

## Year's comments for 2010

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As in previous years, over 2010 microbiology has been—either directly or indirectly—in the spotlight of many science news. However, it has been almost forgotten for many institutions that, on the occasion of the International Year of Biodiversity, celebrated life on Earth and the value that life's diversity represents for humans. In fact, the logotype designed for that purpose only reflected a part of the Earth's biodiversity: plants, animals, including human species, and the sea, with fish. Three of the major groupings of life—fungi, protists and prokaryotes, call them Domains, Kingdoms or whatever you like—were not represented there. (See Fig. 1 with the “unofficial” logotype drawn by our journal.) Biodiversity had been a priority area of the 6th Environmental Action Programme of the European Union (EU), which was in agreement with the global target of the United Nations Convention on Biological Diversity to halt biodiversity loss worldwide by 2010.

However, neither in the EU nor in the rest of the world was that target achieved, and biodiversity has declined globally. Thus, more realistically, new strategies to preserve biodiversity were set up in 2010 to be developed over the next decades.

To preserve something, one must first know what has to be preserved. Thus, to preserve microbial diversity, it is necessary to have an inventory of the diversity of microbial “species”—whatever they are—and to understand the role of

those species in the ecosystem. Microbial ecosystems respond to the ecological theory and follow the same patterns as the ecosystems usually studied; it is just a matter of size. The study of microbial diversity, however, cannot be approached the same way that the study of diversity in other groups. Only a small percentage of microorganisms has been identified, and an even much lower percentage can be cultured. In addition, horizontal genetic transfer in prokaryotes makes the concept of species more complex than in other groups of living beings. Microbial community genomics and the study of microbial functional diversity must be taken into account. Diversity and function are two concepts that cannot be separated when studying microbial diversity.

Methodological constraints and analytical limitations in the study of microbial diversity might be overcome with a new approach consisting of an initial PCR

step to obtain only 16S rRNA genes sequences and subsequent pyrosequencing, which provides thousands of operational taxonomic units. Over the last few years this approach has provided information about richness and evenness of microbes in various environments. It has been applied to seawater and soil samples, and also to more restricted ecosystems such as lakes, termites guts and the human gut. The study of what has been called human microbiome—i.e., the thousands of microbial species



**Fig. 1.** The journal's “unofficial” logotype of the 2010 International Year of Biodiversity, focusing on the invisible diversity: the microbes.

that reside in our bodies and have become part of us through-out evolution—will surely have repercussions in medicine. Microbiota transplantation might be in the future a treatment for intestinal diseases and other disorders related to the immune system. A paper was published in March 2010 that reported the sequencing, assembly and characterization of 3.3 millions of non-redundant microbial genes from the human gut. Even though not all sequences were found in all members of the cohort analyzed, the study revealed that many genes are shared among individuals [8].

At the beginning of July, the media spread the news that Craig Venter's team had synthesized life in the laboratory. 'Artificial life' was a term widely spread to refer to the design, synthesis and assembly of a genome that was then inserted into a pre-existing cell whose DNA had been removed. The 1.08-megabase pair genome was built from digitized information of the *Mycoplasma mycoides* JCVI-syn1.0 genome, and it was transferred into a *Mycoplasma capriolum* cell, which became a new *M. mycoides*. In fact, the new genome took control of the cell and after a few generations the new bacteria were similar to the one whose DNA had been copied and synthesized [3]. Nevertheless, this achievement did not come out from serendipity.

For some fifteen years, Venter and his teams have been in the quest for building a minimal cell that contained only genes that were essential to the cell's normal vital cycle. Most mass media showed Venter's achievement as if what had been synthesized were a whole 'created' organism. But not only the media. The authors themselves (or the journal's editors?) propose a title of the paper that emphatically starts with "Creation", without quotations marks. Some serious newspapers and science journalists, however, took the news with a pinch of salt. It will surely take much time before a completely synthetic organism can be produced, but the work reported now is a first step to this goal and indeed a milestone in the field of synthetic biology which opens new ways to genetic engineering.

Another finding in microbiology that has been magnified, and in most cases misunderstood, has been the recent report of a bacterium growing on arsenic instead of phosphorous [9]. Many newspapers and other mass media used the word 'extraterrestrial' to refer to the bacterium described, which made many people believe it was a bacterium originated in the outer space. The bacterium, however, was growing in an actual terrestrial environment: the hypersaline arsenic-rich waters of Mono Lake, California (Fig. 2). The fact that a bacterium grew on an arsenic-rich environment was not any novelty. It was already known that certain prokaryotes from a wide range of habitats use arsenic in their metabolisms and that there is a biogeochemical cycle of arsenic in which three

kinds of prokaryotes participate: dissimilatory arsenate-respiring, heterotrophic arsenite oxidizers, and chemoautotrophic arsenite oxidizers [7]. The novelty in the Wolfe-Simon et al. work was that, through successive cultures, in which phosphorous was replaced by arsenic, the authors discovered that this element had replaced phosphorous in molecules crucial to life, including nucleic acids and ATP.

Press agencies (they belonging either to national agencies, universities or private companies) often behave like those fishermen that stretch their arms to show the size of the fish they caught, usually magnifying the actual sizes of their preys. Anyway, exaggerating the results of the research is not exclusive of them. Also, many researchers cast press releases and interviews showing their "fishes" also magnified. Probably, they do so because the echo these press releases get in the media are of help when they apply for grants. So, we are often told about discoveries that turn out to be not novelties or that are only half-discoveries. The description of a living being growing on arsenic instead of phosphorous, even exchanging the two elements in crucial molecules, however, was a momentous discovery. There was not need to disguise it with an alien dress. Of course, provided that what the authors described in the paper had actually happened.

When someone reveals a phenomenon that means a change in pre-established paradigms, other scientists tend to show themselves skeptical. And this is an essential trait of the scientific method, and burst the progress of research. The results reported by Wolfe-Simon and her colleagues have been widely criticized in social networks at the Internet and by bloggers that have soon spread the opinions of other microbiologists or experts in biochemistry. They have mostly criticized the methodologies used in the Wolfe-Simon's experiments to purify the cell components that she claims to have been transformed by the use of arsenic instead of phosphorous, as well as in the analysis done to show the change. Another argument against Wolfe-Simon's results is based in the fact that life has persisted in a planet where available phosphate is scarce. It has been throughout natural-selection mechanisms that life has become able to capture small amounts of phosphate. The authors of the article have recognized that their cultures were not completely phosphate-free, but that it were present in amounts in the order of micromoles.

In addition, from the chemical point of view, there is the fact that organic derivatives of arsenate are much more labile, with very short mean lives. The authors have not been able to explain how a cell could stabilize such labile molecules, nor how could they extract arsenate-based DNA—conventional methodologies, based on the use of chloroform and phenol to get pure DNA, leave it in an aqueous solution, which would

destroy the genetic material, were it to be based on arsenic chemistry, instead of phosphorous. Let us wait whether other researchers can repeat the experiment with the same results.

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The last few years have witnessed a change in the way how science, including microbiology, is spread among the scientific community and to the society, and how the scientific knowledge is exchanged and debated. As Melanie D.G. Kaplan expressed recently in the American Society for Microbiology (ASM) bulletin *Microbe*, we can talk now of Microbiology 2.0 [ref. 4]. The debate arisen about the arsenic replacing phosphorous is an example of this change. Skeptical scientists have not had to wait to see their opinions in print. Regarding scientific meetings, you no longer need to travel and pay registration fees to attend many conference sessions. You can follow them either live—and sometimes even participating in the debates by tweeting your questions—or through videos uploaded in the web later. You can as well discuss with distant colleagues, each one from his or her office, and have immediate feedbacks.

New forms of communication have emerged that promote the dissemination of science and help to break the gap between developed and developing countries. Neither scientific conferences nor scientific journals will disappear. However, never before had scientists from all over the world had the possibility to interact and exchange knowledge and experiences as they do now through electronic communication media. Science journalism has also reached a turning point, and only professionals able to take advantage of the new media and adapt to them will be able to survive in their careers. The survival of the fittest is a constant in all kind of evolution, be it biological or cultural.

The SEM website was renewed in 2010. The SEM wanted a website that was useful to its visitors, and where they could easily find the contents. A section with educational resources, aimed as complementary tools to both university microbiology courses and high-school education has been added. It includes articles, a photo gallery, videos with teaching material, and podcasts. The latter are the Spanish version of a selection of the 2–3-minute podcasts that the ASM has produced on topics at the forefront, which have been translated by SEM members that volunteered for such a task.

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Throughout 2010, INTERNATIONAL MICROBIOLOGY has received 220 manuscripts, dealing with different topics of microbiology. Once again we must recognize the work carried out by the 97 reviewers (46 from Spain and 51 from abroad) who volunteered to review the manuscripts received,



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**Fig. 2.** Mono Lake (California, USA), formed more than 760,000 years ago. It has not any outlet to the ocean, which makes it an hypersaline lake (salinity ca. 81 g/l). [Photo by M. Berlanga.]

and their names and affiliations can be seen in p. 225 of this issue. In many cases, in addition of their assessment of the scientific quality of the works submitted, the reviewers provided advice for the authors to improve the presentation of their works. The editorial board tries also to help authors who submit manuscripts with sound scientific content but with flaws in their presentation.

The four micrographs at the front cover of INTERNATIONAL MICROBIOLOGY, were in 2010, as in previous years, provided by microbiologists working either in Spain, in Portugal or in Latin America. Besides, the images at the center of the cover are always related to some article published in the same issue. The fact that those in March and December show, respectively, the carnivorous plant *Sarracenia purpurea* and an apple tree blossom supports the idea that microbiology is related to other life sciences. Finally, the ties between our journal and Latin America microbiology are present in the portrait—and signature, if available—of outstanding classical microbiologists that are represented on the back cover of the journal, with minibiographies included inside the issue.

Those chosen for 2010 were Rodolfo Robles, from Guatemala (March and June issues) and Carlos Chagas (September and December issues).

INTERNATIONAL MICROBIOLOGY wants to increase the visibility of both the SEM and the Latin American Association of Microbiology (ALAM) conferences [1,2]. The 2010 March issue presented the inaugural lecture of the 2009 SEM conference, which was imparted by Roberto Kolter, by then ASM president [5], while the June issue contained the lecture by Alex Mira, who was awarded the SEM's Jaime Ferrán Prize also in that conference [6]. Finally, this December issue contains a report of the 20th ALAM conference, which took place in Uruguay on 27–30 September 2010 [see this issue, pp. 213-218].

INTERNATIONAL MICROBIOLOGY aims to tighten the ties between Spanish, Portuguese and Latin American microbiologists. Nowadays, thanks to the new technologies of communication, the ocean—our common “puddle”—should no longer be a barrier between Europe and America. ‘Real’ meetings will be of course welcome, but microbiologists from the two shores already form part of a global network

that integrates human knowledge, maybe what Russian ecologist Vladimir I. Vernadsky's (1863-1945) conceived as the *gnososphere*.

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