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A Biographical Memoir by

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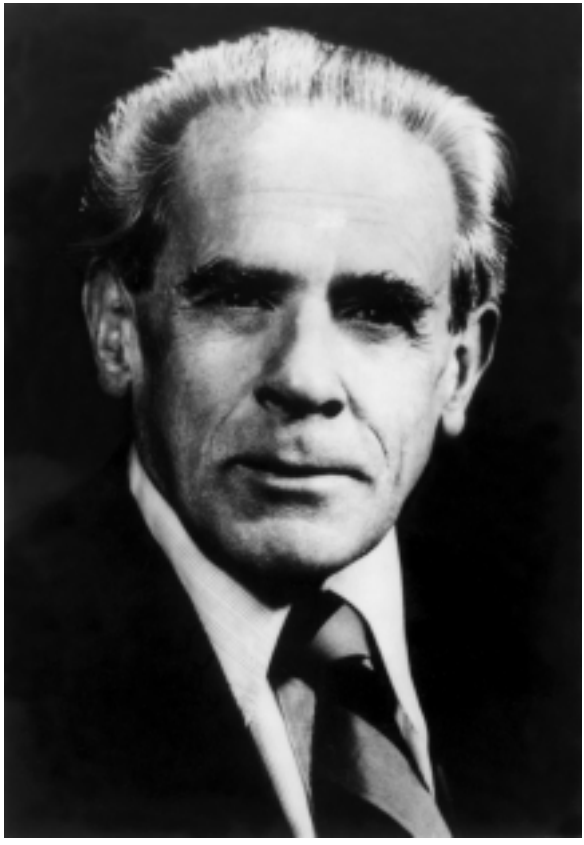

JORDI FOLCH-PI

March 25, 1911–October 3, 1979

BY MARJORIE B. LEES AND ALFRED POPE

JORDI FOLCH-PI[1] WAS A colorful and truly unique personality whose sharp intellect, insight, and willingness to express his opinions were widely appreciated. He was a Catalan physician-scientist and a leader in the emerging field of neurochemistry. Folch made major scientific contributions to the areas of lipid chemistry and structural biochemistry and was widely considered to have inherited the mantle of Johannes Thudichum, the nineteenth-century founder of the field of structural neurochemistry .

Folch's studies at the Rockefeller Institute Hospital Laboratories in New York showed that a brain lipid fraction called cephalin by Thudichum was actually a mixture of several components, which he identified as phosphatidyl ethanolamine, phosphatidyl serine, and inositol-containing lipids. At 33 years of age Folch was called to the McLean Hospital, a psychiatric affiliate of the Massachusetts General Hospital, as director of the new Biological Research Laboratory with the stated mission to characterize the structural components of the nervous system in health and disease. He successfully developed a broad-based, internationally recognized program, which he continued to lead until his retirement in 1977. Folch's initial scientific priority was the quan-

titative extraction of brain lipids free of non-lipid contaminants. The resulting chloroform-methanol lipid extraction and washing procedure became widely used and was one of the most cited papers in the biochemical literature. His approach led to the identification of new lipid and protein components in the brain and to the recognition of proteolipids, the major protein of central nervous system myelin, as a new class of lipoproteins. Other seminal research included methods for the isolation of water-soluble glycolipids, which are still used for isolation of gangliosides and studies on the chemistry of brain maturation, brain electrolytes, copper- containing proteins, and trypsin-resistant proteins.

THE EARLY YEARS

Jordi Folch-Pi was born in Barcelona on March 25, 1911, the son of Rafel Folch and Maria Pi. It was an intellectual Catalan and Spanish family. His father, trained as a lawyer, was a successful businessman and a dedicated poet. His father participated in a Catalan literary competition (The Floral Games) and was awarded the Golden Violet prize for his poem about the destruction of a Catalan cathedral. Folch's mother, Catalan by birth, was brought up in Toulouse, France, spoke fluent French, and was certified as a high-school teacher in Barcelona. Jordi was the third in a family of four children, with two older brothers and a younger sister. He followed the usual education course of his day, with the important exception that he attended the Lycée Française of Barcelona. He credited that experience to the development of a personal discipline that was particularly valuable for his future career. After receiving a bachelor of science degree in 1927 from the Instituto Balmes of Barcelona University, Folch took courses in the Faculty of Medicine and received his M.D. degree cum laude from the University of

Barcelona Medical School in 1932 and his licentiate the following year. The clinical training at the university was first rate and included a period as an intern in the surgical clinic of Dr. Antoni Trias and as the sole physician in Almedret, a small Catalonian village of 800 people, where he substituted for his brother Albert for several months. By contrast, the basic sciences consisted mainly of lectures with little opportunity for hands-on laboratory experience.

Folch was fortunate to have the opportunity to study at the Institute of Physiology in Barcelona, which was founded by his cousin August Pi-Sunyer and Jesus Marie Bellido and was dedicated to carrying out basic research using contemporary methods and ideas. Folch worked as an assistant to another cousin Cesar Pi-Sunyer and by the time he received his M.D. degree, they had jointly published four papers on glycogen synthesis in three different languages (German, French, and Spanish). Folch also studied blood glucose and lactic acid metabolism under the direction of the man he considered his scientific mentor, Professor Rosend Carrasco-Formiguera. He was the person who particularly encouraged the young Folch in his research. It is of interest that many years later, at the age of 80, Carrasco spent several months at the McLean Research Laboratory studying proteolipids (see below) in red blood cells.

Folch's experiences at the Institute of Physiology intensified his interest in physiology and in clinical questions, particularly as they related to metabolic problems. He recognized a need for more formal training in biochemistry in order to pursue an independent scientific career. Thanks to Carrasco's contacts, Francisco Duran-Reynals, a biochemist at the Rockefeller Institute in New York, became interested in Folch and arranged for him to come to that institution as a volunteer. This was made possible in mid-1936 by fellowships from the Barcelona City Hall and the Autonomous

Catalan Government. In a presentation much later Folch stated: "After I arrived in New York, Duran-Reynals exercised an enormous influence over me, not only as a scientific model but also as a definer and interpreter of ethical and social values of North American society."[2]

The primary goal of his visit to the United States was to learn biochemistry as applied to medicine under the direction of Dr. Donald D. Van Slyke, the foremost practitioner of that art at the time. Folch intended to return to Spain, where he very much wanted to fight on the Loyalist side in the Spanish Civil War (1936-39), but his family urged him to remain in the United States. The entire Folch family were active Spanish Loyalists. His oldest brother, Alfred, a physician and surgeon, and his second brother, Frederic, an engineer, both fought for the Loyalists but had to flee to Toulouse at some point during the war. Albert subsequently emigrated to Mexico, as did his sister, Nuria Folch de Sales and her husband, a famous Catalan poet. One day, Folch's father received word that he was on a list of people to be arrested the next day, and he immediately escaped to France by boat and headed for Toulouse. Shortly thereafter, Folch's mother fled north and literally walked through the Pyrenees in a harrowing winter nighttime trip. Jordi acquiesced to his family's wishes, remaining at the Rockefeller Institute for a total of nine years.

THE ROCKEFELLER YEARS

Folch arrived at the Rockefeller in 1936 as a volunteer assistant. The following year he obtained a formal position as an assistant and later as an associate on the scientific staff of the Hospital of the Rockefeller Institute for Medical Research in Van Slyke's department. Folch's first assignment at the Rockefeller Institute was a project with Dr. Irvine Page on pituitary hormone disturbances. Folch's role

was to analyze plasma lipids in these disorders. He soon realized that the commonly used extraction of lipids with petroleum ether had problems in that the extraction was not quantitative and the extract contained non-lipid contaminants. These simple observations influenced the direction of Folch's research for many years thereafter. He devised a procedure that involved precipitation of lipids and proteins with colloidal iron and removal of most of the non-lipid components with water.

Concomitantly, he played a role in the development of two other methods.[3] One was a manometric method for carbon analysis of organic materials utilizing a glass apparatus previously developed by Van Slyke. At the time, this apparatus was widely used for gas analysis in clinical and basic research. The other was a quantitative method for measuring potassium in organic samples. Each of these methods was pertinent to Folch's subsequent research activities. To address the need for methods for the analysis of specific lipids the first priority was to obtain purified lipids from bovine brains to be used as standards. Using the newly developed method for carbon analysis, along with other chemical methods, he characterized the isolated cephalin fraction. According to Thudichum, the physician, oenologist, and founder of the field of structural neurochemistry, this was pure phosphatidyl ethanolamine, but Folch showed that the amounts of carbon and of amines were not consistent with the accepted formula. This in turn led to a series of classic papers published in the *Journal of Biological Chemistry* showing that cephalin was not a single lipid but rather was a mixture of at least three lipids. This was shown by elegant studies that culminated in the isolation, purification, and characterization of phosphatidyl ethanolamine and a new amine-containing lipid entity identified as phosphatidyl serine. With D. W. Wooley he showed for the first time

that inositol was a component of brain lipids and subsequently isolated and characterized mono-, di- and triphosphoinositides.

During the first half of the twentieth century, the Rockefeller Institute was the premier center for biomedical research in America and generated first-rate science in a stimulating intellectual environment. This environment led to Folch's many long-term friendships with distinguished biomedical scientists. Nobel laureate Herbert Gasser was director of the Institute during Folch's tenure, and other notables with whom he interacted included Rafael Lorente de Nó, Réné Dubos, Lyman Craig, Sanford Moore, and William Stein. Additional active collaborators included Jordi Casals, Howard Schneider, Peter Olitsky, and D. W. Wooley. During Folch's first four years in New York, he lived at International House, where he had an opportunity to interact with people of all disciplines and from many countries. For the following two years he shared an apartment with the microbiologist and scientific philosopher Réné Dubos. In 1940 Jordi met a young Barnard student Willa Babcock, whom he courted for several years and married in June 1945. They had three children: Raphael Charles (1946), Diana Maria (Mrs. Everett Ferguson) (1951), and Frederic Albert Jordi (1958). Willa Babcock Folch-Pi was a scholar in her own right and obtained a Ph.D. in 1968 in Romance languages at Harvard University with a major interest in medieval poetry .She was a Bunting fellow at Radcliffe College, taught both Spanish and French at Tufts University in Medford, Massachusetts, and was an academic dean at the latter institution. Mrs. Folch-Pi currently resides in Center Sandwich, New Hampshire.

THE TRANSITION TO MCLEAN HOSPITAL

McLean Hospital is a psychiatric affiliate of the Massa-

chusetts General Hospital and already had a distinguished record of research on mental illness dating back to 1888. In 1901 Otto Folin began a program to develop methods to study the urine of psychiatric patients, but the ensuing comprehensive studies showed no significant differences between urinary metabolites in normal and mentally ill people. In 1908 Folin left to head the Department of Biological Chemistry at Harvard Medical School, where he became the first Professor of Biological Chemistry in the United States. The tradition of biochemical research had continued at McLean in accordance with the view stated by E. Stanley Abbot that "in psychiatry we must seek to learn the patient's total reaction (biological and psychological) to his total environment."[4]

Over the years several competent, dedicated biochemists in the McLean Laboratories maintained this commitment with minimal financial support. By the early 1940s, however, the basic sciences were no longer active and a new beginning seemed in order. To the credit of the Board of Trustees of the Massachusetts General Hospital and a prestigious committee of Harvard Medical School professors a decision was made to establish a free-standing research center devoted to fundamental investigations in biomedical sciences pertinent to mental health and disease. This visionary decision was backed by a commitment of funds to construct and equip a new laboratory building and to search for and support a director who would develop a comprehensive program on the biochemistry of the nervous system. A. Baird Hastings, an active member of the committee and at the time chairman of the Department of Biological Chemistry at Harvard Medical School, had been a student of Donald D. Van Slyke. Van Slyke was called upon for advice and recommended his protégé, the 33-year-old Jordi Folch-Pi.

Folch's original findings at Rockefeller had brought him

immediate attention as a leader in lipid chemistry, a field particularly appropriate for studying the brain. Folch's creativity, vision, and scintillating personality soon convinced the committee of his potential as a leader. In 1944 he was appointed director of scientific research at McLean and assistant professor of biological chemistry at Harvard Medical School and was given the challenge to establish a broad research program on the biochemistry of the nervous system that would have long-range relevance for the problems of mental disease. Folch enthusiastically threw himself into the task of planning a state-of-the-art building, while simultaneously continuing his research at Rockefeller. In May 1946 the new building was dedicated with a scientific symposium of distinguished speakers. Folch gave a masterful presentation, describing the special attributes of the biochemistry and physiology of the brain and the nature of the problems that had to be solved. It is striking to realize the amazing progress that has been made since his presentation in 1946. Yet, the concepts he discussed remain valid to this day and provide a useful framework for current neuroscientists to consider .

By autumn the laboratories were fully operational with support staff that came with him from New York and additional staff that he recruited. Folch's strategy was to begin the program with two divisions, one representing his own area of interest and expertise in the structural chemistry of the macromolecular components of the brain. He was soon joined in these endeavors by Marjorie Lees, a graduate student and recipient of one of the first predoctoral fellowships in a newly instituted U.S. Public Health Service program. A complementary division was set up to study the microchemical anatomy and pathology of the brain. Dr. Alfred Pope, a neuropathologist with training in microchemistry, was appropriately recruited to head this unit.

THE SCIENTIFIC PROGRAM AT THE MCLEAN HOSPITAL RESEARCH LABORATORY (BIOCHEMISTRY)

Folch rapidly demonstrated his ability to get to the heart of a problem, to focus on his scientific goals, and to avoid extraneous questions. He felt strongly that, to understand brain function at the molecular level, new analytical methods had to be developed, and he set about doing so. It should be remembered that much of his work began in an era when methods used routinely today were in their beginning stages or did not exist. Chromatography—including thin-layer chromatography, gas chromatography, and mass spectrometry—was at a primitive stage, tissue culture techniques were only recently introduced, and immunological and molecular approaches were essentially nonexistent. Biochemical reagents often had to be purified in the laboratory or synthesized from scratch. It was even necessary to build one's own equipment. Despite these limitations, or perhaps because of them, Folch was able to make remarkable progress by utilizing his insights for the development of imaginative chemical and physical approaches.

Folch's fundamental philosophy was that, to understand the structural chemistry of the brain and its macromolecular complexes, it was necessary to identify and quantitate all the brain components (i.e., "everything" must be accounted for). He had recognized early the limitations of the then current harsh methods of lipid extraction and had explored several potential new procedures. The initial goal at McLean was to develop mild procedures for the quantitative extraction of brain lipids free of non-lipid contaminants. Recognizing the high lipid-solvating power of chloroform-methanol mixtures, Folch used these solvents for brain tissue extraction. Several years were required before the now "classic" method for removal of non-lipid contaminants in a two-

phase system evolved. The final choice was elegantly simple but had widespread impact: A chloroform-methanol tissue extract was mixed with water and a lower chloroform phase and an upper methanol-water phase separated either by gravity or centrifugation. To select the appropriate volumes of water a series of cylinders containing a known volume of solvent were lined up, various amounts of water were added, and the mixture that separated into two phases most rapidly was selected.

This extraction and washing procedure was important because it resulted in the quantitative extraction of tissue lipids in a single step and the subsequent removal of water-soluble contaminants in the upper phase; however, the upper phase contained gangliosides (see below). The method was gentle and was carried out at room temperature or below; boiling solvents that might alter the lipids structurally were not required. The same procedure could be applied to any tissue and in amounts ranging from milligrams to hundreds of grams, the only requirement being that solvent proportions had to be kept constant. The method became one of the most highly cited papers of the 1950s, second only to the Lowry procedure for protein analysis. In more recent years scientists have often failed to cite the original reference and Folch periodically indicated his displeasure about that. This omission may be the ultimate compliment in that the procedure had become so standard and well known that there was no need to cite it. Indeed, in laboratories around the world the name Folch was commonly used as an adjective and referred to as the Folch procedure or as a verb (to Folch the tissue meant to extract the tissue as described by Folch, Lees, and Sloane Stanley [1957]).

First and foremost the procedure literally opened up a new era in the field of lipid structure, metabolism, cell biol-

ogy, and physiology and allowed scientists worldwide to address new questions concerning lipid structure and function. It also provided the foundation for a major part of Folch's subsequent scientific contributions. He used it to examine the changes in brain lipids and proteins during development and in brain pathology, particularly in lysosomal storage diseases. It provided the starting point for experiments that ultimately identified the myelin proteolipid protein as an encephalitogenic agent in an animal model for multiple sclerosis. His pioneering studies in these areas provided insights into the structure and function of myelin.

The procedure was used to address the question of the differences between the composition of brain gray and white matter. Because purified myelin could not be isolated in that era, the best that could be done was to scrape off gray matter and scoop out white matter from the remaining brain to produce gray- and white matter-enriched fractions. Large amounts of sample were required for the subsequent chemical analysis and there were periods when staff members went to the local slaughterhouse almost daily to obtain bovine brains. Everyone—students, technicians, postdoctoral fellows, and scientific staff—spent the day scraping gray matter from the brains using wooden tongue depressors. As one technician commented: "For this I had to go to college?" But, it was worthwhile, because as an outgrowth of these monotonous activities, two classes of components were identified: proteolipids in white matter and water-soluble glycolipids in gray matter. Both were identified as a consequence of Folch's insights and insistence on accounting for everything. Conceptually, his most important finding and the one that had the greatest impact on the understanding of myelin and other membrane proteins was the presence of a new class of ubiquitous "lipoproteins" that he designated proteolipids.

After washed total lipid extracts of bovine white matter were dried and redissolved in chloroform-methanol, a reproducible amount of solids remained insoluble. Most investigators would have viewed this as junk and would have discarded it. The combination of Folch's curiosity and his determination to account for "everything" led him to pursue the observation further. The solids were found to contain a marked excess of nitrogen, and an amino acid analysis indicated a hydrophobic protein with a high content of sulfur-containing amino acids. It became evident that the lipid extracts contained proteins with lipid-like properties (i.e., they could be extracted from the tissue with organic solvents). They were lipoproteins with the reverse solubility properties of the blood lipoproteins and were therefore named proteolipids and affectionately called PLP.

The characterization of proteolipids became a major focus of Jordi Folch's research program. Brain white matter PLP was identified as the major protein of central nervous system myelin, and much effort went into its chemical and physical characterization. Progress was slow because of the tendency of proteolipid proteins to precipitate irreversibly and because of their resistance to proteolytic digestion. Initially it was assumed that the solubility in organic solvents derived from a lipid shell surrounding the protein, but he later showed that all of the free lipid could be removed with retention of chloroform-methanol solubility. The apoprotein, however, still contained 2-3 percent covalently bound, esterified, long-chain fatty acids. Although acylated bacterial and viral proteins had been described previously and shown to have diverse structural and metabolic functions, to the best of our knowledge, PLP was the first acylated protein identified. The relatively rapid turnover of the fatty acid moiety[5] compared to the slow turnover of the protein moiety suggests an important physiological function for the

fatty acid. Under appropriate conditions, the protein devoid of lipid was converted from a chloroform-methanol-soluble form to a water-soluble form. This conformational flexibility was associated with a relative decrease in alpha helical structure and an increase in beta structure, properties postulated to have functional significance. The existence of a molecule with these properties was initially greeted with skepticism, but subsequent studies showed it to be the structural prototype for a widely distributed family of membrane proteins referred to as tetraspan proteins and to have properties similar to certain ion-channel proteins.

Chloroform-methanol extracts of gray matter revealed the presence of water-soluble glycolipids. These were identified in the upper phase of gray matter extracts as gangliosides on the basis of the excess amino nitrogen in the upper phase of the washed extracts. Gangliosides had been described previously by the German chemist Ernst Klenk. The gangliosides isolated by Folch were high-molecular-weight, water-soluble glycolipids that crystallized as long strands. Careful chemical analysis showed the presence of fatty acids, sphingosine, carbohydrate, a primary amine, and a chromogenic group later identified as neuraminic acid. Folch realized that he was dealing with either an aggregate or a mixture of closely related compounds, but analytical procedures to differentiate between the alternative possibilities were limited. It was much later that the diverse structures and functions of gangliosides were recognized. Nevertheless, Folch's isolation procedures provided the basis for these later studies and are still widely used for the study of gangliosides. With Folch, one of the authors (M.B.L.) of this memoir, carried out early analyses of tissues from patients with infantile and juvenile Tay-Sachs disease, which not only confirmed the ganglioside accumulation in these

diseases but also demonstrated additional lipid abnormalities.

Although Folch is best known for his studies on lipids and proteolipids, his scientific contribution to biochemistry and neurochemistry were remarkably broad and included proteins and disease processes. He was interested in neurokeratin, a protein component obtained by early chemists after subjecting the brain to brutal chemical procedures. To attempt to prepare neurokeratin by mild procedures, he isolated from a chloroform-methanol-insoluble fraction a trypsin-resistant protein fraction (TRPR), which contained phosphopeptides and phosphoinositides chemically bound to protein. Further studies on brain proteins were directed to determining optimal conditions for aqueous extraction. These led to an in-depth study of copper-containing proteins in Wilson's disease that showed the excess protein in Wilson's disease occurred in a different form from the protein in the normal brain.

At the dedication of the new McLean Research Building Folch emphasized the importance of electrolytes in the nervous system. An anion deficit had been reported in the brain, but a role for acidic lipids had not been considered. Folch discovered phosphatidyl serine and polyphosphoinositides, isolated gangliosides, and devoted much time to characterizing sulfatides. These acidic lipids are all in myelin, and he proposed that they could compensate for the low anion levels reported. This hypothesis was supported later when the three major central nervous system myelin proteins were each shown to have high isoelectric points. Thus, in addition to hydrophobic interactions, ionic interactions between these basic myelin proteins and acidic lipids may help to maintain the multilamellar myelin structure. More focused studies were carried out on the effects of specific cations on sulfatides and gangliosides.

Despite these diverse projects, Folch's bibliography is not very extensive by current standards. Each publication was significant, however, and presented new insights and concepts. Data he considered trivial or incomplete were simply filed away. It was well known that Folch had the largest collection of unpublished material of any scientist. His memory was phenomenal, and he never forgot an experiment. Much of the unpublished material survives in the McLean Hospital archives.

A STATESMAN OF SCIENCE

Jordi Folch-Pi is recognized universally as one of the founders of the field of structural chemistry of complex lipids and as a leader in the development of neurochemistry as a distinct discipline within the neurosciences. Folch's arrival at Harvard and McLean corresponded with a time of renewed interest in neurochemistry in the United States and Europe, but it was not as yet viewed as an organized field of study. Over the next two decades, in major part through his leadership, the International Society of Neurochemistry (ISN) and the American Society of Neurochemistry (ASN) were formed. Folch's contributions to these activities have been amply documented in *Journal of Neurochemistry* articles by Herman Bachelard[6] and Donald Tower.[7] The immediate roots of the ISN were traced by Bachelard to a series of biennial International Neurochemical Symposia beginning in the 1950s. Folch presented his landmark studies on the chemical maturation of the brain at the first of these Symposia and served as editor for two of the subsequent symposia. Discussions in the course of these Symposia identified the need for a permanent international forum for neurochemistry, and a provisional organizing committee was formed with Folch taking a lead role in what culminated in the formation of the ISN. He subsequently

served as ISN secretary, chairman, program committee chairman (three times), historian, and president of the fifth ISN meeting held in Barcelona, the city of his birth. Concomitant with the beginnings of the ISN, Folch became a founding member of the Committee on Neurochemistry of the World Federation of Neurology and had a leading role in the organization of the ASN. He served as secretary of the organizing committee and subsequently as ASN secretary, president, and councilor. His contributions to that organization can best be summarized by a quote from Tower's history of the ASN: "If any one person were to be credited with having conceived, created, and nurtured the ASN, it would be Jordi Folch-Pi." [7] Other leading scientists were, of course, actively involved and supportive of Folch's efforts, but it was he who sparked others to action and made things happen. The fruits of his role in neurochemistry are perhaps shown by five major neurochemical societies that are now listed on the World Wide Web, along with many smaller local neurochemistry societies.

During Folch's years as Director of Scientific Research at McLean Hospital he built the laboratory rapidly into a world-class research center within the hospital, Harvard, and the greater Boston community. At the McLean Hospital Research Laboratories, Folch not only provided intellectual leadership but also presided over all aspects of its functioning—from recruiting staff to ensuring the correct temperature of the cold room. The force of his personality along with his scientific abilities attracted students, collaborators, and visiting scientists from throughout the world. Folch thoroughly enjoyed working on experiments at the laboratory bench and took every opportunity to work directly with students in the tradition of the old European master-apprentice relationship. This provided an invaluable opportunity for trainees to learn to think about scientific questions,

design experiments, and write manuscripts. It is thus not surprising that among the 30 or more trainees who passed through the Biochemical Research Laboratory and were exposed to his influence are scientists who became professors, medical school deans, departmental chairmen, and entrepreneurs.

As a consequence of Folch's able management and personal example of scientific achievements, the resources of the laboratory quadrupled within a decade of its founding, with a ten-fold increase in the professional staff. The next decade brought physical and intellectual expansion with the addition of two new units, along with suitable laboratory space and staff. One, headed by Dr. George Hauser, was established to study dynamic aspects of brain structure and a second unit headed by Dr. J. David Robertson introduced biophysical methods to the study of brain structure. This essentially completed the incorporation of aspects of neurochemistry envisioned at the time of the dedication of the McLean Research Laboratory in 1946.

In addition to building the scientific image of McLean Hospital, Folch's wise counsel was consistently sought in crucial changes at McLean and at Massachusetts General Hospital, of which McLean was a part. He brought to any deliberations in which he participated a clarity of thought and a willingness to articulate an unpopular opinion that was invaluable for decision making. Folch also played an important role at Harvard Medical School, where in 1956 he became the first Professor of Neurochemistry in the Department of Biological Chemistry. Folch was particularly proud of his service at Harvard on the Beecher committee, which had been charged with developing a formal definition of death. He will mostly be remembered by members of the Harvard Medical School faculty for his marvelous blend of integrity, candor, wit, irreverence, and good sense

embodied in his comments on key faculty issues—all delivered in idiosyncratically literate, heavily accented, passionate language.

During his illustrious career Folch received many honors. He was elected to the American Academy of Arts and Sciences in 1956 and to the National Academy of Sciences in 1978. He was an honorary professor in the Faculty of Medicine at the University of Barcelona, Spain. He was awarded honorary degrees by the University of Montpelier, France, and by the University of Chile, Santiago. He was one of Spain's most prestigious scientists and the king of Spain, Juan Carlos, presented him with a medal as honorary councilor of the Supreme National Council for Scientific Research.

One cannot conclude a memoir of Jordi Folch without commenting on his personality and his interests outside the scientific domain. Everyone who knew him, be it well or casually, will recall the amazing breadth of his knowledge, his sharp intellect, and the intensity of his opinions. He loved nature, mountain climbing, and skiing, all of which he indulged in passionately. He cultivated the art of conversation and could discuss his views on literature, history, food, or politics with equal knowledge and fervor. After his retirement in 1977 he was Professor of Neurochemistry Emeritus and continued to be active as honorary biochemist at McLean Hospital until his death. On October 3, 1979, after a day of spirited discussions in the laboratory, Folch drove through a thunderstorm and arrived at his Back Bay Boston home. Shortly afterward he was found dead of a heart attack in his chair. It was a loss of a gifted scientist, friend, and mentor, known not only for his contributions to neurochemistry but also loved for his wisdom, humanity, and joie de vivre.

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NOTES

l. We have used Folch-Pi, the Spanish version of the family name, and Folch, the paternal version of the name, interchangeably. Mostly, he used only the latter. During the later part of his life, however, he reverted to the hyphenated name, according to the Spanish convention.

2. Translated by Willa Folch-Pi from an article by J. Folch-Pi: La formacié d'un home de ciencié. *Ann. Med.* 62(1976):623-39, a publication of the Academy of Medical Sciences of Catalonia and the Balearic Islands.

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