IN MEMORIAM
International Microbiology 20(4):151-154 (2017)
doi:10.2436/20.1501.01.297. ISSN (print): 1139-6709. e-ISSN: 1618-1095
www.im.microbios.org

Julio R. Villanueva, microbiologist, researcher, and mentor of generations of scientists

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Received 20 December 2017 · Accepted 30 December 2017

On November 21, 2017, Professor Julio R. Villanueva died in Salamanca. Born on April 27, 1928 in Villamayor, council of Piloña (Asturias), he lived almost to the age of 90. His was an accomplished life, full of endeavors and exciting works in the world of research and teaching, which earned him very broad recognition both in Spain and the international arena.

Villanueva was undoubtedly the driving force of Fundamental Microbiology in Spain. His early steps came at a time when experimental biology was arriving at an important new age, using microbial systems for experimentation that lead to general conclusions about all living beings. The unveiling of the majority of biological phenomena came from the study of microbial systems. From this context Villanueva derived his motivation - he was always known for the energy he put into all his endeavors - to promote his research and create a scientific and academic school of thought.

He tried to project his passion for research at the University at all costs, in a manner that was often timely, and other times not so much, and always proclaimed that only universities that research actively deserve their titles. To this purpose, he sought out the most highly qualified and motivated graduates to invite to join his group and pursue academic careers. We, his disciples, always felt the encouragement - and also the demand - to continually train in research, as an essential requirement of being a university professor. Few mentors have encouraged the lives of so many researchers, valuing above all else their virtues and motivation, with no interest other than for them to be the best.

Committed to Spain reaching the highest scientific and academic levels, he also served in important positions, such as the Rector of the University of Salamanca. In his laboratory, a critical resource for microbial studies was initiated, creating the Spanish Type Culture Collection (CECT), which continues today at the University of Valencia. His efforts in favor of promoting research were also developed in collaboration with outstanding organizations, especially the Ramón Areces Foundation. He was tireless when participating on the selection committees for diverse educational and scientific awards, highlighted by the "Premio Principe (Princesa) de Asturias" for scientific and technical research, which he chaired for several years. And finally, it is also necessary to remember his performance as "full academician" and President of the Royal National Academy of Pharmacy (Spain).

Prof. Villanueva always showed special appreciation for the living world as a whole, with its immense diversity despite the unity of essential processes that occur in all living things. In taxonomy, his name was given to a biological species, not microbial but of insects: A few years ago, the INBio (an important center in global biodiversity in Costa Rica) described a new species of fly, assigning the name of *Mesorhaga villanuevi*. Given the name by the Australian researcher Bickel, it is a small insect collected in the foothills of the Guanacaste mountain range. Without a doubt, Prof. Villanueva appreciated this designation of the exotic species.

To better understand the key aspects of his life and work, we put the different phases in context with the circumstances in which they happened.

Early years. Microbial physiology

In 1952, Prof. Villanueva finished a degree in Pharmacy at the Complutense University of Madrid, Spain. It can be said that these were years in which Spain was striving to survive scientific isolation, overcome a shortage of resources and achieve some presence in international forums.

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With regard to the field of microbiology in this era, we should note that the journal "Microbiología Española" represented a meritorious effort, but was insufficient given the pressing need to publish original research in English. Trying to glean relevant aspects of its publications, two are worthy of special mention. The first was the creation of the *Bordetella* genus by Moreno López, including the causative agent of pertussis (whooping cough), *B. pertussis* (leaving the genus *Bacillus*), a designation that was finally accepted into the Bergey Manual of bacterial systematics. The second was the description of the HO locus, which controls sexual type in *Saccharomyces cerevisiae*, by the agronomist and professor Santamaría Ledochowski. Scientific development during this period was limited, though the creation of antibiotics factories in León and Aranjuez in the early Fifties, although in the line of consolidating Spanish self-sufficiency, was important for the development of microbial scientific and technical industries.

These were not easy times for the development of a scientific career in Spain, but always driven by who he considered to be his main mentor, Professor José María Albareda, Villanueva did not hesitate to travel to Portugal, performing experiments for his first doctoral thesis in the "Estación Agronómica de Sacavem" near Lisbon. With this work, in 1955 he defended his thesis entitled "Metabolic aspects of some fungi associated with Uredineas" for a doctorate in Pharmacy, a study of species that are still considered exotic such as *Tuberculina persicina* and *Verticilium hemileiae*.

The thesis involved an exhaustive analysis of the physiology of these fungi in laboratory culture, based on their growth in different defined media, to establish the effects of different nutritional sources and physical characteristics of growth. With this, Villanueva delved into Eukaryotic Microbiology, unusual as most microbiologists work with prokaryotes or viruses as an experimental system. Undoubtedly, the use of fungal species in research served as the basis for his subsequent interest in eukaryotic microorganisms or bacterial species such as actinomycetes, which have served as the basis for many of the accomplishments of members of his school.

Dazzled by Cambridge

After his first Ph.D. in Spain, Prof. Villanueva had the opportunity to travel to the University of Cambridge. It was again the urging of his mentor Dr. Albareda, professor of soil science and his teacher in the Faculty of Pharmacy at the Complutense University of Madrid, which got him into the British university, at that time one of the most progressive centers of Life Sciences research. I never knew Albareda personally, but I always felt the appreciation and gratitude that Julio professed to him upon receiving this support and guidance.

In Cambridge in the mid-fifties, Villanueva found an environment that would serve as the definitive drive for his scientific ambitions. Watson and Crick's formulations on the double-helix model of DNA structure were recent, and everything was done in a context of true leadership of global scientific activities. Those of us who worked with Prof. Villanueva were able to see how his fascination with that British academic environment, in which he cultivated cutting-edge science, was a true source of inspiration for him.

Return to Spain. CSIC his first horizon

Trained in Cambridge as a researcher, Villanueva returned to Spain in 1959 with the Spanish National Research Council (CSIC) as his first prospect. Together with Manuel Losada and Gonzalo Giménez Martín, he undertook the task of setting up the Institute of Cell Biology, within the Center for Biological Research (CIB), which for many years would be the focal point of the most advanced Life Sciences research in Spain. He worked as an independent researcher during an important era of growth for Spanish microbiology throughout the fifties and sixties. The study of microorganisms, a foundation of experimental biology, consolidated knowledge about the functionality and variations of genetic material.

Fig. 1. Prof. Julio R. Villanueva. XV National Congress of the Spanish Society of Microbiology. Madrid, 1995.

Molecular Biology emerged strongly thanks to microbial studies, while deciphering the universal genetic code and study of the genetic organization of bacteria and their viruses dominated the scene. In addition, the enormous practical impact of research into the "mode of action" of antibiotics and microbial biochemistry made them focal points, with the scale of industrial fermentation increasing accordingly. Microbes are not just pathogens or saprophytes, but above all they are living beings, and very convenient models to study essential biological phenomena.

The world of microbes. Professor of Microbiology. Discovery of Salamanca

It was 1965 when the Spanish version of a book that would become a flagship for the teaching of Microbiology around the world appeared, with guidelines for teaching that placed microbes as living beings, fundamental to understand vital processes. With the suggestive title of "The World of Microbes", written by Roger Stanier, Michael Doudoroff and Edward Adelberg, the translation was in the charge of Julio Villanueva, Manuel Losada and Isabel García Acha, and was published by Editorial Aguilar.

Villanueva, who had already been creating a remarkable group of researchers at CSIC, made the leap to the university setting, opting for a Chair of Microbiology in 1967 in the newly-created section of Biological Sciences in the Faculty of Sciences of the University of Salamanca, Spain. Achieving this position was a true culmination of the aspirations of the researcher Villanueva, who felt Salamanca to be the supreme goal of his academic and professional development.

To Salamanca he dedicated his drive and experience, which was notable for his age of almost forty years. It wasn't easy because the necessary infrastructure for his research work was yet to be developed. However, again applying all the energy he was able, he soon gathered a large group of Ph.D. students, and other scientists he had studied with in Madrid joined him in Salamanca after valuable experiences in research centers in Europe and the United States. The work at the University of Salamanca, in which the first classes of biologists graduated from the hand of Prof. Villanueva, continued in the direction chosen during his era in Madrid. Numerous students joined the Department of Microbiology to pursue their doctorates, with the clear idea that their future would be to graduate and migrate to prestigious foreign centers for a vital period of postdoctoral work. From there each one could consider reincorporation into Spanish institutions having gained the capacity to perform at the highest scientific levels.

Focusing its research on complex microbial systems (yeast, fungi, actinomycetes), the Villanueva group developed works based on biochemical approaches, and also morphological and structural studies based on electron microscopy. This is how his approach became known as "the School of Villanueva" or "the School of Salamanca", characterized by the opening of cutting-edge questions that arose during microbial studies. Likewise, his involvement with societies of Microbiology and Biochemistry underscored the importance of collaboration to him, and despite the limited resources, the task of conservation of cell culture was taken on with determination, with the start of the CECT.

Prof. Villanueva, always with encouragement and urging from Severo Ochoa, Alberto Sols and others, ascended to the presidency of the Spanish Society of Biochemistry (SEB) and from there to that of the Federation of European Biochemical Societies (FEBS). This led to his commission to organize the European Congress of Biochemistry in Madrid in 1968, a major event that was unheard of in Spain up to that point, with a scientific community already eager to make a real leap into internationalization.

A radiant school of thought

Starting from the aforementioned initial stages at CSIC, Villanueva knew how to motivate new generations of researchers, in a decisive bid for the lift-off of science in Spain. Numerous students, candidates for academic research careers, were surprised to receive an offer from a researcher who showed them an enormously attractive path for their future professional development. His generous dedication to his disciples was accompanied by notable demands, as the path to success is only passed with great effort. His career was therefore an example of what defines a university teacher: capable of stimulating his students, of selecting the most appropriate people and respecting their personality and ideas, of encouraging each one to reach the highest goals they are capable, of demanding dedication and performance. With students he was understanding of difficulties, facilitated solutions, built self-esteem in a realistic manner; in short, guiding each one of us on the path through which we could best travel.

The echoes of his work as the teacher of several generations of professors and researchers are present today in many parts of Spain. The results ended up in the creation of a true scientific school that projects in a special way at the university level. Numerous students who trained with Villanueva have occupied positions in the scientific and academic staff of CSIC institutions in Madrid and Salamanca, and in departments in centers of higher education of Oviedo, León, Complutense, Alcalá de Henares, Extremadura, Valencia, Murcia, Santiago de Compostela, La Laguna (Tenerife), etc. as well as other centers in the international arena. More than two dozen full professors and many more teachers and researchers attest to the value of the teachings of Professor Villanueva, whose most important goal was to promote disciples capable of exceeding the accomplishments of their teacher. In addition to the prestigious Department of Microbiology of the Faculty of Sciences of Salamanca, two excellent research institutes, the Center of Functional Biology

and Genomics and the Center for Cancer Research, both linked to the University of Salamanca and CSIC, have emerged from the efforts of Prof. Villanueva, established in the city of the river Tormes.

Accepting the Rectorate. A Rector present in every aspect of Spanish life

In 1972, another essential event in the career of Prof. Villanueva took place, which was his ascension to the position of Rector of the centuries-old University of Salamanca, thus succeeding outstanding personalities that are part of the history of Spain. His appointment, made by the Ministry of Education and Science in times of difficulty for the institution, was ratified shortly thereafter by an election by the academic staff.

The echoes of his work materialized throughout Spain, his achievements keeping him at the forefront of social concerns in favor of education and training, during the several years of political transition that began in Spain in 1975. He was the founder and first President of the Conference of Rectors of Spain, involved in those years in a determined defense of the role of the university in Spanish society. Once again, his drive emerged to communicate publicly about what was at stake, nothing less than higher education as a commitment to the future. Nor were times easy, as nothing was during the political transition, in which Spain sought and found its way forward to shape a new political system based on democracy and freedom.

Spain and Science

It can be said that the life and work of Julio R. Villanueva were inspired by an idea that has continued in the minds of later generations of scientists and professors reaching to the present, a dissatisfaction with Spain's contribution to the development of Science at certain times throughout history, including today. In line with Cajal, Ochoa, and also Villanueva's mentor Albareda, he applied himself to the difficult but not impossible task: to put Spanish Science in the place it rightfully belongs. It is true that there are many ways to approach the problem, and they don't always agree. But it can be said that Prof. Villanueva's efforts focused much more on overcoming the challenge than on arguing about its scope.

The above is a very limited summary of the work of Prof. Villanueva, always accompanied by his wife, Dr. García Acha, always guided by the friendship of other scientists and teachers.

Fig. 2. Prof. Julio R. Villanueva at his laboratory. Around 1980.

We mentioned also his involvement in scientific communication, managing scientific societies and organizing countless courses, conferences and other events, a responsibility that was also inherited by many of his disciples. In the sixties, he presided over the Spanish Society of Biochemistry (SEB) as well as the Federation of European Biochemistry Societies (FEBS), and thus the European Congress of Biochemistry was held in Spain in 1988. Chaired by Prof. Villanueva, with the assistance of Severo Ochoa and several Nobel prize winners, it was an event that triggered great advances for the Spanish scientific community in the Life Sciences.

The additive effects exerted by all the groups emanating from the Villanueva School in Salamanca makes its influence more widespread in Spain and abroad. It is the best example of desirable academic mobility, which is a current topic for some politicians, but in reality, current regulations make it impossible nowadays in Spanish universities. Only with determination, effort, and confidence in our country can this be achieved. Julio Villanueva's clairvoyant vision of the future, along with a great determination to face any challenge, explain his remarkable achievements in Spanish education. His name is undoubtedly part of a small group of pioneers, to whom we owe that our universities have the potential and capacities that fit the demands of modern Spain. As this remains a daunting task, it is necessary to carry on with examples like his because the road is long. It is the requirement that we have seen in those who have been able to set an example.