

J.C. Argüelles

Learning about microbiology: virus or bacteria?

Published online: 7 September 2001
© Springer-Verlag and SEM 2001

Microbiology is one of the scientific disciplines which have most expanded their horizons during recent years, in terms of both basic research and applications. The work of clinical microbiologists is nowadays indispensable for the correct diagnosis and treatment of many human diseases; and analytical biologists are to be found in laboratories which examine food, water, soil and a variety of ecosystems. Microbiologists are increasingly employed in quality control services and pharmaceutical companies searching for new antibiotics. There is also the no less indispensable, but less noticed, role of teachers and researchers at all levels of the educational system.

Despite its wide relevance, many people are almost in complete ignorance of microbiology. Much of this ignorance is due to the intrinsic nature of microorganisms, which escapes detection by the naked eye. Microbial life is a most fascinating field to explore for the researcher and to explain for the vocational teacher. Yet, it is difficult to understand or imagine for the non-initiated, who tend to consider microbial world as peopled by wicked minuscule monsters and research institutions as peopled by less minuscule but still strange humans. Even students of microbiology, whether in the biological, medical, pharmaceutical or veterinary sciences, must make an additional effort to understand organisms which they cannot see directly and which need previous fixing and staining to be observed. Such microorganisms cannot be defined by criteria such as morphology, structure, nutritional requirements or biochemical, serological or pathological properties.

One more factor seems to be responsible for the lack of knowledge in this field and that is the way in which

findings are published. Specialized scientific journals have a restricted circulation and information (or misinformation) reaches the general public through the mass media. Such mass media do not have (or, at least, only very few of them have) journalists capable of providing truthful and believable reports on microbiological findings that inform accurately. In the past few years, there has been an increase in microbiology-related news referring either to localized or epidemic outbreaks of infection, or to new advances in the understanding and treatment of infectious diseases or even to basic research and its industrial application, and the genetic analysis of microorganisms. Nevertheless, serious typological errors recur: the causes of infectious diseases may be attributed to viruses or bacteria, regardless of which of them were to blame. There is also confusion between bacteria and microscopic fungi. All in all, the list of errors is so great that mere lapses and typological mistakes must be ruled out.

Let us look at a few examples. Occasionally, the media mention cases of widespread food-poisoning as “the outbreak of gastroenteritis caused by the virus *Salmonella*”. Recently, according to some newspapers, the complete genome of the “cholera virus” was cloned. In this case, however, there may have been some confusion over the name of the pathogen responsible for cholera, *Vibrio cholerae*, which is transmitted by either contaminated food or water and which still causes severe epidemics in some areas of the planet, with high mortality rates. Sometimes, typhoid fever is erroneously described as typhus, although their causal agents, means of transmission and treatments are totally different. Recently, too, new hopes for controlling malaria by genetic modification of the mosquito vector that spreads this parasitic infection have been described. However, contrary to what was expressed in several newspapers, there is no such thing as a malaria bacterium, since the etiologic agent is a protozoan.

Several Spanish television stations reported an outbreak of legionellosis in the autumn of 2000. Erroneous details were given about the origin of the outbreak,

J.C. Argüelles
Área de Microbiología, Facultad de Biología,
Universidad de Murcia, 30071 Murcia, Spain
E-mail: arguelle@um.es
Tel.: +34-96-8367131
Fax: +34-96-8363963

about the natural habitat of *Legionella* and also about prophylactic measures and treatment. From the media, it is also difficult to ascertain the causes of the re-emergence of tuberculosis, a disease which involves the exaggerated or inadequate response of the immune system. Immunocompromised people release into the atmosphere new strains of tuberculosis bacilli resistant to conventional chemotherapy (streptomycin, isoniazide or ethambutol), seriously undermining the health services of the world. More understandable perhaps is the confusion about the nature and control mechanisms of "mad-cow disease", since the biology of prions is difficult to understand, even for reputed specialists.

For people not familiar with the field, it is difficult to distinguish between the various categories of living beings that cannot be seen directly because of their microscopic size. To students of general microbiology, teachers will often state that biological differences between a virus and a bacterium are greater than between an ant and an elephant. Microbiology is concerned with bacteria which are totally distinct from us in their prokaryotic type of cell organization and also differ from other eukaryotic organisms which share our pattern of cell organization. However, only a few intuitively associate bread, wine and beer with microscopic yeasts. When it comes to different viruses, it is even more difficult to explain the behavior of this unusual group of infectious agents, which live and reproduce only with the help of a cellular host. That these biological entities with an extremely simple structure (a molecule of nucleic acid surrounded by a capsid of proteins) can colonize and subsequently dominate dissimilar cells of higher organisms and make them work on their behalf is the most intriguing biological mystery.

I find it difficult to explain to my neighbors that some of the commonest and some of the most lethal diseases such as influenza, rabies, hepatitis, the initial infection in AIDS and foot and mouth disease in cattle are caused by viruses and not by bacteria. To the uninitiated, they are similar "bugs" (a term not infrequently heard in the

microbiology laboratory itself). For this reason, they do not understand why there are two different kinds of treatment. The particular characteristics of viruses and their ways of transmission are a serious hurdle in the search for antiviral drugs. Most conventional antibiotics useful against bacteria are totally useless against viruses; and new antiviral compounds are limited in their efficiency or cause serious toxic effects to patients.

Therefore, some microbiologists face a serious challenge: they themselves must become communicators! It is a difficult task to make a general audience understand academic science; and it is even more difficult when the subject cannot be visualized or known from its manifestations or symptoms. The media themselves should take a leading position in this matter by employing experts, both in science in general and in microbiology in particular. Independently of their line of thinking or business strategy, the credibility and prestige of newspapers and television channels depend on the truthfulness and accuracy of their reporting. There is no hesitation to hire expert political, economic or sport analysts. But, when it comes to scientific reporting, there is much to be desired.

This need is even more pressing with the vast strides being made in science and in the light of advances which often outstrip ethical, political or legislative considerations. Rigor in scientific reporting is the only remedy to fill such a gap. Experts suggest that science should be included in the curriculum of journalistic studies. There is a risk, however, that in the absence of specialist comments, attempts to provide scientific information in a colloquial language may diminish the importance of science. I believe the risk is worth running. The intrinsic complexity of technical terminology can no longer be an excuse. Computer science and technology have complex languages too, but this has not prevented computers from entering our homes. Now that we are on the subject, let us start by differentiating the term virus from bacterium.