CHEMISTRY
VATICAN CITY	COTTIER G.M.M.	OTHER DISCIPLINES
	COYNE G.V.	ASTRONOMY
	FARINA R.	OTHER DISCIPLINES
	PAGANO S.	OTHER DISCIPLINES
	RATZINGER J.	OTHER DISCIPLINES


Argentina
Australia
Austria
Belgium
Brazil
Canada
Chile
China (Rep. of)
Congo (D.R.)
Denmark
France
Germany
Ghana
India
Israel
Italy
Japan
Mexico
Nepal
Poland
Russia
Spain
Sweden
Switzerland
UK
USA
Vatican City
0
3
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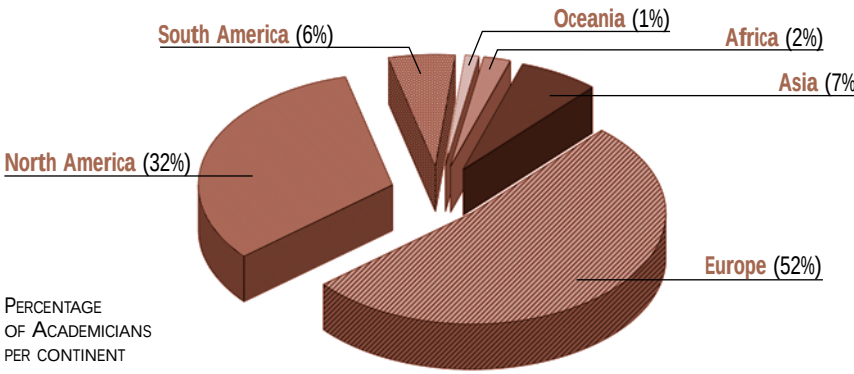
12
15
18
21
24
27
30
Nation of Residence
Number of Academicians

6. CONTINENT OF RESIDENCE AND DISCIPLINE

Continent	Name	Discipline
AFRICA	BEKOE D.A.	CHEMISTRY
	MALU F.W.K.	APPLICATIONS OF SCIENCE
ASIA	ASHOKA P. (formerly LAMBO)	APPLICATIONS OF SCIENCE
	CHANG T.-T.	LIFE SCIENCES (Genetics)
	MENON M.G.K.	PHYSICS
	NOYORI R.	CHEMISTRY
	RAO C.N.R.	CHEMISTRY
	SELA M.	LIFE SCIENCES (Biochemistry)
EUROPE	ARBER W.	LIFE SCIENCES (Genetics)
	BERGSTRÖM S.	LIFE SCIENCES (Biochemistry)
	BERTI E.	FOUNDATIONS OF SCIENCE
	BOHR A.	PHYSICS
	BOON-FALLEUR T.	LIFE SCIENCES (Molec. Biol.)
	CABIBBO N.	PHYSICS
	COHEN-TANNOUDJI C.	PHYSICS
	COLOMBO B.M.	OTHER DISCIPLINES
	COTTIER G.M.M.	OTHER DISCIPLINES
	COYNE G.V.	ASTRONOMY
	CRUTZEN P.J.	EARTH SCIENCES
	DE DUVE C.	LIFE SCIENCES (Biochemistry)
	EIGEN M.	CHEMISTRY
	ESCHENMOSER A.	CHEMISTRY
	FARINA R.	OTHER DISCIPLINES
	GARCÍA-BELLIDO A.	LIFE SCIENCES (Molec. Biol.)
	GERMAIN P.	MATHEMATICS
	HAWKING S.W.	PHYSICS
	HELLER M.	FOUNDATIONS OF SCIENCE
	HIDE R.	EARTH SCIENCES
	KAFATOS F.C.	LIFE SCIENCES (Molec. Biol.)
	LE DOUARIN N.M.	LIFE SCIENCES (Molec. Biol.)
	LEHN J.-M.	CHEMISTRY
	LÉNA P.J.	ASTRONOMY

Continent	Name	Discipline
EUROPE	LEVI-MONTALCINI R.	LIFE SCIENCES (Neuroscience)
	MALDAMÉ J.-M.	FOUNDATIONS OF SCIENCE
	MANIN Y.I.	MATHEMATICS
	MARTINI C.M.	OTHER DISCIPLINES
	MITTELSTRASS J.	FOUNDATIONS OF SCIENCE
	MÖSSBAUER R.L.	PHYSICS
	NOVIKOV S.P.	MATHEMATICS
	OLECH C.	MATHEMATICS
	PAGANO S.	OTHER DISCIPLINES
	PUPPI G.	PHYSICS
	QUÉRÉ Y.	PHYSICS
	RATZINGER J.	OTHER DISCIPLINES
	REES M.J.	ASTRONOMY
	DI ROVASENDA C.E.	OTHER DISCIPLINES
	RUBBIA C.	PHYSICS
	SÁNCHEZ SORONDO M.	FOUNDATIONS OF SCIENCE
	SIEGBAHN K.	PHYSICS
	SINGER W.J.	LIFE SCIENCES (Neuroscience)
	SOUTHWOOD R.	LIFE SCIENCES (Zoology)
	SZCZEKLIK A.	LIFE SCIENCES (Molec. Biol.)
	THIRRING W.E.	MATHEMATICS
	TUPPY H.	LIFE SCIENCES (Biochemistry)
	ZICHICHI A.	PHYSICS
NORTH AMERICA	BALTIMORE D.	LIFE SCIENCES (Molec. Biol.)
	BECKER G.S.	OTHER DISCIPLINES
	BERG P.	LIFE SCIENCES (Biochemistry)
	BLOBEL G.	LIFE SCIENCES (Molec. Biol.)
	CAFFARELLI L.A.	MATHEMATICS
	CAVALLI-SFORZA L.L.	LIFE SCIENCES (Genetics)
	JAKI S.L.	FOUNDATIONS OF SCIENCE
	KEILIS-BOROK V.I.	EARTH SCIENCES
	KHORANA H.G.	LIFE SCIENCES (Biochemistry)
	LEDERBERG J.	LIFE SCIENCES (Genetics)
	LEE T.-D.	PHYSICS

Continent	Name	Discipline
NORTH AMERICA	MINTZ B.	LIFE SCIENCES (Genetics)
	MOLINA M.J.	CHEMISTRY
	MOSHINSKY M.	PHYSICS
	MURRAY J.E.	LIFE SCIENCES (Surgery)
	NIRENBERG M.W.	LIFE SCIENCES (Genetics)
	PALADE G.	LIFE SCIENCES (Molec. Biol.)
	PHILLIPS W.D.	PHYSICS
	POLANYI J.C.	CHEMISTRY
	PRESS F.	EARTH SCIENCES
	RAVEN P.H.	LIFE SCIENCES (Botany)
	RICH A.	LIFE SCIENCES (Molec. Biol.)
	RUBIN V.C.	ASTRONOMY
	SAGDEEV R.Z.	PHYSICS
	SINGER M.F.	LIFE SCIENCES (Biochemistry)
	TOWNES C.H.	PHYSICS
	WHITE R.J.	LIFE SCIENCES (Neuroscience)
	YANG C.N.	PHYSICS
	ZEWAIL A.H.	CHEMISTRY
SOUTH AMERICA	BATTRO A.M.	LIFE SCIENCES (Neuroscience)
	CROXATTO H.R.	LIFE SCIENCES (Biochemistry)
	MURADIAN R.	ASTRONOMY
	PAVAN C.	LIFE SCIENCES (Genetics)
	VICUÑA R.	LIFE SCIENCES (Biochemistry)
OCEANIA	CORY S.	LIFE SCIENCES (Molec. Biol.)



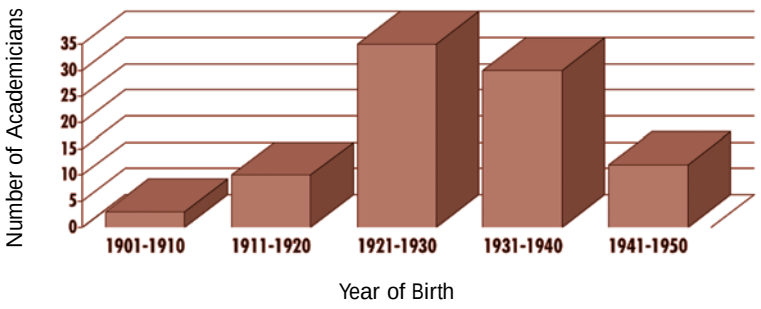
PERCENTAGE OF ACADEMICIANS PER CONTINENT

7. YEAR OF BIRTH AND DISCIPLINE

Birth	Name	Discipline
1906	DI ROVASENDA C.E.	OTHER DISCIPLINES
1908	CROXATTO H.R.	LIFE SCIENCES (Biochemistry)
1909	LEVI-MONTALCINI R.	LIFE SCIENCES (Neuroscience)
1912	PALADE G.	LIFE SCIENCES (Molec. Biol.)
1915	TOWNES C.H.	PHYSICS
1916	BERGSTRÖM S.	LIFE SCIENCES (Biochemistry)
1917	DE DUVE C. PUPPI G.	LIFE SCIENCES (Biochemistry) PHYSICS
1918	SIEGBAHN K.	PHYSICS
1919	COLOMBO B.M. MURRAY J.E. PAVAN C.	OTHER DISCIPLINES LIFE SCIENCES (Surgery) LIFE SCIENCES (Genetics)
1920	GERMAIN P.	MATHEMATICS
1921	KEILIS-BOROK V.I. MINTZ B. MOSHINSKY M.	EARTH SCIENCES LIFE SCIENCES (Genetics) PHYSICS
1922	BOHR A. CAVALLI-SFORZA L.L. COTTIER G.M.M. KHORANA H.G. YANG C.N.	PHYSICS LIFE SCIENCES (Genetics) OTHER DISCIPLINES LIFE SCIENCES (Biochemistry) PHYSICS
1923	ASHOKA P. (formerly LAMBO)	APPLICATIONS OF SCIENCE
1924	JAKI S.L. PRESS F. RICH A. SELA M. TUPPY H.	FOUNDATIONS OF SCIENCE EARTH SCIENCES LIFE SCIENCES (Molec. Biol.) LIFE SCIENCES (Biochemistry) LIFE SCIENCES (Biochemistry)
1925	ESCHENMOSER A. LEDERBERG J.	CHEMISTRY LIFE SCIENCES (Genetics)
1926	BERG P. LEE T.-D. WHITE R.J.	LIFE SCIENCES (Biochemistry) PHYSICS LIFE SCIENCES (Neuroscience)

Birth	Name	Discipline
1927	CHANG T.-T.	LIFE SCIENCES (Genetics)
	EIGEN M.	CHEMISTRY
	MARTINI C.M.	OTHER DISCIPLINES
	NIRENBERG M.W.	LIFE SCIENCES (Genetics)
	RATZINGER J.	OTHER DISCIPLINES
	THIRRING W.E.	MATHEMATICS
1928	BEKOE D.A.	CHEMISTRY
	MENON M.G.K.	PHYSICS
	RUBIN V.C.	ASTRONOMY
1929	ARBER W.	LIFE SCIENCES (Genetics)
	HIDE R.	EARTH SCIENCES
	MÖSSBAUER R.L.	PHYSICS
	POLANYI J.C.	CHEMISTRY
	ZICHICHI A.	PHYSICS
1930	BECKER G.S.	OTHER DISCIPLINES
	LE DOUARIN N.M.	LIFE SCIENCES (Molec. Biol.)
1931	OLECH C.	MATHEMATICS
	QUÉRÉ Y.	PHYSICS
	SINGER M.F.	LIFE SCIENCES (Biochemistry)
	SOUTHWOOD R.	LIFE SCIENCES (Zoology)
1932	SAGDEEV R.Z.	PHYSICS
1933	COHEN-TANNOUDJI C.	PHYSICS
	COYNE G.V.	ASTRONOMY
	CRUTZEN P.J.	EARTH SCIENCES
	FARINA R.	OTHER DISCIPLINES
1934	RAO C.N.R.	CHEMISTRY
	RUBBIA C.	PHYSICS
1935	BERTI E.	FOUNDATIONS OF SCIENCE
	CABIBBO N.	PHYSICS
1936	BATTRO A.M.	LIFE SCIENCES (Neuroscience)
	BLOBEL G.	LIFE SCIENCES (Molec. Biol.)
	GARCÍA-BELLIDO A.	LIFE SCIENCES (Molec. Biol.)
	HELLER M.	FOUNDATIONS OF SCIENCE

Birth	Name	Discipline
1936	MALU F.W.K. MITTELSTRASS J. MURADIAN R. RAVEN P.H.	APPLICATIONS OF SCIENCE FOUNDATIONS OF SCIENCE ASTRONOMY LIFE SCIENCES (Botany)
1937	LÉNA P.L. MANIN Y.I.	ASTRONOMY MATHEMATICS
1938	BALTIMORE D. NOVIKOV S.P. NOYORI R. SZCZEKLIK A.	LIFE SCIENCES (Molec. Biol.) MATHEMATICS CHEMISTRY LIFE SCIENCES (Molec. Biol.)
1939	LEHN J.-M. MALDAMÉ J.-M.	CHEMISTRY FOUNDATIONS OF SCIENCE
1940	KAFATOS F.C.	LIFE SCIENCES (Molec. Biol.)
1942	CORY S. HAWKING S.W. REES M.J. SÁNCHEZ SORONDO M.	LIFE SCIENCES (Molec. Biol.) PHYSICS ASTRONOMY FOUNDATIONS OF SCIENCE
1943	MOLINA M.J. SINGER W.J.	CHEMISTRY LIFE SCIENCES (Neuroscience)
1944	BOON-FALLEUR T.	LIFE SCIENCES (Molec. Biol.)
1946	ZEWAIL A.H.	CHEMISTRY
1948	CAFFARELLI L.A. PAGANO S. PHILLIPS W.D.	MATHEMATICS OTHER DISCIPLINES PHYSICS
1949	VICUÑA R.	LIFE SCIENCES (Biochemistry)

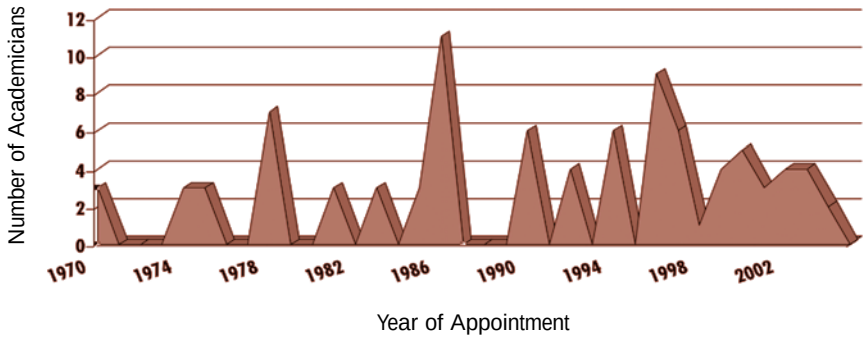


8. YEAR OF APPOINTMENT AND DISCIPLINE

Appointment	Name	Discipline
1970	DE DUVE C.	LIFE SCIENCES (Biochemistry)
	MÖSSBAUER R.L.	PHYSICS
	TUPPY H.	LIFE SCIENCES (Biochemistry)
1974	ASHOKA P. (formerly LAMBO)	APPLICATIONS OF SCIENCE
	LEVI-MONTALCINI R.	LIFE SCIENCES (Neuroscience)
	NIRENBERG M.W.	LIFE SCIENCES (Genetics)
1975	CROXATTO H.R.	LIFE SCIENCES (Biochemistry)
	PALADE G.	LIFE SCIENCES (Molec. Biol.)
	SELA M.	LIFE SCIENCES (Biochemistry)
1978	BALTIMORE D.	LIFE SCIENCES (Molec Biol.)
	BOHR A.	PHYSICS
	COYNE G.V.	ASTRONOMY
	KHORANA H.G.	LIFE SCIENCES (Biochemistry)
	PAVAN C.	LIFE SCIENCES (Genetics)
	PUPPI G.	PHYSICS
	RICH A.	LIFE SCIENCES (Molec. Biol.)
1981	ARBER W.	LIFE SCIENCES (Genetics)
	EIGEN M.	CHEMISTRY
	MENON M.G.K.	PHYSICS
1983	BEKOE D.A.	CHEMISTRY
	MALU F.W.K.	APPLICATIONS OF SCIENCE
	TOWNES C.H.	PHYSICS
1985	BERGSTRÖM S.	LIFE SCIENCES (Biochemistry)
	RUBBIA C.	PHYSICS
	SIEGBAHN K.	PHYSICS
1986	CABIBBO N.	PHYSICS
	ESCHENMOSER A.	CHEMISTRY
	GERMAIN P.	MATHEMATICS
	HAWKING S.W.	PHYSICS
	MINTZ B.	LIFE SCIENCES (Genetics)
	MOSHINSKY M.	PHYSICS
	OLECH C.	MATHEMATICS

Appointment	Name	Discipline
1986	POLANYI J.C. DI ROVASENDA C.E. SINGER M.F. THIRRING W.E.	CHEMISTRY OTHER DISCIPLINES LIFE SCIENCES (Biochemistry) MATHEMATICS
1990	HELLER M. JAKI S.L. RAO C.N.R. RAVEN P.H. REES M.J. SAGDEEV R.Z.	FOUNDATIONS OF SCIENCE FOUNDATIONS OF SCIENCE CHEMISTRY LIFE SCIENCES (Botany) ASTRONOMY PHYSICS
1992	COLOMBO B.M. COTTIER G.M.M. SINGER W.J. SOUTHWOOD R.	OTHER DISCIPLINES OTHER DISCIPLINES LIFE SCIENCES (Neuroscience) LIFE SCIENCES (Zoology)
1994	CAFFARELLI L.A. CAVALLI-SFORZA L.L. KEILIS-BOROK V.I. MURADIAN R. SZCZEKLIK A. WHITE R.J.	MATHEMATICS LIFE SCIENCES (Genetics) EARTH SCIENCES ASTRONOMY LIFE SCIENCES (Molec Biol.) LIFE SCIENCES (Neuroscience)
1996	BERG P. CRUTZEN P.J. HIDE R. LEDERBERG J. LEHN J.-M. MANIN Y.I. MURRAY J.E. NOVIKOV S.P. RUBIN V.C.	LIFE SCIENCES (Biochemistry) EARTH SCIENCES EARTH SCIENCES LIFE SCIENCES (Genetics) CHEMISTRY MATHEMATICS LIFE SCIENCES (Surgery) MATHEMATICS ASTRONOMY
1997	BECKER G.S. CHANG T.-T. FARINA R. MALDAMÉ J.-M. PAGANO S.	OTHER DISCIPLINES LIFE SCIENCES (Genetics) OTHER DISCIPLINES FOUNDATIONS OF SCIENCE OTHER DISCIPLINES

Appointment	Name	Discipline
1997	YANG C.N.	PHYSICS
1998	SÁNCHEZ SORONDO M.	FOUNDATIONS OF SCIENCES
1999	COHEN-TANNOUDJI C. LE DOUARIN N.M. PRESS F. ZEWAIL A.H.	PHYSICS LIFE SCIENCES (Molec. Biol.) EARTH SCIENCES CHEMISTRY
2000	MARTINI C.M. MOLINA M.J. RATZINGER J. VICUÑA R. ZICHICHI A.	OTHER DISCIPLINES CHEMISTRY OTHER DISCIPLINES LIFE SCIENCES (Biochemistry) PHYSICS
2001	BERTI E. BLOBEL G. LÉNA P.J.	FOUNDATIONS OF SCIENCE LIFE SCIENCES (Molec. Biol.) ASTRONOMY
2002	BATTRO A.M. BOON-FALLEUR T. NOYORI R. MITTELSTRASS J.	LIFE SCIENCES (Neuroscience) LIFE SCIENCES (Molec. Biol.) CHEMISTRY FOUNDATIONS OF SCIENCE
2003	GARCÍA-BELLIDO A. KAFATOS F.C. LEE T.-D. QUÉRÉ Y.	LIFE SCIENCES (Molec. Biol.) LIFE SCIENCES (Molec. Biol.) PHYSICS PHYSICS
2004	CORY S. PHILLIPS W.D.	LIFE SCIENCES (Molec. Biol.) PHYSICS



9. YEAR OF APPOINTMENT AND CONTINENT OF RESIDENCE

Appointment	Continent	Name
1970	EUROPE	DE DUVE C.
	EUROPE	MÖSSBAUER R.L.
	EUROPE	TUPPY H.
1974	ASIA	ASHOKA P. (formerly LAMBO)
	EUROPE	LEVI-MONTALCINI R.
	NORTH AMERICA	NIRENBERG M.W.
1975	ASIA	SELA M.
	NORTH AMERICA	PALADE G.
	SOUTH AMERICA	CROXATTO H.R.
1978	EUROPE	BOHR A.
	EUROPE	COYNE G.V.
	EUROPE	PUPPI G.
	NORTH AMERICA	BALTIMORE D.
	NORTH AMERICA	KHORANA H.G.
	NORTH AMERICA	RICH A.
	SOUTH AMERICA	PAVAN C.
1981	ASIA	MENON M.G.K.
	EUROPE	ARBER W.
	EUROPE	EIGEN M.
1983	AFRICA	BEKOE D.A.
	AFRICA	MALU F.W.K.
	NORTH AMERICA	TOWNES C.H.
1985	EUROPE	BERGSTRÖM S.
	EUROPE	RUBBIA C.
	EUROPE	SIEGBAHN K.
1986	EUROPE	CABIBBO N.
	EUROPE	ESCHENMOSER A.
	EUROPE	GERMAIN P.
	EUROPE	HAWKING S.W.
	EUROPE	OLECH C.
	EUROPE	DI ROVASENDA C.E.
	EUROPE	THIRRING W.E.

Appointment	Continent	Name
1986	NORTH AMERICA	MINTZ B.
	NORTH AMERICA	MOSHINSKY M.
	NORTH AMERICA	POLANYI J.C.
	NORTH AMERICA	SINGER M.F.
1990	ASIA	RAO C.N.R.
	EUROPE	HELLER M.
	EUROPE	REES M.J.
	NORTH AMERICA	JAKI S.L.
	NORTH AMERICA	RAVEN P.H.
	NORTH AMERICA	SAGDEEV R.Z.
1992	EUROPE	COLOMBO B.M.
	EUROPE	COTTIER G.M.M.
	EUROPE	SINGER W.J.
	EUROPE	SOUTHWOOD R.
1994	ASIA	MURADIAN R.
	EUROPE	SZCZEKLIK A.
	NORTH AMERICA	CAFFARELLI L.A.
	NORTH AMERICA	CAVALLI-SFORZA L.L.
	NORTH AMERICA	KEILIS-BOROK V.I.
	NORTH AMERICA	WHITE R.J.
1996	EUROPE	CRUTZEN P.J.
	EUROPE	HIDE R.
	EUROPE	LEHN J.-M.
	EUROPE	MANIN Y.I.
	EUROPE	NOVIKOV S.P.
	NORTH AMERICA	BERG P.
	NORTH AMERICA	LEDERBERG J.
	NORTH AMERICA	MURRAY J.E.
	NORTH AMERICA	RUBIN V.C.
1997	ASIA	CHANG T.-T.
	EUROPE	FARINA R.
	EUROPE	MALDAMÉ J.-M.
	EUROPE	PAGANO S.
	NORTH AMERICA	BECKER G.S.

Appointment	Continent	Name
1997	NORTH AMERICA	YANG C.N.
1998	EUROPE	SÁNCHEZ SORONDO M.
1999	EUROPE	COHEN-TANNOUDJI C.
	EUROPE	LE DOUARIN N.M.
	NORTH AMERICA	PRESS F.
	NORTH AMERICA	ZEWAIL A.H.
2000	EUROPE	MARTINI C.M.
	EUROPE	RATZINGER J.
	EUROPE	ZICHICHI A.
	NORTH AMERICA	MOLINA M.J.
	SOUTH AMERICA	VICUÑA R.
2001	EUROPE	BERTI E.
	EUROPE	LÉNA P.J.
	NORTH AMERICA	BLOBEL G.
2002	ASIA	NOYORI R.
	EUROPE	BOON-FALLEUR T.
	EUROPE	MITTELSTRASS J.
	SOUTH AMERICA	BATTRO A.M.
2003	EUROPE	GARCÍA-BELLIDO A.
	EUROPE	KAFATOS F.C.
	EUROPE	QUÉRÉ Y.
	NORTH AMERICA	LEE T.-D.
2004	NORTH AMERICA	PHILLIPS W.D.
	OCEANIA	CORY S.

10. ACADEMICIANS APPOINTED BY EACH SUPREME PONTIFF*

Pope		*N.*
PIUS XI	(1936-1939)	82
PIUS XII	(1939-1958)	41
JOHN XXIII	(1958-1963)	24
PAUL VI	(1963-1978)	56
JOHN PAUL I	(1978)	1
JOHN PAUL II	(1978-)	104
	Total	308

* In the above table are included the following who are still alive but no longer Academicians:

ABRAGAM Anatole (15-12-1914), Honorary Professor of Physics, Collège de France, Paris, France. (Resigned)
METZLER Josef, O.M.I. (7-2-1921), Prefect, Secret Vatican Archive from 24-5-1984 to 27-7-1996. ('Perdurante Munere')
PITTAU Giuseppe, S.J. (20-10-1928), Chancellor, Pontifical Academy of Sciences from 1-7-1997 to 4-10-1998. ('Perdurante Munere')
STICKLER Card. Alfons Maria, S.D.B. (23-10-1910), Prefect, Apostolic Vatican Library from 25-3-1971 to 8-9-1983. ('Perdurante Munere')

WINNERS OF THE PRIZES OF THE ACADEMY

PIUS XI *and* PIUS XII PRIZES 1939-1943

Year	*Name*	*Nation*	*Discipline*
1939	HEYMANS Corneille J.F.	Belgium	Life Sciences
1942	SHAPLEY Harlow	USA	Astronomy
1943	DE MARGERIE Emanuel	France	Earth Sciences

THE PIUS XI MEDAL 1961-2002

Year	*Name*	*Nation*	*Discipline*
1961	WOODWARD Robert B.	USA	Chemistry
1962	ANDERSSON Bengt E.	Sweden	Life Sciences
1963	BOHR Aage	Denmark	Physics
1964	GROS François	France	Life Sciences
1966	SANDAGE Alan R.	USA	Astronomy
1970	KANATANI Haruo	Japan	Life Sciences
1972	NÉMETHY György	Hungary	Physics
1975	HAWKING Stephen W.	UK	Astronomy
1976	LUZZATTO Lucio	Italy	Life Sciences
1978	PAES DE CARVALHO Antonio	Brazil	Life Sciences
1981	LEHN Jean-Marie	France	Chemistry
1983	t'HOOFT Gerardus	Netherlands	Physics
1986	BERNAYS Elizabeth A.	Australia	Life Sciences
1988	CAFFARELLI Luis A.	Argentina	Mathematics
1992	SHAMIR Adi	Israel	Other Disciplines
1996	DAVIS Mark M.	USA	Chemistry
1998	BATES Gillian P.	UK	Life Sciences
1998	DAVIES Stephen W.	UK	Life Sciences
2000	DEHAENE Stanislas	France	Life Sciences
2002	MALDACENA Juan M.	USA	Life Sciences

EX **MOTU PROPRIO**

THE PONTIFICAL ACADEMY OF SCIENCES
28th October 1936
PIUS PP. XI

Amongst the many consolations which Almighty God has seen fit to bestow on Us during the course of Our Pontificate We are pleased to acknowledge that We have seen that not a few of those who experiment with the secrets of nature change their spiritual inclinations and attitude so radically, as to appear entirely renewed in spirit.

Science, which consists in a true recognition of fact, is never opposed to the truths of the Christian faith; in fact – as everyone who examines and meditates on the history of science, is bound to admit – the Pontiffs, together with the Church, have never at any time failed to encourage the research work of learned men, also in the sphere of experimental science; this research work has, in turn, made a valid contribution to the defence of the treasure of heavenly truth entrusted to the Church.

Consequently, as was solemnly declared by the Vatican Council, 'not only can faith and reason never disagree with each other, but they rather offer each other reciprocal help, because real reason demonstrates the foundation of faith and, illuminated by the light thereof, develops the science of things divine; while faith, in turn, liberates and defends reason from errors and enriches it with considerable knowledge'.

Unhappily, in recent times, some, who formerly lived in the paternal home of their inherited religion, have, like the 'prodigal son', miserably abandoned it, though not really for the purpose of learning the truth. It has also been asserted, especially during the last century, with false deductions and daring rashness, that the methods and reasonings of human science and of Divine Revelation are contrary one to the other. But now – and it is with no little consolation that We note it – such prejudiced opinions have been so thoroughly discredited that scarcely anyone can be found, among those who worthily carry on research in the physical sciences, who still asserts and defends such an error.

Nor do We wish here to pass over in silence the fact that, during the years of Our Pontificate, a number of scientists – among whom some were considered the highest in their special field and who had received the highest hon-

ours – when visiting Rome, even from various very distant lands, to attend meetings for the advancement of science, came to offer Us their deferential homage, or, rather, to offer it to that venerable Authority which, in the person, although undeserving, of the Successor of St. Peter, has been entrusted in perpetuity to this Apostolic See.

It has also happened that, among those eminent persons, some there were who, though they had not the precious gift of the Catholic Faith, did not, nevertheless, think it unbecoming to bow in reverence before this, Our Chair of Truth.

Some of these, moreover, speaking to Us in their own name as well as in the name of their colleagues, did not hesitate to state, and rightly, that all natural science prepares and consolidates the road leading to the Christian Faith; and their words filled Our fatherly heart with great happiness.

Therefore by the plenitude of Our Authority, *motu proprio,* and after careful deliberation, We constitute and declare established 'The Pontifical Academy of Sciences'.

To testify that We attribute to this Institution a dignity equal to its very high task, We ourselves appoint – and for this first time not by Our Authority alone, but of Our direct and spontaneous will – the seventy renowned scientists who will constitute the Pontifical Academy, and who will be called Pontifical Academicians.

These We have chosen with the greatest care from among those learned men who have, in their own countries, attained the highest peaks of renown.

In making Our choice, We have not only been influenced by the excellence of the research and achievements by which each of them has contributed to the advance of science, but also have taken into consideration their personal renown among scholars, as attested by the approbation and general esteem they enjoy.

Consequently, this Apostolic See hopes and expects to receive from them that help and honour of which this Senate of learned men, as it were a 'Scientific Senate', is a certain augury.

Nor should it seem excessive that this Assembly of noble disciplines should be designated by Us as, so to say, the Senate of the Apostolic See in the field of science. In fact, all honour rendered by scientists to the Divine is not only the homage due from human reason to the Supreme Truth, but also a noble expression of reverence to God the Creator.

Verily then do We desire and expect that the Pontifical Academicians, by means of this Institute of studies, which is both Ours and theirs, will give an

ever greater and higher contribution to the advance of science. We ask no more than this, since the service we expect of these servants of the truth is based on this high purpose and noble efforts.
Given in Rome, at St. Peter's, on the twenty-eighth day of October in the year 1936, the fifteenth of Our Pontificate.

PIUS PP. XI


ACTA APOSTOLICAE SEDIS

COMMENTARIUM OFFICIALE

STATUTES

PART I
CONSTITUTION AND PURPOSE

Art. 1 The Pontifical Academy of Sciences, founded by Pius XI of hallowed memory, is placed under the exalted and direct protection of the reigning Supreme Pontiff.

Art. 2 The purpose of the Pontifical Academy of Sciences is to promote the progress of the mathematical, physical and natural sciences and the study of related epistemological questions and issues.

Art. 3 In order to achieve its ends the Academy:
a) holds plenary sessions of the Academicians;
b) organises meetings to promote the progress of science and the solution of important scientific-technical problems at the root of the development of mankind;
c) promotes scientific investigations and research which can contribute, in the appropriate spheres, to the exploration of moral, social and spiritual questions;
d) arranges conferences and celebrations;
e) engages in the publication of the Proceedings of its own meetings and the results of the scientific research and studies of the Academicians and other scientists.

Art. 4 With the object of promoting scientific research, the Academy every two years awards the Pius XI Medal to a young scientist of international reputation.

PART II
THE ACADEMICIANS

Art. 5 Candidates for a seat in the Academy are chosen by the Academy on the basis of their eminent original scientific studies and their acknowledged moral personality, without any form of ethnic or religious discrimination, and are appointed for life by sovereign act of the Holy Father.
In addition, *ex officio*, the Director of the Vatican Observatory; the Director of the Astrophysical Laboratory of the Vatican Observatory; the Prefect of the Vatican Library; and the Prefect of the Secret Archives of the Vatican, are

appointed 'Academicians pro tempore'. The Academicians 'pro tempore' enjoy the same rights and perform the same functions as the Pontifical Academicians. As an exception, and in a purely honorary capacity, persons who deserve the special gratitude of the Academy, by honouring it and helping it and its scientific undertakings, after being proposed by the Council of the Academy, can be appointed by the Holy Father 'Honorary Pontifical Academicians'.

Art. 6 The full complement of the Academy consists of seventy life members, chosen in such a way that as far as possible all the principal branches of the sciences and all the great geographical regions are represented.[1]

PART III
THE GOVERNMENT OF THE ACADEMY

Art. 7 The Academy is governed by a President, appointed from among the Academicians by the Supreme Pontiff, Motu Proprio. The President is under the direct authority of the Supreme Pontiff. The President remains in office for four years and can be reappointed by the Supreme Pontiff. The President guides and directs every activity of the Academy and represents it in relations with the Holy See and every other Authority or Institution.

Art. 8 The President is assisted by the Council of the Academy, which is constituted as follows:
a) the outgoing President for a period of four years;
b) the former President appointed by the Holy Father President Emeritus for life;
c) five Councillors appointed by the Holy Father, after being proposed by the President, for a period of four years, who can be reappointed.[2]

Art. 9 The President is assisted directly by the Director of the Chancellery,[3] who is appointed by the Holy Father for a period of four years and can be reappointed.

[1] On 8 January 1986 John Paul II increased the number of Academicians for life to eighty.
[2] On 20 November 1995 John Paul II increased the number of Councillors to seven.
[3] On 30 January 1995 John Paul II appointed the Director of the Chancellery: 'Chancellor', 'Academician Perdurante Munere' and 'Councillor Perdurante Munere'.

Part IV
FINANCIAL RESOURCES

Art. 10 The financing of the Academy is ensured by the Administration of the Patrimony of the Apostolic See.

Art. 11 The Academy can also make use of possible gifts, legacies and income derived from its activity.

Art. 12 The President with his Council considers the expenditure necessary for the life of the Academy and approves the budgets and accounts.

Part V
GENERAL REGULATIONS

Art. 13 The present Statutes, promulgated by their publication in the *Acta Apostolicae Sedis,* replace the former Statutes published in the *Acta Apostolicae Sedis* of the year 1936, p. 427 and ff. Every modification of the present Statutes is reserved to the Supreme Pontiff, who is the sole authority competent to dissolve the Academy.

Art. 14 The present Statutes are supplemented by the Regulations drawn up and approved by the President with his Council.

Haec Statuta Paulus VI Summus Pontifex in Audientia infrascripto concessa die I mensis Aprilis, anno MCMLXXVI, approbavit et publici iuris fieri iussit.

Ioannes Card. Villot, *Secretarius Status*

SCIENTIFIC MEETINGS

1949-2003

Title	*Year*
The Biological Problem of Cancer	1949
The Problem of Microseisms	1951
The Problem of Oligo-elements in Vegetal and Animal Life	1955
The Problem of Stellar Population	1957
The Problem of Macromolecules of Biological Interest with Special Reference to Nuclear Proteins	1961
The Problem of Cosmic Radiation in Interplanetary Space	1962
The Econometric Approach to Development Planning	1963
Brain and Conscious Experience	1964
Molecular Forces	1966
Organic Matter and Soil Fertility	1968
Nuclei of Galaxies	1970
Use of Fertilizers and its Effect in Increasing Yield with Particular Attention to Quality and Economy	1972
Oriented Mutation in Man	1974
Biological and Artificial Membranes and Desalination of Water	1975
The Effect of Ionizing Radiation in Man	1975
Natural Products and the Protection of Plants	1976
The Role of Non-specific Immunity in the Prevention and Treatment of Cancer	1977
Nerve Cells, Transmitters and Behaviour	1978
Molecular Aspects of the Origin of Life	1978
The Dangers of a Nuclear War	1980
Mental Deficiency	1980
Mankind and Energy: Needs, Resources, Hopes	1980
Cosmology and Fundamental Physics	1981
Perspectives on Immunization in Parasitic Diseases	1981
The Consequences of the Use of Nuclear Weapons	1981
Recent Advances in the Evolution of Primates	1982
Peace and the Rights of Man	1982

Title	*Year*
The Gregorian Reform of the Calendar	1982
The Prevention of Nuclear War	1982
Modern Biological Experimentation	1982
Pattern Recognition Mechanisms	1983
Biological Implications of Optimization in Radiation Procedures	1983
Specificity in Biological Interactions	1983
Modern Biology Applied to Agriculture	1983
Chemical Events in the Atmosphere and their Impact on the Environment	1983
Effects of a Nuclear Explosion in the Atmosphere: Nuclear Winter	1984
Immunology, Epidemiology and Social Aspects of Leprosy	1984
Energy For Survival and Development	1984
Extra Corporeal Fecundation	1984
The Impact of Space Exploration on Mankind	1984
Weaponization of Space	1985
Developmental Neurobiology of Mammals	1985
The Artificial Prolongation of Life and the Determination of the Exact Moment of Death	1985
Interaction of Parasitic Diseases and Nutrition	1985
Remote Sensing and its Impact on Developing Countries	1986
Persistent Meteo-oceanographic Anomalies and Teleconnections	1986
Molecular Mechanisms of Carcinogenic and Antitumor Activity	1986
The Fiftieth Anniversary of the Academy	1986
Aspects of the Uses of Genetic Engineering	1987
A Modern Approach to the Protection of the Environment	1987
Large Scale Motions in the Universe	1987
Agriculture and the Quality of Life. New Global Trends	1988
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16 Oct. 2004	Anniversary of the Pontificate
31 Oct.-2 Nov. 2004	Working Group on 'Interactions between Global Change and Human Health'
5-8 Nov. 2004	Plenary Session on 'Paths of Discovery'
Feb. 2005	Working Group on 'Life – Worthy of Protection from Beginning to End'
27 March 2005	Easter
11-14 Nov. 2005	Working Group on 'GM Crops'
Nov. 2005	Joint Meeting PAS and PASS on 'Globalisation and Education'

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