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COMMEMORATION
OF THE
ACADEMICIANS

Deceased from 1992 to 1994

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COMMENTARII
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COMMEMORATION OF ACADEMICIANS

Deceased from 1992 to 1994
(Alphabetical order)

1. **LEJEUNE Jérôme.** Human Genetics - France
born 13.6.1926 - appointed 24.6.1974 † 3.4.1994.
Commemorated by Bernard Pullman and Birthe Lejeune

2. **MORGAN William Wilson.** Astronomy - U.S.A.
born 3.1.1906 - appointed 24.9.1964 † 21.6.1994.
Commemorated by Martin J. Rees

3. **OCHOA Severo.** Biology - Spain
born 24.9.1905 - appointed 24.6.1974 † 1.11.1993.
Commemorated by Hector R. Croxatto and Santiago Grisolia

4. **OORT Jan Hendrik.** Astronomy - The Netherlands
born 28.4.1990 - appointed 18.8.1961 † 5.11.1992.
Commemorated by Martin J. Rees

5. **SIDDIQUI Salimuzzaman.** Chemistry - Pakistan
born 19.10.1987 - appointed 24.9.1964 † 14.4.1994.
Commemorated by Chintamani N.R. Rao

6. **SZENTÁGOTHAI János.** Neuroanatomy - Hungary.
born 31.10.1912 - appointed 12.5.1981 † 8.9.1994.
Commemorated by Rita Levi-Montalcini and Balázs Gulyás

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1.

JÉRÔME LEJEUNE

Prof. J. Lejeune born in Montrouge (France) on 13 June 1926, died in Paris on 4 April 1994. Appointed Member of the Pontifical Academy of Sciences on 24 June 1974. Professor of Genetics at the "Institut de Progrès" of Paris. His principal scientific discovery was in 1958, the first human chromosomic anomaly: the "trisomy 21", cause of Down's Syndrome. His works contributed greatly to the foundation of human cytogenetics as a new discipline.

Commemorated

by

Bernard Pullman and Birthe Lejeune

BERNARD PULLMAN *

Monsieur le Président, Monseigneur, Madame,
Mes Chers Confrères,

Avec la disparition — tellement prématurée — de Jérôme Lejeune, L'Académie Pontificale des Sciences perd un de ses membres les plus éminents et les plus attachants; l'Église, un de ses fils les plus doués et les plus dévoués, un défenseur intransigeant de son enseignement religieux et éthique; la France, sa patrie, un de ses savants les plus remarquables qui lui a assuré, dans le domaine de sa spécialité, une position de premier plan sur la scène mondiale.

Lorsque l'on est confronté — comme je le suis en ce moment — avec la tâche d'évoquer l'existence d'une personnalité aussi polyvalente, riche de tant de talents, aux activités aussi multiples que Jérôme Lejeune — chercheur, savant, enseignant, médecin, moraliste, homme public, dans le sens le plus noble du terme — il est naturel que l'on ait tendance à essayer de mettre en relief ces différents aspects, ces différentes facettes de sa forte individualité et de son vaste œuvre. Et il est juste — indispensable même — parlant de Jérôme Lejeune, de souligner:

— ses remarquables découvertes *scientifiques*, en premier lieu la plus célèbre, faite en 1958 à l'âge de 33 ans et qui devait orienter toute son activité future, à savoir la mise en évidence de la première anomalie chromosomique humaine, consistant

* Prof. Bernard Pullman born in Wloclawek (Poland) on 19 March 1919 and appointed Member of the Pontifical Academy of Sciences on 5 May 1981. Professor of Quantum Biochemistry and Biophysics at the "Institut de Biologie Physico-Chimique" (Fondation Edmond de Rothschild).

en la présence, chez les mongoliens, d'un chromosome 21 surnuméraire, responsable de leur maladie (appelé depuis trisomie 21), découverte qui a ouvert la voie à une science nouvelle *la cytogénétique humaine*, au développement de laquelle il devait contribuer par la suite par toute une série de découvertes impressionnantes, en particulier, la mise en évidence des anomalies chromosomiques par translocation ou délétion de fragments, découvertes qui ont eu des applications dans des domaines aussi variés que la gémellité, l'étude des tumeurs cancéreuses, des mécanismes d'évolution et de l'origine de la débilité intellectuelle. Il a énoncé, dans ce dernier domaine, des hypothèses hardies (le rôle du métabolisme des monocarbones) et proposé des traitements chimiques (par l'acide folique) qui ont réussi à améliorer l'état des patients.

— son travail d'enseignant. Professeur de Génétique Fondamentale à la Faculté de Médecine de Paris depuis 1964, nommé donc à ce poste à 38 ans, on lui doit la formation d'une pléiade de chercheurs, savants, médecins, qui ont poursuivi et étendu son œuvre et qui, nombreux, ne tarissent pas d'éloges sur ses capacités pédagogiques et son dévouement à la tâche de la propagation de la connaissance.

— son activité de médecin. Tous ceux qui l'ont connu dans ce rôle ont exprimé leur admiration pour ses grandes qualités professionnelles, certes, mais encore plus, pour ses qualités humaines, son amour du métier de médecin, son attachement profond aux malades qu'il soignait, attachement d'autant plus profond qu'ils étaient plus souffrants et plus malheureux. C'était un homme de cœur que la douleur d'autrui ne laissait jamais indifférent. Il vouait un amour particulier aux petits mongoliens. Il souffrait profondément des brimades que ces êtres innocents rencontraient souvent dans la vie et a mené un combat incessant pour défendre leur dignité et améliorer autant que possible les dures conditions de leur existence. Il ferait sûrement siennes les paroles de saint Augustin: "*Aimez donc la science, mais préférez la charité. Si la Science est seule, elle enfle le cœur*".

— son activité de moraliste dont je dirai seulement, tout au moins pour l'instant, qu'elle fut reconnue et appréciée par ses pairs comme en témoigne son élection à l'Académie des Sciences Morales et Politiques de l'Institut de France en 1982 (année où il fut également élu, soit dit en passant, membre de l'Académie Nationale de Médecine).

Mais, parlant des Académies, il y en eut une qui, dans une anticipation inspirée et clairvoyante, l'a élu en son sein beaucoup plus tôt que ces Académies nationales. C'est l'Académie Pontificale des Sciences, la nôtre, dont il est devenu membre, pour la renommée de cette Académie et le plaisir de nous tous, dès 1974. Par cette élection, qui avait pour lui une signification profonde, l'Académie Pontificale s'enrichissait d'une personnalité hors pair qui devait la servir avec dévotion et fidélité pendant deux décennies, toujours disponible, toujours prête à mettre ses connaissances, son intelligence et son sens du devoir au service des causes que notre Compagnie jugeait utile, nécessaire de défendre.

En effet, si j'ai rappelé tout à l'heure — cette analyse, il fallait la faire — les *différents* aspects remarquables de sa personnalité et de ses activités, cette vision fragmentaire n'acquiert sa pleine signification que lorsque l'on met en évidence ce qui, au-delà de cette apparente diversité, donne à cette existence exemplaire sa plénitude et lui confère sa cohésion interne, son reflet *unitaire*. Car, cet homme était un bloc, dont toutes les démarches et toutes les ambitions — dans le sens le plus noble du terme, est-il nécessaire de le dire — découlaient de sa foi religieuse profonde, de son attachement indéfectible et inébranlable aux enseignements, aux conceptions, aux valeurs de l'Église catholique. C'est dans l'adhésion absolue à ces enseignements, ces conceptions, ces valeurs qu'il puisait l'inspiration et la force d'affronter les multiples et complexes problèmes sociaux et moraux qui assaillent notre société moderne et — tel un noble chevalier au Service de sa Dame — le courage d'affronter les objections des adversaires, qui ne manquaient pas.

Si, dans une tentative extrême de synthèse, je devais résumer, au delà de sa foi, en *un mot* clef, *un seul*, l'essentiel de ses convictions, le fondement, la source de toute son inspiration, j'aurais des difficultés à le faire. Mais je crois que j'y parviendrais si j'étais libre d'utiliser *deux* tels mots.

Le premier est: "la vie". La vie était pour lui l'acte suprême de la création, le don le plus grand du créateur à l'Univers. Elle était pour lui sacrée. Pour cet homme profondément croyant la défense de la Vie, sous toutes ses formes, était donc une mission, un apostolat, selon les paroles de sa Sainteté Jean-Paul II, à l'accomplissement duquel il s'adonna avec persévérance, abnégation et courage. Il fut ainsi constamment et ardemment à l'avant-garde du combat pour l'intangibilité de l'*embryon humain*, exigeant que lui soit reconnu le statut de *personne humaine* et accordé la protection de la Loi. C'est la même inspiration qui guidait sa lutte acharnée contre l'avortement de convenance, contre toute conception non naturelle, et son attitude critique vis-à-vis de tout contrôle artificiel des naissances. Comme l'a dit le Cardinal Angelini, c'était *"un chantre de la vie"*. Quoi de plus naturel donc que le Pape l'ait nommé, en mars de cette année, Président de la nouvellement créée Académie Pontificale pour la Vie qui a pour mission de défendre la sacralité de la Vie, idéal auquel il tenait tant. Qelle tristesse, quelle tragédie donc qu'il n'ait malheureusement pas pu assumer cette présidence. Nous présentons à notre jeune Académie-sœur nos vifs regrets pour cette perte douloureuse, irremplaçable. Nous espérons qu'elle trouvera dans l'exemple de son Président disparu l'encouragement et l'élan nécessaires pour mener à bien sa mission.

Apres "La Vie", le deuxième mot, dont j'ai absolument besoin pour compléter mon esquisse de la personnalité de Jérome Lejeune, est la bonté. Je commencerai par une citation que je tire du Résumé (exploit pas facile, soit dit en passant, et qui exige de son auteur de vastes connaissances et des capacités exceptionnelles de synthèse) qu'il a fait des délibérations du Groupe de Travail sur "L'Emergence de la complexité en mathématique, physique, chimie et biologie" qui s'est tenu, pendant notre dernière Réunion Plénière, en Octobre 1992 (la dernière réunion plénière, hélàs — qui aurait pu s'en douter alors? — à laquelle il lui a été donné d'assister). Se rapportant aux paroles d'un de nos confrères, qui insistait dans son exposé sur une certaine dose d'imprévisibilité, un "petit chaos" selon le terme de Lejeune, qui interviendrait dans le développement de la complexité du monde, il remarqua: "*J'avoue que j'ai eu un moment de malaise, lorsque le conférencier nous a parlé d'un jeu de Dieu, en soulignant qu'Il joue honnêtement. Le mot 'honnêtement' m'a un peu choqué car il sous-entendait, si j'ai bien compris, qu'Il se soumettait volontiers aux lois du hasard. J'avoue que plutôt que de croire l'Etre Suprême honnête, je préfère tout simplement qu'il soit bon*". Voilà la bonté élevée au plus haut piédestal des qualités divines et sans doute aussi humaines. On pense à la phrase de Voltaire, à l'occasion des discussions sur la nature de l'âme: "*Qu'importe de quelle substance l'âme est faite pourvu qu'elle soit vertueuse*". La bonté ainsi exaltée, Jérôme Lejeune en a fait le fondement de son attitude vis-à-vis des hommes et surtout des malades, des exclus, de ceux qui souffrent. Tout comme, homme de science, il fut aussi un médecin *praticien* d'un dévouement exceptionnel, homme de foi, il fut aussi homme de bonté et de compassion.

Arrivé à ce stade de ma réflexion je me rends compte que, en fait, les deux mots, la vie et la bonté, avec lesquels j'ai pensé pouvoir cerner la personnalité et l'activité de Jérôme Lejeune, ne suffisent pas. Pour qui veut une esquisse complète, un troisième dénominatif vient irrésistiblement à l'esprit, que tous ceux qui l'ont connu approuveront, j'en suis sûr, instantanément. Ce troisième mot est "le charisme". Cet homme avait un charme incroyable, fait de séduction naturelle, d'un sourire doux, d'une élégance et d'une délicatesse de propos absolument désarmants. Au point qu'il était agréable, très agréable même, d'être en désaccord avec lui, tant on pouvait apprécier alors la finesse de ses arguments, la clarté de son raisonnement, l'amplitude de ses connaissances, sa bonne foi évidente et, surtout, l'exquise politesse dont il ne se départait jamais.

Et aussi, un très raffiné sens de l'humour. L'éloge d'un grand disparu assume nécessairement une allure sérieuse et solennelle. Mais je suis sûr que Jérôme Lejeune ne m'en voudrait pas si je cite deux exemples de cet humour en dentelle fine. Je crois que nous le sentirons encore plus proche de nous en entendant les passages suivants de ce Résumé sur la "Complexité", dont j'ai parlé déjà, qu'il a fait devant nous, il y a deux ans à peine.

Le premier passage: "*Monsieur le Président, j'ai été assez intéressé par le développement des discussions, où nous avons péniblement démontré que les lois physiques ou chimiques connues aujourd'hui n'interdisaient pas l'apparition de la vie. Je crois que c'est une très bonne découverte, car si les lois physiques ou chimiques que nous connaissons aujourd'hui interdisaient l'apparition de la vie ce sont les lois physiques ou chimiques qu'il faudrait changer*".

Ceci est fort différent de la boutade d'Einstein qui, à la question lui demandant ce qu'il aurait fait si l'expérience sur la courbure de la lumière par la masse du soleil n'avait pas confirmé les prédictions de sa théorie, a répondu: "*J'aurais alors du chagrin pour le Bon Dieu (dear Lord), car la théorie est correcte*".

Le deuxième extrait nous montre qu'adulte, il n'a pas oublié l'enfant qu'il a été, par quoi il se plaçait tout près de tous les enfants d'aujourd'hui. Je cite: "*Malheureusement nous n'avons pas pu entendre M. Lions et nous ne saurons pas pourquoi l'environnement de la terre est si stable. Je le regrette beaucoup car j'ai toujours eu quelque peur — je suis gaulois — que le ciel nous tombe sur la tête. Apparemment il tient bon et j'aurais bien aimé savoir pourquoi*".

Monsieur le Président, Monseigneur, Madame,
Mes Chers Confrères,

Nul n'a su résumer mieux la vie de Jérôme Lejeune que le Saint Père en écrivant dans le Message qu'il a envoyé au Cardinal Archevêque de Paris à l'occasion des obsèques de notre Confrère: "*Le Professeur Lejeune a toujours su faire usage de sa* *profonde connaissance de la vie et de ses secrets pour le vrai bien de l'homme et de l'humanité, et seulement pour cela*".

Nous pleurons la disparition de ce confrère aux qualités exceptionnelles. Je voudrais assurer Madame Jérôme Lejeune et sa famille, à qui je me permets de présenter au nom de nous tous nos très sincères condoléances, que son souvenir restera toujours vivant dans notre mémoire.

BERNARD PULLMAN
Académicien Pontifical

BIRTHE LEJEUNE

Je suis profondément émue de m'adresser à vous aujourd'hui et je tiens à exprimer ma très profonde gratitude à mon ami le Président et au cher Chancelier qui m'ont invitée avec mon fils, dans cette Académie où, depuis vingt ans j'accompagnais mon mari, deux fois par an, lorsqu'il se joignait à vos travaux.

Le Professeur Pullman l'a déja dit: oui, c'est vrai que Jérôme n'était pas attaché aux honneurs de ce monde. Il jugeait sans importance les quelques titres de gloire que la société avait bien voulu lui offrir. Mais je me souviens que lorsqu'un journaliste l'interrogeait et lui demandait quels étaient ses titres, il répondait toujours: "Le seul auquel je tiens vraiment, c'est celui de membre de l'Académie Pontificale des Sciences", lui, parmi vous, il avait le sentiment que le dessein qui conduisait sa vie était vrai: comprendre la Science dans la lumière de la foi et éclairer la foi humaine par l'intelligence de la connaissance. Il était profondément heureux de ces rendez-vous, où la richesse humaine est réunie pour conseiller et inspirer le Pape sur les questions scientifiques.

Jérôme avait choisi d'être médecin. Dans chaque petit malade qu'il soignait, il aimait tendrement l'homme, il détestait la maladie. Parce que se battre contre la maladie est le devoir de tout médecin, il est devenu chercheur. Il était convaincu que l'intelligence humaine viendrait à bout des maladies de l'intelligence. Il disait souvent: "Ce ne sont pas les médecins qui étouffaient les enfants atteints de la rage sous des oreillers qui ont trouvé le vaccin contre la rage. C'est Pasteur qui voulait espérer contre toute espérance et qui a tenté ce que la raison humaine trouvait absurde. "Il avait déjà beaucoup avancé dans ses recherches, puissent de jeunes médecins reprendre le flambeau.

Jérôme aimait tant la vie qu'il a consacré la sienne à défendre la vie. Il avait d'ailleurs expliqué un jour son métier de génétien en paraphrasant le Prologue de Saint Jean: "La génétique moderne se résume à un credo élémentaire qui est celui-ci: Au commencement il y a un message, ce message est dans la vie et ce message est la vie".

Jérôme avait beaucoup de talent. Avec mes enfants et les amis proches nous avons pensé qu'il fallait continuer son action et diffuser son message. Nous avons donc créé une Association des amis du Professeur Jérôme Lejeune afin d'unir nos talents autour de lui, pour défendre la vie.

Et puisqu'après tout, il est là au milieu de nous aujourd'hui, en son nom, je vous souhaite Bonne Chance pour la poursuite de vos travaux.

BIRTHE LEJEUNE

2.

WILLIAM WILSON MORGAN

Prof. W.W. Morgan born in Bethesda (Tennessee - U.S.A.) on 3 January 1906, died in Chicago on 21 June 1994. Appointed Member of the Pontifical Academy of Sciences on 24 September 1964. Professor Emeritus at the Yerkes Observatory of the University of Chicago. His scientific activity was concerned with organized observational searches for regularities, among the various categories of astronomical bodies.

Commemorated

by

Martin J. Rees

MARTIN JOHN REES *

William Wilson Morgan's greatest discovery concerned the structure of our Milky Way galaxy. Ever since the 1920s it had been suspected that our galaxy was a huge spinning disc of stars — rather like the Andromeda galaxy, the Whirlpool Nebula, and the other beautiful galaxies that feature in every book about astronomy. But did our Galaxy, like these others, have spiral arms — the distinctive bright features delineated by the bright blue stars in the other disc galaxies? This is a hard question because we are ourselves in the disc — in the plane of the Milky Way — and cannot view our own galaxy from outside. It was Morgan who first showed convincingly that we indeed live in a spiral galaxy. This discovery gained him a standing ovation at the meeting of the American Astronomical Society in 1951 when he announced it — something rare in the proceedings of scientific societies.

How did Morgan achieve this? Because he was an acknowledged master of spectroscopy. The discovery of spiral arms was essentially a byproduct of his sustained efforts to classify stars from the appearance of their spectra. The spectrum of a star depends, obviously, on its surface temperature. But there are other parameters. One is obviously the chemical composition. But the other is the surface gravity of the star, which determines the scale height of the atmosphere. So-called giant stars, which are at a later stage in their life cycle than

* Prof. Sir Martin J. Rees born in York (United Kingdom) on 23 June 1942 und appointed Member of the Pontifical Academy of Sciences on 25 June 1990. Royal Society Research Professor. Institute of Astronomy at University of Cambridge.

ordinary stars like the sun, would have very different-looking spectra from the Sun even if their temperature and composition were just the same. Morgan's interest in stellar spectra started with his PhD thesis. He then developed it further with his colleagues Patrick Keenan and Edith Kellman: in 1943 they jointly published 'An Atlas of Stellar Spectra, with an Outline of Spectral Classification'; this classification scheme is called the MK system after its inventors.

In 1979 a conference was held at the Vatican Observatory on the occasion of the centenary of the astronomer Angelo Secchi. Its topic was 'Spectral classification of the future', and the MK system was its starting point. Morgan was unable to attend, but he communicated a paper in which, with characteristic modesty, he wrote "Its only authority lies in its usefulness; if it is not useful, it should be abandoned". In fact it survived the test of time remarkably well. There was recently a conference to commemorate the 50th anniversary of the MKK system (at this meeting, incidentally, contributions were made by Fathers Corbally and McCarthy, both well known to many members of this academy).

After the war, Morgan extended his earlier work, now in collaboration with H.L. Johnson; in the early 1950s they developed the so-called UBV photometric system, still familiar to every present-day astronomer.

The virtue of the MK system was that it allowed Morgan to discriminate very effectively between intrinsically faint nearby stars and intrinsically luminous distant stars, which appear equally bright and at first sight are hard to distinguish. Thus it was that Morgan could discover the spiral arms in our Galaxy. He studied the spectra of very many stars in the plane of the Milky Way, picking out those that were intrinsically bright, and estimating their intrinsic luminosity. He could then estimate how far away each star was. The stars turned out to be bunched at particular distances, which were where our line of sight passed through the spiral arms.

In his later career, Morgan extended his horizons beyond our own galaxy. In collaboration with Mayall and with Osterbrock, he developed new morphological schemes for the classification of galaxies, which have also been widely adopted.

Morgan was particularly successful because he approached stellar spectra and the shapes of galaxies not only in terms of atomic physics and dynamics but also in terms of visual patterns. He strongly felt that his deep interest in the visual arts had been an inspiration for his astronomical discoveries.

Morgan was born in 1906, in Bethesda, Tennessee, his parents both being protestant missionaries. He spent three years at Washington and Lee University (in Lexington, Virginia) intending then to become a teacher of English literature; he found employment as an assistant at the Yerkes Observatory. This is in Williams Bay, Wisconsin, and is run by the University of Chicago. He earned a bachelor's degree at Chicago by correspondence and reading, and then worked towards a PhD at Yerkes. He thereafter spent his entire career attached to the observatory. He was a Professor at Chicago, and served terms as Editor of the Astrophysical Journal, and as Director ot the Yerkes and McDonald Observatories. He trained many generations of students. One of his most distinguished former students, Professor Donald Osterbrock, recalls the personal support and inspiration that students received from Morgan. He would not only play softball with them, but teach them about the local flora, take them to concerts, to Frank Lloyd Wright's architectural school, and enthuse them about photography and silent movies.

Morgan formally retired in 1974, having by then achieved wide recognition and numerous honours. He became a member of the Pontifical Academy in 1964, and participated in two Study Weeks.

After his retirement, he continued to work at the Yerkes Observatory until his health began to fail about 5 years ago. He was active in the local community where he resided for several decades, and frequently preached at the local United Church of Christ.

Morgan had unusually wide intellectual interests beyond science, encompassing literature, visual arts, philosophy and psychoanalysis.

An autobiographical article written in 1988, when he was already over 80 years old, was entitled "A Morphological Life". It expressed his distinctive approach to science. He writes: Much of the creative process takes place in the unconscious, in an area of incomplete communication, and poetry is far from being the only discipline where such things can happen. It is in such uncharted areas of mental space where some of the deepest science has its origins, and where the revolutionary philosophy of Wittgenstein's 'Philosophical Investigations' must have laboured before birth.

Morgan made several unexpected discoveries because he tried to approach the data free of theoretical preconceptions. He expressed his attitude in another eloquent passage from his autobiographical article, which I shall quote in closing.

He writes: "Since youth I have been entranced by what I later discovered Husserl called 'the thing itself'. In my field of astronomy it could be a star (that is, a *particular* star), a star cluster, a galaxy, or a cluster of galaxies. When the mind turns in other directions, the 'thing itself' could be a tree of special beauty or interest, a chickadee, or a chirping sparrow. ... The mental state of the observer towards all these subjects would be remarkably similar. *The 'thing itself' whether breathing or not, growing or not, has a fundamental, property or existence far deeper than any conceptual construction.* And how does this bear on the classification of stars, galaxies and clusters of galaxies? It induces a very deep feeling of respect for these things *for themselves*, as independent structures of Nature".

Morgan died in June this year, aged 88, at his home in Williams Bay.

MARTIN J. REES

3.

SEVERO OCHOA

Prof. S. Ochoa born in Luarca (Spain) on 24 September 1905, died on 1st November 1993. Appointed Member of the Pontifical Academy of Sciences on 24 June 1974. Honorary President of the "Centro de Biología Molecular" of the Autonomous University of Madrid. He obtained the Nobel Prize in Physiology in 1959. His work was in the area of enzymology. Together with R. Peters, he established the role of pyrophosphate as a coenzyme of pyruvate oxidation in animal cells.

Commemorated

by

Hector R. Croxatto and *Santiago Grisolia*

HECTOR REZZIO CROXATTO *

Last year we received the sad news that our admired colleague Severo Ochoa died on November 1st, at the age of 88 years. I know that all of us, members of this Academy, feel that it is proper today, in this general assembly, to pay homage to the fine qualities of Professor Ochoa's gifted spirit and to the prodigious and prolific scientific legacy he rendered to humanity. I am quite aware that my brief words here could not grasp the huge productivity and the fruitful impact of his discoveries, promoting striking advances in the biochemistry and molecular biology fields, for more than fifty years.

Ochoa was born in Luarca, a little coastal town in the Asturian region of Spain, in 1905. Early on at school, he showed a great interest in natural sciences; he was particularly attracted by living creatures, which nurtured his precocious mind and interest in biology. In 1922, he entered the University of Madrid School of Medicine. Although he was not primarily interested in becoming a medical doctor, the School of Medicine was at that time the best place to acquire basic knowledge in biology. On the other hand, the powerful voice of the most celebrated among the Spanish scientists, Ramón y Cajal, was fortunately still resounding in that University and promoting scientific research. Ochoa obtained his Medical Doctor degree in 1929 and two years later, because of his remarkable interest in Biology, he was appointed Assistant Professor in the Department of

* Prof. Hector R. Croxatto born in Valparaiso (Chile) on 8 July 1908 and appointed Member of the Pontifical Academy of Sciences on 2 December 1975. Professor of Physiology at the Laboratory of Physiology (Faculty of Biological Sciences of the Pontifical University of Chile).

Physiological Chemistry, under the direction of Dr. Juan Negrin, a renowned physiologist, who was later elected President of the short-lived Spanish Republic, during a period of violent political unrest.

During the summer of 1927, Ochoa had the opportunity to work in Glasgow for a short period of time, under the direction of Prof. Noël Paton. This relationship afforded him the great joy of seeing his first paper ("The action of guanidine on the melanophores of the frog's skin") published in the Proceedings of the Royal Society, in 1928. At the same time, the world was witnessing a sudden outburst of creative power in biochemistry, that was opening new promising roads to discover how the living structures could obtain the necessary energy to support cell life from metabolic substrates. These advances, devised by highly gifted European biologists, emerged as the cornerstone of the modern biochemistry building.

Ochoa's quick mind and strong desire to enlarge his biological background allowed him — with the financial support from the Spanish Council of Scientific Research (Consejo Español de Investigaciones Científicas) — to pursue postgraduate studies at the Kaiser Wilhelm Institut für Medizinische Forschung, in Berlin and Heidelberg, where Otto Meyerhof (1922 Nobel Prize) was investigating the fundamental metabolic processes by which the chemical energy of glycogen is transferred to muscle fibres during contraction. The investigations Ochoa carried out in that laboratory, in order to decipher some enzymatic phases of aerobic and anaerobic glycolysis, stimulated the creativity of his fertile imagination to enlarge the knowledge about the role of the enzymes in the energy transfer in every step of the metabolic chain, which is a field of unlimited boundaries for research work. He entered the area of enzymology from the outset.

In 1937, Ochoa was awarded a fellowship to work in collaboration with Professor Rudolf A. Peters, at Oxford University. Most of the time he was devoted to study the mechanism of action of vitamin B1. They were able to demonstrate that thiamin pyrophosphate (co-carboxylase) was like a coenzyme of pyruvate oxidation in animal cells. In addition he had found that large quantities of inorganic phosphate are esterified when pyruvic acid is oxidized by dispersions of brain tissue. This "oxidative" phosphorilation is recognized as a part of the fundamental mechanism whereby energy is made available from biological oxidations.

Among the several papers he published in 1938, there was one entitled "Pyruvic acid oxidation in the brain", which was published in the Berichte of the XVI International Congress of Physiology, held in Zurich. I was attending that meeting and had the opportunity to read it, but I missed Ochoa. That was easy to understand: sometime before the opening ceremony, General Franco's forces had overthrown the Spanish Republic. Professor Negrin and a considerable number of Spanish scientists tried, dramatically but unsuccessfully, to obtain from the organizers a public declaration condemning the military coup.

In 1939, the II World War broke out in Europe, and Ochoa — with great fortune — could keep up until 1941 his research activity in Oxford. But later, in a period of great difficulties, he could reap the benefits of his achievements in enzymology, and succeeded in obtaining a position as instructor and assistant research in Pharmacology, in the famous laboratory of Drs. Carl and Gerty Cori. After one year of hard work, they could characterize fructose-1-phosphate, one of the important steps in the Krebs's metabolic cycle. In 1942, he was appointed Associate Researcher at the New York University School of Medicine, where through the years he gained high recognition and was called to take teaching responsabilities as Professor of Pharmacology (1946), Professor of Biochemistry (1948) and Head of the Biochemistry Department (1956). This was one of his most cherished places, where he developed his most brilliant line of research. With a legion of students, he discovered enzymes of CO^2 fixation of bacteria, animals and plants. He analyzed the metabolism of carbohydrates and fatty acids. One of his major contributions was the purification of the citrate condensing enzyme and the elucidation of the condensing reaction.

I cannot restrain myself from reading some paragraphs of a testimony written one month after Ochoa's death by Arthur

Kornberg, one of his former students and co-winner with Ochoa of the 1959 Nobel Prize in Physiology and Medicine. He wrote: "He (Ochoa) was pursuing what I regarded to be the Holy Grail of Biochemistry — the soluble enzymes that make ATP upon oxidation of carbon compounds in the citric (Krebs cycle). Although the key event of ATP synthesis was later shown to reside in the indissoluble mitochondria, Ochoa did more than any one else to resolve the enzymes and clarify the mechanisms that generate and use of citric acid at the hub of intermediary metabolism. Insights and techniques that emerged from these studies led him to explore and understand stages in the synthesis of fatty acids and the conversion of light to chemical energy in photosynthesis".

It is fresh in my memory an enjoyable moment I had on the occasion of a visit I paid to Ochoa's laboratory, which was for many Spanish-speaking postdoctoral fellows a place to enrich the mind in the most pleasant way. At that time, he was busy in a vigorous program inserted in one fundamental field identified by the greatest biological achievement of all times: the discovery of DNA structure by Watson and Crick, in 1953. There was no longer dissent about the genetic role of DNA, but this development raised a large number of new questions, which became the major focus of modern biological research. The term "genetic code" came into being. The genes control the synthesis of protein, but the relationship between DNA and proteins was still very obscure. Dealing with this problem, a very lucky event happened in Ochoa's Department. One of his postdoctoral fellows found that an enzyme isolated from a microorganism was able to catalyze the synthesis of polynucleotides from nucleoside diphosphate. In their hands, the enzyme proved to be a wonderful tool to obtain, for the first time, a polynucleotide phosphorylase that made an RNA-like polymer in a cell-free system. The experiment was the key to the early deciphering of the genetic code. Actually, the capacity to synthesize RNAs of defined composition made it a decisive reagent to decipher the genetic code. The achievements paved the road leading to the discovery of the translational processes in protein synthesis, which are fundamental in the understanding of the crucial role played by DNA in every living cell.

Upon retirement from New York University, in 1974, Ochoa was received with great affection by the Roche Institute of Nutley, where he continued in this vein, with unflagging support, investigating the role of phosphorylation in the control of the translational level in eukaryotic cells. His retirement was not idle; as always, he kept the interest alive, attracting students who came from many countries.

With passionate devotion, he used to talk about his works as they were endeavoured to reveal all mysteries in the amazing play of molecules in the organic structures. In every step, he demonstrated that a requirement for a victorious life in an intelligent scientific worker is to be emotionally engaged in the task.

Ochoa will be remenbered not only as a great leader in biochemistry and a great and warmhearted teacher, but as one of the greatest promoters of science and technology development, in Spain and Latin America. Particularly, after his retirement and when Spain turned to be a democratic country, he made strong efforts to obtain from the Government investments in education to improve the level of scientific research. The prestige of his high scientific status and the cooperation of a legion of young Spanish scientists, who during the years had obtained excellent training in his Laboratory at New York, yielded considerable expansion and support in many fields of scientific research, which were reflected in the recent years by a continuous increase in science productivity. In the last years, Ochoa spent several months each year helping a group of colleagues in a Center of Molecular Biology. It is out of the question that the intellectual patronage Ochoa exerted in the Spanish society the last year of his life has considerably raised the scientific creativity level of his beloved country.

In addition to the Nobel Prize, Ochoa has received world-wide recognition for his fundamental discoveries. He has been awarded stet a considerable number of Scientific Academies, with medals, prizes and memberships. His contributions, the huge number of papers published, more than 450, have propelled the vertiginous growth of biological knowledge. These are merits of the highest appreciation, but even more are the seeds he disseminated in a legion of younger students, who today are the beavers of Ochoa's spirit. For these many reasons we have, almost a year after his death, to honour Severo Ochoa.

HECTOR R. CROXATTO

SANTIAGO GRISOLIA *

Mr President, members of the Pontifical Academy, ladies and gentlemen, I thank the Pontifical Academy of Sciences for giving me the opportunity, and this is indeed a sad honour, to speak in memory of Severo Ochoa who was a member of this distinguished Academy, and my teacher and friend. I have written these notes with a great deal of sadness, since I cannot possibly condense in a few minutes the brilliant scientific career of Severo Ochoa, or his many and outstanding human attributes, which I had the fortune to observe and learn from in almost fifty years of close relationship. Thus, I have written this outline with admiration, nostalgia, and deep sorrow.

Admiration because his scientific personality was great. He in turn admired greatly Ramon y Cajal, the only other Nobel prize-winner of Spanish origin, a scientist who is still quoted very frequently in spite of the fact that he died in 1932, and who influenced Professor Ochoa as well as many other young Spanish scientists. Nostalgia because I can no longer listen to his advice and warm friendship. Sadness, great sadness, because he is no longer with us, and because I saw him suffer a great deal, particularly since the death of Carmen, his beloved wife for over half a century, who was his constant companion and advisor, and particularly to see him in the last few months in a lengthy and debilitated condition. However, then as always, he never complained, and politely inquired for the others when they asked about him.

* Prof. Santiago Grisolia born in Valencia (Spain) on 6 January 1923. Professor of Biochemistry at the "Instituto de Investigaciones Citologicas" of Valencia, and Professor of the University of Kansas Medical School, U.S.A.

I heard half a century ago from my first teacher, Professor José Garcia Blanco, the name of Ochoa, as in his opinion, the best young biochemist from Spain; this was after the Civil War. Ochoa who had been born in Luarca in Northern Spain, in the province of Asturias in 1905, had, even as a young boy, been interested in science. He told me how, as a youngster of seven years or so, he had planned a scheme to obtain continuos energy, the often dreamed of perpetual motion machine of many curious youngsters. He learned French, mostly by himself, and he spent his youth between Asturias and Andalusia, Malaga, principally, because of health problems of his widowed mother. That is to say, Ochoa lost his father when he was about seven years old. He had wanted, since he was young, to succeed and to make his mother happy and proud as he wrote in a letter to her, which I have seen, when he was still a very young medical student in Madrid. He was a very good student in physiology, and this was noted by the Professor of Physiology and Biochemistry, Juan Negrin, who later on became Premier of the Republican Government. Doctor Negrin, who had been well trained in physiology in Germany, used to select brilliant students as laboratory assistants. This was the beginning of the scientific training of Severo Ochoa. He lived for many years in Madrid, in the so-called Residence for Students, an exciting and intellectual centre still very much alive, where many gifted individuals, including the painter Salvador Dalí, the movie director Buñuel, and the poet Federico García-Lorca lived. There were a few labs in one of which worked another great and respected scientist, a pupil of Cajal, Pio Del Rio Hortega. Doctor Negrin also had a lab there, and there were, then as now, many lectures by distinguished visitors such as Marie Curie and Albert Einstein, in the times when Ochoa lived and worked there. During the summer of 1927, when he was a fourth year medical student, on the advice of Negrin, Doctor Ochoa went to Glasgow to work with Professor Paton on the action of guanidine on frog melanophores. Even in this short time, and being a beginner, he was able to publish a note, his first scientific paper, in the Proceedings of the Royal Society. Shortly thereafter, in Madrid, he sent to the J.B.C. a paper concerning a micro-method to measure creatine, which after only minor corrections was immediately published. Doctor Ochoa often talked about this for he was very pleased that his English was already good enough. Doctor Ochoa finished his medical training in 1928 and immediately applied for and was successful in obtaining a fellowship to go and work with Otto Meyerhof in Berlin. The reason for the selection of Meyerhof's laboratory was his interest in muscle contraction and in the possible role of creatine. He renounced the economic portion of his fellowship on behalf of his friend Doctor Valdecasas, since he felt that Doctor Valdecasas was more in need than he. His stay in Meyerhof's laboratory was a happy one for him, for among others, he made close friends with David Nachmanson and Fritz Lipmann who also became a Nobel Prize-winner.

In 1929 Severo Ochoa attended the International Congress of Physiology in Boston and visited several places in America where at the time lived one of his brothers. I have the impression that he fell in love with America during that visit. On his return to Madrid, he completed some of the requirements for his Doctor's degree. In December of that year he went back to Germany and to Doctor Meyerhof's laboratory. He returned to Spain in 1930 and continued working on muscle contraction at the Residence of Students.

He married Carmen in 1931 and shortly thereafter went to England to the laboratory of Sir Henry Dale where, in collaboration with Doctor Dudley, he worked for the first time on an enzyme, glyoxylase.

From that time on he found his true biochemical love enzymology. He remained in England for some two years, then he returned to Spain to read his doctoral dissertation in 1934. The President of the committee for this event was Professor Jimenez Diaz, who was going to, later on, influence much of Ochoa's life. Indeed, Doctor Ochoa died in the clinic of Jimenez Diaz.

In 1935 he attended the seventeenth International Congress of Physiology in Leningrad. It seems that by that time Professor

Negrin had cooled somewhat his interest in helping Severo Ochoa. According to him this was because Professor Jimenez Diaz offered him a position as head of the section of Physiology in his newly-created Institute for Clinical Research. However, in the same year and, seemingly, on the insistence of Negrin and against his own wishes, he entered the competition for a chair in Physiology. He hardly spoke of this, and only in his later years, but the chair was denied to him, he thought in spite of a brilliant exercise, as a revenge by Negrin. Certainly he was very upset, particularly because of the negative attitude of his lifelong friend Valdecasas, whom he had, as I already indicated, helped earlier. Some of his friends took him for a lengthy excursion to the Monastery of Silos in North Spain.

In 1936 the Spanish Civil War started, and Ochoa could not stand the terrible atmosphere. He used to tell me how, on his way to the laboratory where he was the only person left, and where he kept working to keep his sanity, he often would encounter cadavers of assassinated persons on the streets near the medical school. He decided to leave Spain and obtained the help of Negrin for a visa to go to France. From there he went again to Germany and to Meyerhof's laboratory, now in Heidelberg, where he stayed a short time, namely from November 1936 to June 1937. This was because Meyerhof had to leave Germany as did many other Jews. Given the situation in Germany, Doctor Ochoa decided to go to England, and worked first at Plymouth and then at Oxford with Peters.

It is important to mention that before Meyerhof left Germany he wrote a letter which facilitated Doctor Ochoa's relocation and in obtaining a fellowship at Plymouth. Doctor Ochoa's affection for his teachers was deep and sincere, especially for Meyerhof. Thus in the archives of the museum there are letters of Meyerhof dated much later, in America, thanking Doctor Ochoa for his help in obtaining research money. Doctor Ochoa did carry for many years a letter in his wallet from Meyerhof and another from his mother. His stay at Oxford was very productive and indeed resulted in his discovery of oxidative phosphorylation and in the calculation of the P:O ratios, a value which has not changed since he proved it experimentally, that is to say the mechanism by which cells transform the energy from the food which we eat. At Oxford he again encountered Rio Ortega and made many other friends, especially Ernest Chain. Since the laboratory at Oxford, as well as many others in England, shifted towards the war effort, and since he was an alien, he decided to go to America. He left England in 1940 and after a short stay in Mexico, contacted Carl Cori and went to work with him in 1941. However, and mostly on the advice of Carmen and with the help of a fellowship, he transferred to New York in 1942, where I later met him and where he worked until his first retirement when he was 69 years old, since from that time until he was 80 he worked at the Roche Institute of Molecular Biology.

It should be pointed out as an example of his character, determination and optimism, that in 1944 he was virtually fired from the Department of Psychiatry where he had a lab and where he found, on arriving one day, his desk and his equipment in the corridor because the new Department Head needed space. He never lost faith, in spite of being an alien. Fortunately Professor Isidore Greenwald offered him a laboratory in the Chemistry Department, where I first met Doctor Ochoa. The head of the Department, Professor Cannan, to whom Professor Greenwald had spoken of this serious, hard-working young man, provided him with an assistant professorship. Doctor Ochoa was thirty-nine years old and this was essentially his first permanent job.

On my arrival in the United States at the end of 1945 I went to visit Ochoa and asked him to take me for training. As I already indicated, Doctor Ochoa had no laboratory of his own and told me that he had to request permission from Doctor Cannan. Once this was done I started working with him in January of 1946. Doctor Ochoa's group consisted of Alan Mehler, a graduate student (the first one he had and one of the very few graduate students that Professor Ochoa ever had, since mostly he worked with post-doctorals), Doctor Arthur Kornberg who had arrived a few days earlier than I, and a part-time worker, Doctor Weiz Tabori.

Since that time I maintained a very close relationship with Doctor Ochoa and asked him often for scientific advice throughout my life. Doctor Ochoa generously accepted me and, not only that, but my wife and, later on, my children, as very close friends. He and Mrs Ochoa shared our modest home in the United States and later on in Spain on a number of occasions.

The scientific career of Doctor Ochoa is very well-known. However I would like to point out that he himself thought one of the most exciting moments of his life was his discovery of carbon dioxide fixation in animal tissues in 1944. He often spoke of it in his later years. As I mentioned before, his scientific interest was now directed to classical enzymology, and he was properly considered one of the best in the world. In 1955 he decided to return to his initial interest: oxidative phosphorylation which led him to the momentous discovery of the polynucleotide phosphorylase and the synthesis of RNA for the first time in a test-tube. This discovery resulted in the awarding of the Nobel prize in Medicine or Physiology which he shared with Arthur Kornberg in 1959.

His work on the genetic code in passionate competition with Marshall Nirenberg (in which many people, some of whom are here helped) started in 1961, led to the complete clarification of the code in some three and a half years. It should be noted that polynucleotide phosphorylase played a crucial role in this work and that Doctor Ochoa was fond of considering it akin to the Rosetta Stone. In his later years and for a period of about ten at the Roche Institute of Molecular Biology, his main interest switched to protein synthesis where he made important advances.

The complete edition of his papers was undertaken on the occasion of his seventieth anniversary, a most festive occasion which was held in Barcelona and in Madrid and in which a number of Nobel prize-winners participated, among them Hans Krebs (Hugo Theorell), Ernest Chain, Carl Cori, Fred Sanger, Fritz Lipmann, etc. All of them, among other distinguished guests, whose work had been related to that of Ochoa.

His collected papers at the time occupied three volumes and some 3600 pages. His papers from that time to his last scientific paper published when he was 82 occupied another volume. Fortunately his mind remained perfectly clear until the day of his death.

Doctor Ochoa received many distinctions including 36 Doctorates Honoris Causa and 120 medals and decorations including that of this distinguished Academy when he was made a member in 1984. This, together with 219 diplomas, nearly 2000 books and his extensive files containing documents of the main figures of the golden age of metabolic biochemistry including laboratory notebooks of Meyerhof, photographs, newspaper clippings, and memoranda of the many honours he received were organised by my wife, Dr. Frances Grisolia, in a small museum which was started in 1980 with his generous donations. He donated all his non-scientific library, which included incunables, to the Valencian Foundation of Advanced Studies, to be used mainly by residents there. Among the very interesting documents contained in the files is his hand-written speech for the ceremonies on receiving the Nobel award as well as numerous notebooks and early notes of his work showing his careful and organised approach to science. His interest in the international scope of science and education led him to accept many offices which occupied much of his time. However he was never in a hurry and always answered all scientific inquiries with a great deal of courtesy.

The main components of the museum were listed and photographed and made into a book, a copy of which I am donating to this Pontifical Academy. Doctor Ochoa was not only a great scientist but also a great teacher, both at the undergraduate and post-doctoral levels. At this level he left a very large family, his true sons, since he left no children of his own. The people who trained with him came from every corner of the planet, and he had hundreds of them; moreover, his influence permeated much of biochemistry, especially in Spain, which, largely through his influence changed from practically non-existent to occupying the seventh place in the world, in about some thirty years. He spent many hours preparing his lectures for medical students: they were so well prepared that the rest of the staff attended them regularly, a custom which was then extended to the other members of the staff. He told me several times that his worst dream was to go to a class without having prepared his lecture. His elegant hair, face and figure were often compared to those of El Greco figures.

Perhaps the best résumé of his love and commitment to science was written by him in Annual Reviews of Biochemistry in 1980, and I quote: "One evening, in the late 1940s, my wife and I were at a party given in honour of Otto Loewi and Sir Henry Dale, co-recipients of the 1936 Nobel prize in Medicine for the discovery of the chemical transmission of the nerve impulse. We were all asked to sign the guest book and then state our hobby, and I did this as Sir Henry looked over my shoulder. As I put down my hobby as biochemistry, he roared with laughter. At that time I was Professor of Pharmacology and Chairman of the Department at New York University School of Medicine, and Sir Henry said: "Now that he is a pharmacologist he has biochemistry as a hobby". I tell this story to justify the title of this essay because in my life biochemistry has been my only real hobby".

However he was very knowledgeable and fond of photography, painting and music. He used to ride horses as a young man, and also had many other interests.

Just about a year ago when he died he left his fortune for the creation of a foundation for the development of biochemistry in Spain.

This Foundation in which I serve as a board member, also, provides for an annual scientific Prize and a Memorial lecture which will be given in the next few days by Arthur Kornberg.

I remember, and I want to finish with this, that someone once asked him how he wanted to be remembered, and he said, "as a good person", and that he was. Thank you.

SANTIAGO GRISOLIA

4.

JAN HENDRIK OORT

Prof. J.H. Oort born in Franeker (Netherlands) on 28 April 1900, died on 5 November 1992. Appointed Member of the Pontifical Academy of Sciences on 18 August 1961. Professor Emeritus of Astronomy at the "Sterrewacht te Leiden, Huygens Laboratorium" of Leiden. His scientific research was principally concerned with the structure and dynamics of our Galaxy.

Commemorated

by

Martin J. Rees

MARTIN JOHN REES *

Jan Oort was born in 1900. He began research in 1921, and his quiet persistent quest to understand the universe continued for 70 years. His intellectual brilliance was combined with deep-seated curiosity, prescient intuition about what lines of research would offer most promise, and a flexibility and openness to new ideas that continued throughout his long life. He never completed an autobiography, but he once wrote that, if he had, it would have been entitled 'Looking forward in wonder'. Even when over 90 years old, he was still doing this — discussing the results from the new Space Telescope with colleagues and students at Leiden. So wide-ranging were the achievements of his immensely influential career that only a few highlights can be mentioned here.

Oort began his research when serious controversy still persisted about whether other galaxies existed as seperate entities, rather than being just satellites of our Milky Way; and almost a decade before the expansion of the universe was discovered.

Oort's first classic contribution concerned the structure of our Milky Way Galaxy. This was already recognised to be a vast flattened system, but little was known about its dynamics or equilibrium. Oort suspected that it was rotating, but that the rotation was differential — like in the solar system — with the outer parts moving slower. He realised that such a motion could

* Prof. Sir Martin J. Rees born in York (United Kingdom) on 23 June 1942 and appointed Member of the Pontifical Academy of Sciences on 25 June 1990. Royal Society Research Professor. Institute of Astronomy at University of Cambridge.

be discerned by the motion of relatively nearby stars (which were of course the only ones that could be readily seen). There would be a local shearing motion, manifested both by the transverse motions of the stars, measurable by astrometry, and by the radial motions, measurable by the doppler effect in the spectra. Despite uncertainties in the distances of stars, Oort discovered that stellar radial velocities relative to the Sun were systematically different in different quadrants, just as would be expected from differential rotation. Efforts to measure the two so-called Oort constants, which determine the dynamics of the galaxy, continued to this day.

In 1932, Oort initiated an equally momentous line of research by studying the motions of stars *perpendicular* to the plane of the galactic disc. Stars moving away from the disc are pulled back towards its plane by the gravitational attraction of everything in it. Oort was interested to discover whether this force could be accounted for by the gravitational pull of all the visible stars, or whether some other gravitating stuff must be there as well. This was the first instance of the famous 'dark matter problem' which in various guises remains pivotal to modern astronomy and cosmology.

In the 1940s Oort developed a sustained interest in what might lie between the stars. He wondered whether diffuse hydrogen gas in interstellar space could be detected. His student, van der Hulst, calculated that atomic hydrogen would produce distinctive emission at 21 cm wavelength. Although very weak, this could be detected by suitably sensitive radio receivers. This opened up an exciting prospect because radio waves would not be absorbed by interstellar dust, and might therefore be detected from all over our Galaxy, not just our local part of it.

Immediately after the war, Oort initiated the Dutch programme in radio astronomy. Their early equipment was destroyed in a fire, so they were scooped by Harvard in the first detection of the famous 21 cm line. But it was the Dutch radio astronomers who developed an impressive series of radio telescopes, and mapped the motions of hydrogen throughout our galaxy, and then also in other galaxies.

This technique revealed complex motions in the mysterious regions near the Galactic Centre, which are invisible to optical astronomers because of intervening dust. The Galactic Centre became one of Oort's continuing interests, and in 1977, well after his retirement, he wrote a comprehensive and much cited review of what had been learnt about the phenomena in that region not only by radio astronomy, but from the newer developments in infra-red and X-ray techniques.

This was typical of his forward-looking versatility. Another abiding interest was supernovae, and the traces they leave behind them in the surrounding medium. He realised that the Crab Nebula was the expanding relic of a supernova recorded by Chinese astronomers in 1054 AD. With Walraven and Woltjer he elucidated the physics of this object, which proved to be an exemplar of almost all the key physical processes in the new field of high energy astrophysics.

In the 1970s and 1980s, astronomers became interested in the largest-scale cosmic structures — superclusters rather than clusters. This topic, the theme of a Study week in 1988, was one on which Oort, in his 80s, was regularly invited to give major lectures. Indeed, Oort's publications after the age of 70 in themselves surpass most astronomers' lifetime output.

Oort's interest lay mainly in large-scale aspects of the cosmos. But there was one significant exception: his theory of comets. He suggested in 1951 that comets came from a huge reservoir of objects, in very slow orbits far beyond Pluto. This concept of the 'Oort cloud' has become generally accepted. Although disjoint from his main interests, this seems to have been the contribution that pleased Oort most. He felt that it was singular to him and had been 'properly rounded off'; he tended to feel, with undue modesty, that his other researches were incremental contributions (albeit crucial ones) to topics that engaged a wider astronomical community.

As a 10-year-old schoolboy he had witnessed the apparition of Halley's comet in 1910. When it returned 77 years later, a flotilla of spacecraft flew to intercept its orbit and observe at close range. Oort was enthusiastic, though when interviewed on television he emphasised that his intellectual gaze was mainly focussed on phenomena millions of times further away than comets.

Almost his entire scientific life was based in Leiden, where he was director of the observatory for 25 years. But he was for several decades influential and effective in the wider international scene. His linguistic ability was an asset, even more so was his quiet but effective diplomatic courtesy. He performed crucial services to the International Astronomical Union, expecially through being its General Secretary for an exceptional 13 year period including the war years. He also played a key role in initiating the European Southern Observatory.

His students and disciples include many who have occupied leading astronomical positions in Europe, the US and Australia. To celebrate his 80th birthday in 1980, his Leiden colleagues prepared a 'Liber Amicorum' in his honour. The contributions to this book, by many of the world's leading astronomers, testify to Oort's influence: reminiscences of his happy family life, and his love of skating and sailing, show the personal affection he inspired.

Oort received almost every international distinction open to an astronomer. He was nominated to the Pontifical Academy in 1961, he regularly attended its plenary sessions and played a leading part in three Study Weeks. At the Study Week on Astrophysical Cosmology, in 1981, a speaker described Oort as 'the Old Master', compared with whom others were only apprentices. That is certainly how we all thought of him.

His death at the age of 92 severed a link with the pioneering days of galactic research; we were bereft of an astronomer who inspired universal respect and affection. On hearing of his death, Professor Chandrasekhar said "The great oak of astronomy has been felled, and we are lost without its shadow". That feeling was shared by all those, of many generations, who had the good fortune to know him.

MARTIN J. REES

5.

SALIMUZZAMAN SIDDIQUI

Prof. S. Siddiqui born in Subeha (Barabanki - India) on 19 October 1897, died on 14 April 1994. Appointed Member of the Pontifical Academy of Sciences on 24 September 1964. Professor of Organic Chemistry at the Research Institute of Chemistry (University of Karachi in Pakistan). His scientific works of research were concerned with the field of alkaloids.

Commemorated

by

Chintamani N.R. Rao

CHINTAMANI NAGESA RAMACHANDRA RAO *

Professor Salimuzzaman Siddiqui was born in the 19th century. He was 97 years old when he passed away. He was a grand old man of organic chemistry. He had his education in Germany and was in India for many years. He left India some time after the partition of India to Pakistan. What was amazing about Professor Siddiqui was his love for chemistry and his students. Everyone who worked with Siddiqui loved him. He was so much loved as a professor of chemistry both in India and Pakistan. He was the head of the Council of Scientific Research in Pakistan. He was very well-known for his work in natural products, especially alkaloid chemistry. Remember his contribution on Raulfia Serpentina, one of the most important alkaloids known for its tranquilliser properties.

Raulfia Serpentina research made Siddiqui famous and got him considerable recognition. He was a Fellow of the Royal Society. He was a Fellow of the Indian Academy of Sciences, and Pakistan Academy of Sciences.

In the Academy he was a grand old man. At the age of ninety-seven, he was still going to the institute of chemistry every day. He had occupied many positions in Pakistan. He was a very respected member of the chemical community and I pay my homage to him. Please join me in remembering him.

CHINTAMANI N.R. RAO

* Prof. Chintamani N.R. Rao born in Bangalore (India) on 30 June 1934 and appointed Member of the Pontifical Academy of Sciences on 25 June 1990. Professor of Chemical Science at the Indian Institute of Science (Bangalore, India).

6.

JÁNOS SZENTÁGOTHAI

Prof. J. Szentágothai born in Budapest (Hungary) on 31 October 1912, died on 8 September 1994. Appointed Member of the Pontifical Academy of Sciences on 12 May 1981. Professor Emeritus of the Anatomy Department at the Semmelweis School of Budapest. His scientific research was concerned with the method for the identification of neuronal connections in the Central Nervous System by experimental secondary degeneration of synapses.

Commemorated

by

Rita Levi-Montalcini and Balázs Gulyás

RITA LEVI-MONTALCINI *

Developments of recent decades require new formulations that include but transcend the hierarchical principle of brain organization. Prominent among them is the concept that the brain is a complex of widely and reciprocally interconnected systems and that the dynamic interplay of neural activity within and between these systems is the very essence of brain function. The large entities of advanced brains and their gross and microscopic inter- and intrasystem connections have developed in phylogeny in accord, it is thought, with evolutionary principles. They are determined genetically, but at the level of ultrastructure and of molecular events they are to some extent modifiable by postnatal experience. These entities are so widely, reciprocally, divergently, and convergently (but specifically) interconnected, and the ongoing activity within the systems they compose is so pervasive and continuous, that — particularly as regards the cerebral hemispheres — the hierarchical principle expressed by such antonyms as higher-lower or newer-older loses some of its heuristic value.

The clearest application of the modular architectonics principle in the CNS is that of the cerebral cortex. Here again there is no visible discontinuity of the neural tissue. However, discontinuities are immediately apparent in connection systems — corticocortical, corticosubcortical, or subcorticocortical.

The size and cell number of such cortical columnar units

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shows considerable stability in mammals. The average basic cortical column contains about 5,000 nerve cells per column, and the ratios of various cortical cell types remain remarkably stable from mouse to humans. Phylogenetic differences involve a spectacular increase of the number of basic columns, which may reach 2×10^6 in humans (about half as many in the anthropoid apes). For the additional difference in brain and especially cortical volume between, say, apes and humans, the dramatic increase in neuropil volume (number and richness of cell connections) with a corresponding decrease in cell density (cell number/unit volume) has to be responsible.

The concept developed by János Szentágothai shows the main organization of the columns in the two hemispheres and their interconnection and connection with subcortical target systems.

Major input to the cortex derives from specific thalamic relay nuclei (specific afferents). Association and callosal input (association and callosal afferents) is, in large part, directed to more superficial layers.

From the study of Szentágothai as well as the neurophysiologist Mountcastle, a most novel concept, which was later further developed by Edelman, was formulated on the structural and functional properties of the columnar organization of the neocortex. It consists of the basic modular unit of the neocortex which is also defined as the minicolumn. The minicolumns are small processing units of the neocortex. They, in turn, are packaged in larger columns also know as larger processing units.

These studies have put the systematic organization of the brain in a new light. The first important factor is that many of the major structures of the brain are constructed by replication of identical cellular units. These modules are local neural circuits of hundreds or thousands of cells linked together by a complex intramodular connectivity.

The second important factor leading to a change of concept about brain function, is accumulation of a vast amount of information concerning the extrinsic connectivity between large entities of the brain.

The third factor of importance is the discovery that each one of the modules of a large entity does not entertain all the connections known for the entity. Thus, the total set of modules of a large entity is fractionated into subsets — each linked by a particular pattern of connections to similar segregated subsets in other large entities.

Distributed systems are by definition and observation both reentrant systems and linkages to inflow and outflow channels of the nervous system. This concept has been further developed by Edelman in his recent well-known definition of evolution and function of distributed systems and their role in higher brain functions such as memory, consciousness and cognition.

As stated in an article written by three of his coworkers: L. Zaborszky, M. Palkovits and B. Flerkò in the occasion of his eightieth birthday «Szentágothai not only established the basic architectural features of many brain structures, but looked beyond the mere facts and actively contributed to the development of many fundamental neurobiological concepts, including the structural basis of synaptic excitation-inhibition, growth, differentiation, plasticity of the nervous system, general organizational principles of the neuraxis, and the mind-brain problem. His work has had a significant impact on such diverse fields as neurology, cognitive psychology, psychiatry and philosophy. His status as a towering figure in neuroscience is reflected in the great number of students, friends and admirers around the world.

RITA LEVI-MONTALCINI

BALÁZS GULYÁS *

Mister Chairman, Monsignor Dardozzi,
Professor Levi-Montalcini,
Respected Members of this Academy, Ladies and Gentlemen,

Professor János Szentágothai, my mentor and the man whom I respected as my second, spiritual father, died unexpectedly on the morning of the 8th of September. He was 82 years old. He is survived by his wife, Alice, their three daughters, Katica, Klára, and Krisztina, and eight grandchildren.

I was given the grace to be, along with his wife, the last person who could meet him and have a long discussion with him on the eve before his passing. He was in full command of his physical and mental faculties. We had, as so many times before, a long and lively discourse on our everyday life, science, political affairs, philosophy and a great many other things. He was preparing with great enthusiasm for the present plenary session of the Pontifical Academy, and, as if he had known he would not be able to be among us, he gave me, together with his advice, a lively account of the atmosphere of the plenary sessions of the Academy and described in detail — and, as I now realise, faithfully — many of you.

János Szentágothai was a towering figure in the neurosciences. He was one of the founding fathers of modern neuroanatomy. A couple of minutes ago, Professor Rita Levi-Montalcini made it crystal clear in her commemoration: János

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Szentágothai played a determining rôle in the development of our recent knowledge of the nervous system. Few appraisals can match the clarity, brevity and strength of the ascetic words of his lifelong friend, collaborator and frequent sparring partner, Sir John Eccles, who wrote of him: "Ramon y Cajal was a great neuroanatomist. János Szentágothai is his worthy heir".

But János Szentágothai was more than just a talented researcher. And here I do not want to talk about his scientific career; I could never hope to outdo Professor Levi-Montalcini in her academically and humanly deep eulogy. I would rather like to recall three features of János Szentágothai's magnificent personality: the Renaissance school-founder, the "*homo ethico-politicus*", and, last but not least, the deeply devout Christian.

János Szentágothai Was a School-Founding Renaissance Personality

Szentágothai's inspirations to become a school-founding scientist are deeply rooted in his family background and historical circumstances. He was born in Budapest in 1912 as János Schimert, the second child of a respected physician, Gustav Schimert and his wife, Margit Antal. The family faithfully represented the riches and versatility of the Hungarian Kingdom, lost forever a few years after his birth. Generations of physicians and teachers, noblemen and professors, soldiers and clerics appear on the folios of their family history books. On his father's side, he inherited Transylvanian Saxon blood. His mother's family came from the Hungarian and Szekler nobility. The father was a rather shy, introspective man with a strong inclination to religious pietism. The mother was a well-balanced, lively, energetic, and down-to-earth "grand lady", with a warm heart and aristocratic manners. The couple had six sons, of whom five reached adolescence. The boys all followed their father's profession and graduated at the Medical School of the Péter Pázmány University in their native Budapest.

After completing the German Gymnasium in Budapest, János began his medical studies in 1930. The atmosphere in

Hungary during the years of his youth — the twenties and the thirties — was determined by, as he often said, "the Carthagesque tragedy which befell Hungary": the Trianon Peace Treaty following the World War, which took from Hungary two thirds of its territory and one third of its ethnic Magyar population. An evident escape route for the Hungarian cultural elite from the paralysing shock of the tragedy, felt by everyone, was to intensify their efforts to establish a cultural dominion on the ruins of a decreased and humiliated country. This is the period which gave to the world not only the musicians Béla Bartók and Zoltán Kodály, but, among others, a flock of physicists and mathematicians, including John von Neumann, Leo Szilárd, Eugene Wigner (Nobel Prize: 1963), Edward Teller, Cornelius Lánczos, Denis Gábor (Nobel Prize: 1971), Theodore Kármán (Pontifical Academician), the chemist George de Hevesy (Nobel Prize: 1943; Pontifical Academician), the physiologist Hans Selye, the chemist and philosopher Michael Polányi (his son, John, a Nobel Laureate and Pontifical Academician), the designer László Moholy-Nagy, and the painter Victor Vasarely. Under the charismatic leadership of the Minister for Culture, Count Kuno Klebelsberg, new universities were established, the existing outstanding scientific workshops were strengthened and new schools were created under the direction of energetic young talents. In Budapest, George von Békésy, a young engineer and soon professor of experimental physics, began his experiments on the mechanisms of hearing (Nobel Prize: 1961), Leopold Szondi set up his laboratory for psychological deepanalysis; Imre Bródy designed the first krypton bulbs, George Jendrassik built the first gas turbines; in Debrecen, Fritz Verzár's research paved the way for a new medical discipline, gerontology; in Szeged, the globetrotting physician and chemist Albert Szent-Györgyi discovered Vitamin C (Nobel Prize: 1937; Pontifical Academician).

One of the burgeoning "old schools" in the country at that time was that of Michael von Lenhossék, professor of anatomy at the University Medical School of Budapest. An outstanding educator and brilliant scientist, von Lenhossék was a promoter of, and world authority on, the neuron theory. The young Szentágothai, who soon after his first anatomy examination joined the Department of Anatomy, first as student demonstrator, later as instructor, then associate professor, was captivated by the flourishing scientific atmosphere of the institute and the impressive personality of von Lenhossék. Following the instructions of his professor, he soon found himself in the midst of an international scientific dispute, the 'neuron theory *versus* reticular theory' debate. Szentágothai's successful development and application of new degeneration techniques soon made him one of the world's leading experts in neuroanatomy.

Following the moral and physical catastrophe of the Second World War, in 1946 Szentágothai was appointed professor of Anatomy at the University of Pécs in southern Hungary. Arriving in Pécs, he found a well equipped department — without staff. The former faculty had disappeared during the calamities of the war. He had to start from scratch. He selected his first collaborators from his own students. The country was locked, the borders were closed, the opportunities of a young department head could not be more different from what his contemporaries enjoyed in the West: he could not place announcements in leading scientific journals and look for the best candidates from all over the world. And it was here, in Pécs, that years after his arrival János Szentágothai had a blossoming school of neuroanatomy, neuroendocrinology, and neuroembryology well known and highly respected in every leading neurobiology institution in of the world.

With a unique sense of judgement he saw in the day-dreaming and shy university student the prospective researcher, and could orient the young man to develop his best talents. He found for each of his younger collaborators the right project, the right questions, the right approach, tailored to the person. His guiding principle in supervising his collaborators and educating generations of students was the same as his principle in pursuing research. In teaching, educating, or doing research, he worked like a Renaissance sculptor, like Michelangelo Buonaroti (*Sonnet*

44), by "peeling off the extraneous" in order to reveal the sculpture — to unravel the inner wealth of a person or to unravel the inner beauty of Nature:

> *Mentre c'alla beltà ch'i' vidi in prima*
> *appresso l'alma, che per gli occhi vede,*
> *l'immagin dentro cresce, e quella cede*
> *quasi vilmente e senza alcuna stima.*

But he was a unique educator of his pupils in other respects, too. With his enormous knowledge in the humanities, languages, arts and sciences, he never failed to seize the opportunity to discuss any question which he found intriguing or which simply came up, whether it was art or philosophy, science or theology, music or literature. None of his early collaborators can forget the famous Sunday excursions, when he and his staff, his students and family roved the Mecsek hills and, as in a classic Greek peripatetic school, enjoyed long discussions on nature, arts, history, and humanities. He was always versatile, lively and pulsating, on occasions almost jumpy, both in private discourse and often in his cathedral lectures, as well. When I now look back on and remember my discussions with him, I realise that he was always a purposeful educator in his conversations, a language magician who clearly knew what he should say to whom, who consciously chose the issues he wanted the younger partner to think about, and who knew that even if the exact words would be forgotten by his audience, the meaning of them would be captured and live on.

In 1963 he was selected to head the institution where he had started his career: he became chairman of the Department of Anatomy in Budapest. His school-building spirit flared brightly inside the old and cosy walls so kind to him. He initiated new research directions and enchanted dozens of young people who followed his path in the neurosciences. But he was not only an educator of specialists, he was a great educator to entire student generations, thousands of medical doctors. His lectures on human anatomy became sensations. Who in the world ever heard of fascinating lectures on the driest possible subject in the medical curriculum? Yet when he lectured in the anatomical theatre of the medical school, not an empty place could be found on the benches or stairs. He was not only an exceptional orator, but he was also a skilled artist, who personally designed his famous anatomy atlas, which has during the past decades been published in thirteen languages and more than 80 editions.

Both his lectures and his anatomy textbooks were amply illustrated and illuminated by historic facts, poems, artistic works, examples, stories, and theories taken from other disciplines including philosophy, psychology, or even, theology. During times when free speech was not possible in the country, when certain ideas were "indexed" and discussing them was regarded dangerous trespass or high treason, he often "smuggled" into his lectures and textbooks facts and stories through which he communicated to his audience information hardly available or suppressed at that time. Who can forget his lecture about the psychology and neurophysiology of learning, when he referred to the spiritual exercises of Ignatius of Loyola and analysed them as the supreme and optimised form of exploiting the learning capacity of the human brain. I will never forget the widely opened eyes of my fellow students most of whom had heard of both Ignatius and "spiritual exercises" for the first time in their lives during that lecture.

János Szentágothai Was a "Homo Ethico-Politicus"

To properly understand and evaluate his personality, one must never forget that János Szentágothai spent a large part of his active life under a dictatorial order. As a young man, he had to witness the upsurge in terror of the Second World War, the tragic fate of his own country which fell victim to its own geopolitical situation between spiritless great powers, and the tragic fate of his countrymen: Hungarians and Jews during the war years, Germans and Hungarians after the war years. He outlived the occupation of Hungary first by the Germans then by the Russians, both accompanied by dictatorships, the latter one lasting a desperately long time.

For János Szentágothai, every deed in his life bore ethical and political aspects. "I try to serve my country to the best of my abilities" he wrote in a short autobiographic note, and this was one of his guiding principles. I sometimes heard that he was not sufficiently outspoken of any regime and that he was not overtly critical in situations where he should have been. Some even said he was often too shy and lenient.

Those who knew him closely, know that he was a man of exceptional moral integrity and, in the last two decades, one of the most efficient promoters of freedom and liberty in his country. Inheriting from his father an introspective nature, he carefully deliberated day by day the manner he had to follow "to remain an honourable man under the historic circumstances". And he knew exactly when he had to resort to overt signs to express his attitude, or when he could exploit his reputation and position in order to promote causes kind to his heart or important for his country and people.

The young but already internationally respected researcher with a well-sounding name in the scientific literature, Johannes Schimert, changed his old Transylvanian Saxon family name in 1941 in protest against the German political influence in his native Hungary. He adopted the name of one of his ancestors, Count Kálmán Láng Szentágothai, landlord of the Transylvanian village Szentágothai. In similar ways, on countless occasions in his life, he never failed to give clear and unmistakable signs to demonstrate where he stood.

I shall never forget when, at that time under strict confidentiality, he told me about his clashes with the ruthless and powerful communist supremos of the Politburo. In his capacity as President of the Hungarian Academy of Sciences (1977-1985), he was occasionally summoned by the rulers of the country to give his opinion on a variety of issues, including the actual state of affairs in society. During these frightening incidents, which certainly contributed to his heart attack in the late seventies, he never concealed his true opinion. At one of the last such meetings, he bitterly and outspokenly criticised the sinful demographic policy of the country, which resulted in intolerably high abortion rates, decreasing life expectancy, death rates surpassing birth rates, and, consequently, a negative demographic balance leading to alarming losses of the population. His criticism was, not surprisingly, not welcomed and he was counterattacked mercilessly. He left the meeting with fear and anxiety which gradually faded, but the memory of which accompanied him for years.

In his later years, he purposefully engaged himself directly in political affairs and in the late eighties became a member of parliament. Among many other, at that time daring, initiatives he was the first deputy to raise in Parliament the question of the Gabcikovo-Nagymaros hydroelectric dam project on the Danube. He protested in the strongest terms and in all possible ways against this environmentally devastating and futile project. In 1990, he was personally asked by the later Prime Minister József Antall to join the Hungarian Democratic Forum as its number two candidate during the first free elections in Hungary after more than forty years. He followed his conscience and dutifully served his parliamentary term in the colours of the governing major coalition party between 1990 and 1994. During his parliamentary activities, as well as in his capacity as Chairman of the Hungarian Paneuropa Union, János Szentágothai always represented the gold standard of European Christian values.

He used his reputation, positions, international connections and any other means at his disposal to promote good causes whether they involved education, the training of younger colleagues, medical treatment of patients unknown to him, healing spiritual wounds caused by the injustices of history, the affairs of his Lutheran church, or the protection of persecuted minorities. Hundreds of younger colleagues received invitations to, and were welcomed by, Western laboratories on the basis of his letters of recommendation. Many of them enjoyed his generosity when he would return from his visits to Western countries and personally bring for them instruments, chemicals, and other supplies which he had bought from his own pocket money or the royalties from his books. Thousands of people, most of them unknown to him, received his advice either in person, during his numerous scientific lectures to lay audiences, or by mail. He never failed to answer a letter, and being a popular person in his country, he received them by the dozen each day.

János Szentágothai Was a Deeply Devout Christian

Last but not least, I feel it important to allude to one of the most radiating and convincing features of his personality: his deep Christian commitment. In private discourse he often referred to his family background as a major source of his motivation for the pursuit of spiritual values. His father was a deeply committed Lutheran, with a strong inclination toward fundamentalist tendencies. In the family his mother balanced his father's religious attitude with her rationalism and pragmatism. In his own personality, Szentágothai enjoyed the superb capability to balance in a most healthy way the imperatives of religious devotion and practicality. He never confused his deep religious convictions with the rational and pragmatic approach used in his lifelong engagement with scientific research, and he was always able to harmonise these various facets of reality in a most convincing manner.

He was always concerned and personally involved in the issues of religious toleration and reconciliation. He was a strong supporter of both ecumenism and the close friendship between Christians and their "elder brethren", the Jewish people. In his last years he served as chairman of a Christian-Jewish fellowship organisation and he used this forum, as well, to stand up and protest any religious discrimination and the appearance of anti-Semitic and anti-Christian tendencies in his native country.

For me, personally, his talent for harmonising scientific pursuit with religious conviction has not only been impressive but exemplary. I shall never forget a tiny episode which took place a few years ago in Brussels at an interdisciplinary conference, where he delivered a marvellous lecture on his brain theory. When he had finished, a British philosopher came up to him and confronted him with a question: "Professor Szentágothai, now you have talked about the brain as a physical-biological system, the supreme command centre of our human being. But we all die once, and our brains cease to exist, their constituent cells break down, their structure, once the vehicle of our personalities, thoughts, and wishes, disappears. However, it is my understanding that you are a Christian believer. How can you reconcile your religious beliefs with the results of your scientific investigation? What will happen to us when we die? Do you believe that we, human beings, will in some way survive the impermanence of our brain? And if yes, how?" — "I believe in every single word of the Apostle's Creed, and I believe that we do not cease to exist after death. But as a humble scientist, it is not my task to investigate the details of the 'how'", replied János Szentágothai. Nevertheless, the British philosopher pressed him further: "But do you even believe in the provision *resurrectionem mortuorum* of the Creed? And if yes, how can you imagine that this beautiful construction, our brain, which is demolished by death, the atoms and molecules of which disperse in nature and are used by other creatures, can be reconstructed so that it be ours again at resurrection? Do you really believe in that?" — "My dear friend", he aswered, "I believe in the Almighty God. And if God is almighty, and I believe without a doubt that He is, I have no reason whatsoever to doubt that He has the power to raise me in whatever way He finds opportune".

I do believe we shall meet him again.

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