EDITORIAL

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Year's comments for 2015

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This year, as in previous ones, microbiology was a frequent topic in the media's scientific news. The journal *Science* chose the genome-editing method CRISPR ("clustered regularly interspaced short palindromic repeat") as the breakthrough of 2015. The development of a genome-editing technique based on CRISPR is a turning point in genetic engineering, similar to PCR in the 1980s. Little known is the fact that it all started at the University of Alicante, around 1993, when Francisco J.M. Mojica, a microbiologist and SEM member, then a PhD student, characterized what is now known as a CRISPR locus in the archaeum *Haloferax mediterranii*, which grows in nearby salterns. (Mojica coined the term CRISPR in 2002, together with the Dutch researcher Ruud Jansen, who was also working on this system). Mojica (Fig. 1) was studying the genetic modifications induced by salt on specific regions of the archaean genome; these modifications altered the behavior of proteins that cut DNA. One of those regions contained several regularly spaced sequences. As those sequences were very abundant, Mojica assumed that they must play a significant role, given that all of the archaean genome is generally useful for these microorganisms. He then learned that a Japanese group had previously described those same sequences in a human intestinal bacterium. In the following years, the whole genome of many microorganisms was sequenced, and Mojica and his collaborators identified CRISPR sequences in many of them. After finding a phage fragment in one of the sequences, Mojica hypothesized that CRISPR was a type of adaptive immune system for the cell. That assumption, which is now widely accepted, was initially met with skepticism by reviewers in 1994. But, after refusals by several journals, Mojica's paper was finally published in *Molecular Microbiology* [Mojica FJM, et al., Mol Microbiol 17:85-93 (1995)].

Fig. 1. Francisco J.M. Mojica, in his lab at the University of Alicante. (Photograph from the University of Alicante website.)

It soon became clear to Mojica that CRISPR was an interference system, although he did not know how it worked. In the meantime, many other scientists became interested on those sequences. In 2011, one of them, Virginijus Siksnys, from Vilnius University, Lithuania, cloned the CRISPR/Cas system from *Streptococcus thermophilus* and expressed it in *Escherichia coli*, providing the latter with heterologous protection against plasmid transformation and phage infection. In 2012, Jennifer Doudna, from the University of California-Berkeley, and Emmanuelle Charpentier, now at Umeå University in Sweden, and the Max Plank Institute for Infection Biology in Berlin, found that CRISPR sequences bound to Cas9, acts as a nuclease and cut specific DNA targets. Soon CRISPR/Cas9 was used to delete, suppress, add, or activate genes in various organisms, both prokaryotes and eukaryotes. Sadly though, while in 2015 Doudna and Charpentier were awarded one of the highest Spanish prizes for science, Mojica's efforts went unrecognized. Indeed, "no

Table 1. Nobel Prizes in Physiology or Medicine related to microbiology or immunology

Year	Scientists	Work	Field*
1901	Emil von Behring	For his work on serum therapy, especially its application to diphtheria	I
1902	Ronald Ross	For his work on malaria, showing how the parasite enters its host	P
1905	Robert Koch	For his investigations and discoveries in relation to tuberculosis	B
1907	Alphonse Laveran	In recognition of his work on the role played by protozoa in causing diseases	P
1908	Paul Ehrlich, Ilya Mechnikov	In recognition of their work on immunity	I
1919	Jules Bordet	For his discoveries related to immunity	I
1926	Johannes Fibiger	For his discovery of *Spiroptera carcinoma* (a nematode) "causing cancer" (!)	P
1927	Julius Wagner-Jauregg	For his discovery of the therapeutic value of malaria inoculation in dementia paralytica	P
1928	Charles Nicolle	For his work on epidemic typhus	B
1939	Gerhard Domagk	For his discovery of the antibacterial effects of prontosil	A
1945	Ernst B. Chain, Alexander Fleming, Howard Florey	For their development of penicillin and its curative effects on various infectious diseases	A
1951	Max Theiler	For his discoveries related to yellow fever and how to combat it	V
1952	Selman A. Waksman	For his discovery of streptomycin, the first antibiotic effective against tuberculosis	A
1954	John F. Enders, Frederick C. Robbins, Thomas H. Weller	For their discovery of the ability of poliomyelitis viruses to grow in cultures of various types of cellular tissues	V
1958	George Wells Beadle, Lawrie Tatum, Joshua Lederberg	For the discovery of genetic properties of bacteria, especially their ability for recombination	B
1960	Frank Macfarlane Burnet, Peter Medawar	For the discovery of the acquired immunological tolerance	I
1966	Peyton Rous	For his discovery of tumor-inducing viruses (work done in 1912!)	V
1969	Max Delbrück, Alfred D. Hershey, Salvador E. Luria	For the discovery of the mechanisms of replication and genetic structure of viruses	V
1972	Gerald M. Edelman, Rodney R. Porter	For their discoveries concerning the chemical structure of antibodies	I
1975	David Baltimore, Renato Dulbecco, Howard M. Temin	For their discoveries concerning the interaction between tumor viruses and the genetic material of the cell	V
1976	Baruch S. Blumberg, D. Carleton Gajdusek	For their discoveries concerning new mechanisms for the origin and dissemination of infectious diseases	V-B-P
1997	Stanley B. Prusiner	For his discovery of prions, a new biological agent of infection	V
2005	Barry J. Marshall, J. Robin Warren	For their discovery of the bacterium *Helicobacter pylori* and its role in gastritis and peptic ulcer disease	B
2008	Harld zur Hausen, Françoise Barré-Sinoussi, Luc Montagnier	For the discovery of papilloma virus and its relation to cancer cervix For their discovery of the human immunodeficiency virus (HIV)	V
2015	Willian C. Campbell, Satoshi Omura, Youyou Tu	For their discovery of a therapy against diseases caused by nematodes For her discovery of a new (but coming from Chinese traditional medicine) treatment of malaria	A

Adapted from: The Nobel Foundation [nobelprize.org/medicine/laureates/index.html]
*Field (or related to): A, antibiotics/chemoterapics; B, bacteriology; I, immunology; P, parasitology and protistology; V, viruses and prions. (In some cases, the prize was shared with other persons working on fields not directly related to microbiology or immunology.)

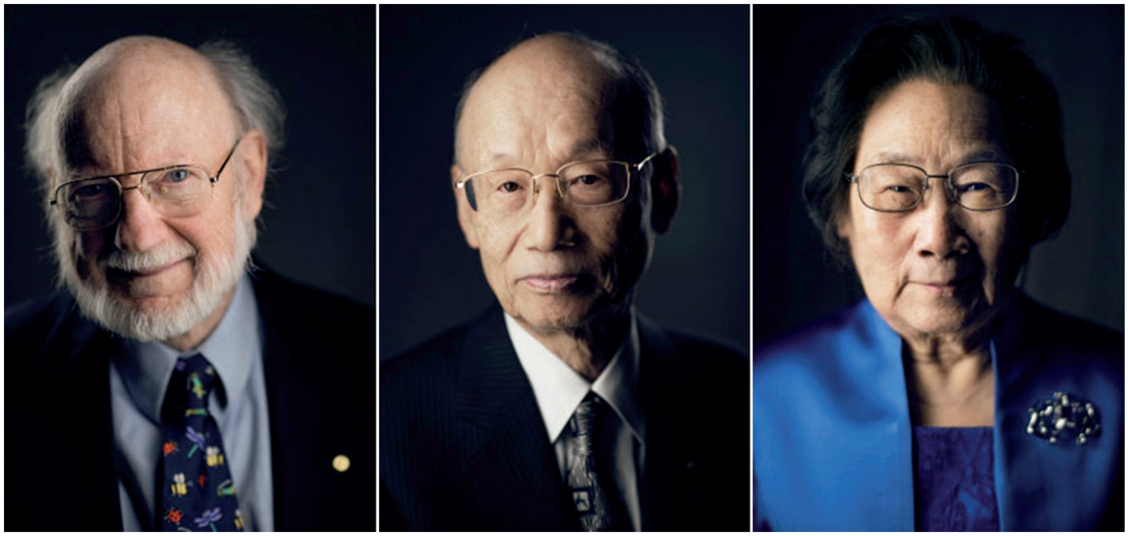

Fig. 2. From the left to right: William C. Campbell, from Drew University, NJ, USA; Satoshi Ōmura, from Kitasato University, Tokyo, Japan; Youyou Tu, the Academy of Traditional Chinese Medicine, Beijing, China. (From The Nobel Foundation website [nobelprize.org/medicine/laureates/index.html].)

one is a prophet in his own land." Now, with Nobel Prize watchers betting on the future likely winners, it is certain that sooner or later they will include the scientists who developed CRISPR/Cas9. Will be Mojica unrecognized again? Will he be as influential as Alexander Fleming, who was awarded the Nobel Prize despite the fact that he did not work in the development of penicillin as a powerful curative molecule? Nevertheless, the applications of this powerful gene-editing technique has raised important ethical questions, especially about its use in humans. As for Mojica, he continues to work on the CRISPR system and now leads a research project on immunization in bacteria and the adaptation of the CRISP-Cas I-E of *Escherichia coli* and *Salmonella enterica*.

Throughout the history of Nobel Prizes, roughly 25 have been directly related to microbiology or immunology (Table 1). The 2015 Nobel Prize in Physiology or Medicine recognized discoveries in the field of parasitic diseases. William C. Campbell, from Drew University, NJ, USA, and Satoshi Ōmura, from Kitasato University, Tokyo, Japan, divided one half of the prize "for their discoveries concerning a novel therapy against infections caused by roundworm parasites." The other half went to Youyou Tu, from the Academy of Traditional Chinese Medicine, Beijing, China, "for her discoveries concerning a novel therapy against malaria" (Fig. 2).

In December 1, 2015, the Pan American Health Organization/World Health Organization (PAHO/WHO) released an epidemiological alert regarding the public health implications of zika virus infection and its possible relation with congenital anomalies, Guillain-Barré syndrome, and other neurological and autoimmune syndromes. The PAHO member states where the autochthonous circulation of zika virus has been confirmed are Brazil, Chile (Easter Island, in mid-Pacific), Colombia, El Salvador, Guatemala, Mexico, Paraguay, Surinam, and Venezuela.

* * *

A basic knowledge of microbiology is crucial for citizens of all countries. The diffusion of this broad-ranging, important subject must be extended beyond the walls of schools and universities. With this objective in mind, museums can play an essential role in educating the public about microbes and their meaning for human life. However, until recently, microbes were for the most part ignored by museums, and, if they were ever mentioned, it was only as dreadful agents of terrible diseases able to decimate human populations. Their major role in the history of life and in present ecosystems was all but ignored. However, as John L. Ingraham wittily wrote [*March of the Microbes*, Harvard University Press, 2010]: "the percentage of disease-causing microorganism (pathogens) is far, far less than the percentage of humans that commit first-degree murder."

Maybe some day the presence of microorganisms in natural history museums will be as typical as now is the presence of animals or minerals. Fortunately, microbes have started to have the same recognition by museums that has long been granted to animals and minerals. Until recently, however, rarely were microbes shown in those museums in permanent exhibits. But that trend has made an inflection in the present decade and sveral museums have started to consider that microbes deserve their own spaces, and that their major role in the history of life and in

Fig. 3. *Planet Life*, a permanent exhibit of the Natural History Museum of Barcelona (the *Blue Museum*), inaugurated in 2011, displays a comprehensive vision of the World of Microbes and the major role that microbes have played in the history of Earth and the biosphere. (Photographs by M. Berlanga.)

the present ecosystems must be explained to visitors.

To our knowledge the first permanent exhibit to show the natural history (phylogeny and evolution, physiology, genetics and ecology) and emphasize the non-pathological importance of microorganisms is at the Natural History Museum of Barcelona (MHNB, the *Blue Museum*), inaugurated on 27 March, 2011. This exhibit is an essential part of the *Planet Life* section and offers visitors a comprehensive vision of the World of Microbes and their critical roles in the history of Earth and the biosphere. The MNHB occupies 9,000 m^2 in an impressive building that architects Herzog & de Meuron made for the 2004 Barcelona's Forum of Cultures. The new MHNB, which have a history of 135 years (!), have more than 2 million specimens of rocks, minerals, fossils, plants and animals. *Planet Life* has pioneered the task of presenting a Gaian view of our planet's tangled history, by revealing how rocks, plants, fungi, animals, and, indeed, microbes interact and modify each other in the Earth (Fig. 3).

In October 2014—and perhaps in keeping with the Netherlands as the cradle of microbiology—an impressive microbial "zoo," named *Micropia*, was established in Amsterdam. *Micropia* is located next to the famous Artis Royal Zoo, one of the oldest zoos in Europe (Fig. 4). More recently, in November 2015, the New York City's American Museum of Natural History inaugurated "The Secret World Inside You," a temporary exhibit that will run until mid-August, 2016. The exhibit includes videos, 3-D models, interactive displays, and tutorial lectures taught by efficient and friendly university students in person. The "teacher" animates "pupils" to look at their own belly buttons, but not for a feeling of self-complacency but to investigate the microbes inhabiting there (Fig. 5). Finally, another project to bring microbes to museums was recently announced. Roberto Kolter (former president of the American Society for Microbiology) and Scott Chimileski, a postdoctoral fellow in Kolter's laboratory at the Harvard Medical School in Boston, are developing a project, with the support of the ASM, to exhibit the microbial world at the Harvard Museum of Natural History, an institution that attracts thousands of visitors each year.

Hopefully, all natural history museums will soon follow the example of Barcelona, Amsterdam, New York, and Cambridge, MA (Harvard), and show the general public that life cannot be explained without taking into account the "Unseen World"—the tiniest living beings in nature—, and that the "macro-bios" (including ourselves) cannot live without the "micro-bios."

* * *

Let's talk about International Microbiology in 2015. But, first, some background considerations must be offered: To the vast number of already existing scientific journals in all fields, many others are added almost daily. These are often announced in unsolicited emails inviting us to submit articles and/or to join their editorial boards. The first thing that comes to mind is that we are in front of a business intention, which would not be reprehensible, because business is one of the aims of publishing companies. Currently, most science and humanities journals are in the hands of a few very large international publishing houses, which, in general, offer excellent products. However, scandals related to the intentions of more recent emerging publications should serve as a reminder that

Fig. 4. *Micropia*, a permanent large exibit of the world of microbes in the Amsterdam zoo inaugurated in 2014. (Photographs from the museum website.)

these new journals should be carefully evaluated by researchers looking for a place to publish their work. The majority of experienced researchers have a list of benchmark journals that they rely on to stay current in their fields. Such lists offer a way to manage the enormous number of scholarly publications available in print and, especially, via the internet. But whether we, as researchers, can and do benefit from this huge amount of information is unclear, as is the impact on science of this plethora of highly specialized journals and their dilution of potentially important knowledge. Today the motto of "publish or perish" still holds true and researchers continue to produce manuscripts at a not always justifiable rate and number ("salami papers", as they are whimsically called). Consequently, the main objective of a scientific research paper—to communicate research results and discuss their significance with other experts—has become "secondary."

Presently, the technical process of the scientific publication has experienced many changes, both in rapidity and quality, but the most important factor is the possibility of reaching the whole world via internet. The management and publication (both online and in print) of International Microbiology is a complex task, depending on the efforts of a small

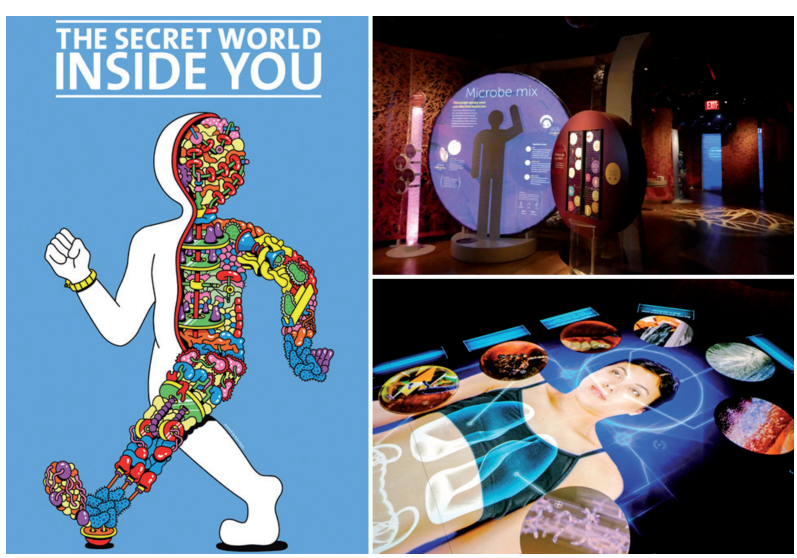

Fig. 5. "The Secret World Inside You," a temporal exhibit at the American Museum of Natural History of New York, inaugurated in December 2015. (Photographs by M. Berlanga.)

group of people working at one or more stages of the process. Although the printed journal has been overshadowed by the online version, there has been no change in our efforts, both from the scientific (content) and editorial (presentation) points of view, to publish good-quality manuscripts. The people responsible for the internal functioning of the journal meet regularly to discuss and decide the manuscript evaluation, editing, and preparation. The Publication Board consists of two Coeditors-in-Chief (located in Madrid and Barcelona), several Associate Editors, a General Secretary, a Managing Coordinator, a Digital Media Coordinator, and a Webmaster. Their names as well as those of the Editorial Board members (national and international) appear on page p. 2 of each issue.

Manuscript management through ScholarOne system was initiated in 2013 for a term of 3 years (2013–2015). At the end of that period, the extremely high fees charged by that company for its services, together with the difficulty and cost of introducing the necessary adaptations led to our decision not to renew the contract for 2016. In addition, the system had the unwanted consequence that many manuscripts of very poor quality were submitted, most of which had to be rejected after the first general evaluation. At the other end, there was no increase in the dissemination of the journal's articles. Currently, authors can submit their manuscripts through our own webpage [http://revistes.iec.cat/index.php/IM], hosted at the Institute for Catalan Studies, Barcelona, where the digital management of the journal is efficiently administered.

Journals that serve as the official publication of a scientific society, as is the case for INTERNATIONAL MICROBIOLOGY and the Spanish Society for Microbiology (SEM), typically have very limited economic resources. These journals need the support of all members of the professional society. The SEM's membership currently numbers about 1800, with members coming from Spain and elsewhere. SEM members are asked to support the journal via efforts to enhance its scientific level, by submitting good-quality manuscripts. The main objective of INTERNATIONAL MICROBIOLOGY is to diffuse the unity and diversity of the microbiological sciences (*In pluribus unum*), But, although the journal publishes articles from all over the world, also try (we think successfully) to promote research in microbiology and the dissemination of the obtained knowledge in Spain, Portugal, and Latin America. The quality of a journal and its international reputation reflect on the quality of the scientific society responsible for its publication. The team that has worked to produce the official SEM's journal since 1994 had little experience in science editing and publishing when they started. They "learned on the job," through small and large successes as well as errors, but they have remained devoted in their efforts to achieve a product in which they and the SEM proudly stand behind.

But all this is not sufficient. Publishing a scientific journal has an economic cost, and what cannot be covered with money is made through the effort and personal commitment of a team. The effort, however, is worthy when the product gets recognition. Suffice it to mention that due to these efforts and the contributions of the authors whose work has been published in the journal, the quality of INTERNATIONAL MICROBIOLOGY has been acknowledged by the FECYT (Spanish Foundation for Science and Technology) in the two calls to which we applied (2012 and 2015, calls are launched every 3 years), consistently obtaining a score of 20 out of 20 criteria evaluated. But the most important recognition was the inclusion of the journal in ISI-Current Contents, which came in 2005 after being sought by the SEM since the early 1980s. In the following years, the journal was included in the major databases of international scientific journals, most importantly, PubMed and Scopus.

Each year, in the December issue we publish information on the manuscripts received, accepted, and rejected, their origin, indexes of the authors, titles, and keywords, and a list of the reviewers active during that year (see pp. 265–270 in this issue). During 2015, 125 manuscripts were received through ScholarOne, with an additional 10 requested directly by the journal to experts (reviews, editorials, and perspectives). A total of 28 articles were published: 18 from ScholarOne and 10 directly received via the webpage of the journal. Among all articles received by ScholarOne, 107 were rejected. According to geographical origin, the published articles came from: Spain (12), the rest of Europe (5), Latin America (6), the USA (2), and Taiwan and Japan (3). INTERNATIONAL MICROBIOLOGY staunchly try to explore and diffuses knowledge about microbiology. While it may not be as pervasive or as persistent as the microorganisms it covers, we do aspire to continue talking about them for as long as possible. To the SEM, its members, microbiologists in general, and friends, we, the members of the Publication Board, thank you for contributing to the continuity of the journal in the way that you best know how to and do: by submitting manuscripts that convey the quality and interest of your work and as devoted readers of the journal.