



Letter from... Brazil



The evolution of Brazilian science

The number of Brazilian scientists and publications from Brazil in the international scientific literature has grown substantially in recent years.

The total number of citations in PubMed by country shows 25 000 for Brazil against 300 000 for the UK, 92 000 for Germany and 31 000 for Spain. The number of citations from Brazil was similar to Mexico, but otherwise well in excess of other countries in South or Central America.

Approximately 7000 students complete their PhD yearly in different areas of science in Brazil. The number of clinical trials by multinational pharmaceutical companies has also dramatically increased in the last 4 years. Brazilian scientists have achieved some remarkable breakthroughs in scientific research; for instance, the determination of the full genome sequence of the plant pathogen *Xylella fastidiosa* [Nature (London) (2000) 406, 151–157].

These discoveries have been achieved in spite of low investments and generally poor research facilities. In fact, there has been an important decrease in volume of resources allocated by the federal Brazilian government to science and technology between 1996 and 2002 [Braz. J. Med. Biol. Res. (2003) 36, 1135–1141]. Fortunately, this is not true in São Paulo State where FAPESP (Fundação de

Amparo à Pesquisa do Estado de São Paulo) has been providing substantial support for research (US\$120 million in 2003).

In addition to the limitations in funding, Brazilian scientists have to pay high prices for scientific equipment [Nature (London) (2004) 428, 453]. For example, the cost of centrifuges can be up to 70% higher in Brazil compared with the USA and Germany. The cost of importing drugs for clinical research, scientific equipment and reagents into Brazil is also very high due to excessive import taxes. Moreover, when a foreign university (from the USA or Europe) donates equipment, customs clearance requires tremendous paperwork [Nature (London) (2004) 428, 601]. When the equipment gets to the laboratory, the Brazilian distributors of the international companies are not always well prepared to install it and to train people appropriately. The Brazilian distributors often have no replacement parts and sometimes do not have the necessary expertise to repair the equipment adequately. In addition to this, repair costs are very high.

In spite of the difficulties outlined above, Brazilian scientists are under pressure to publish in top journals, competing with their peers from developed countries [Nature (London) (2003) 422, 259–261], in order to obtain financial support.

Many Brazilian scientists collaborate with colleagues in the USA and Europe to ensure the highest standards of research and publication are obtained. Leopoldo de Meis, a biochemist from the Federal University of Rio de Janeiro, and colleagues analysed the consequences of the growing competition in Brazilian science. They interviewed graduate students, post-doctoral fellows and professors in one university department with a strong research tradition. The authors concluded that the level of stress caused by the increasing competition and diminishing resources has negative effects on creativity and on postgraduate students' career choices [Nature (London) (2003) 424, 723]. This article motivated an intensive discussion on how strategies adopted to publish in top journals can be detrimental to the way Brazilian scientists think of their own work. Marcello A. Barcinski (from São Paulo University) pointed out that a numerical assessment of scientific merit reduces the possibilities of establishing priorities and scientific strategies that best fit the requirements of Brazilian communities [Nature (London) (2003) 423, 280].

During the last meeting of the Brazilian Biochemistry and Molecular Biology Society (May 15–18, 2004, in Caxambu, Minas



Gerais), Gerhard Malnic (from the Department of Physiology and Biophysics, São Paulo University) presented a lecture on the evolution of experimental biology in Brazil.

He pointed out that the move of the Portuguese Royal family to Brazil in 1808 was the starting point for Brazilian biological science. Medical Schools were subsequently created in Rio de Janeiro and in Salvador in the same year. D. João VI (Emperor of Portugal) founded the first Brazilian institution of science, the Imperial Museum in Rio de Janeiro, in 1818, which is still very active under the name of National Museum. The first Brazilian scientific library was founded in the Imperial Museum in 1863.

Biological research started in institutes such as Oswaldo Cruz (now named Instituto Manguinhos) in Rio de Janeiro, and Bacteriological (now named Instituto Adolfo Lutz) and Butantan in São Paulo. In 1913, scientists started moving from research institutes to universities, establishing academic research programmes.

Remarkable breakthroughs have been achieved in Brazil during the twentieth century, such as the action of snake venoms (Vital Brazil), pathogenesis of Chagas disease (Oswaldo Cruz), as well as the discovery of bradykinin (Maurício Rocha e Silva) and the inhibitor of the angiotensin-converting enzyme (Sergio H. Ferreira).

So, Brazilian science is still relatively young compared with European or American science. It follows that Brazil should be able to learn from the mistakes of other countries regarding the role of government and the successful implementation of institutional policies that can be helpful to facilitate and to improve our work. The time for this is ripe: interest in research has grown fast in Brazil, and the Brazilian press pays close attention to what is being done in the universities and research institutes.

There is a consensus that the development of science and technology is the only way to improve the country's economy. A recent article by Jose Fernando Perez (FAPESP) and Fernando de Castro Reinach (a biochemist from São Paulo University) published in an important national newspaper suggested that Brazilian companies should have labour tax benefits to hire PhDs. This measure alone would not only create new positions for our postgraduate students, but also make these companies more competitive abroad.

A body of measures should now be taken by the Brazilian government and official institutions to improve science in Brazil. The scientific competence already established needs to be maintained. Policies to facilitate the importation of drugs, equipment and reagents for research purposes

have to be implemented. Companies that manufacture scientific equipment or produce scientific reagents should be encouraged to establish plants in Brazil. New strategies to improve scientific facilities need to be adopted by universities and research institutions. Brazilian companies ought to be aware that, in order to survive in a competitive world, new technologies are required. Therefore these companies should develop their own facilities for research or even establish agreements with research institutions. Clinical trials demand not only clear ethical procedures, but also adequate legislation to avoid time-consuming tasks and the high costs that jeopardize Brazilian participation in new drug development. The country's natural resources need to be catalogued, and their potential for application should be investigated in a systematic and organized way. This is of particular importance to preserve the Amazon rainforest, currently being plundered for short-term logging and agricultural gain.

The government, research institutions and private companies should now be invited to plan investments and to adopt measures to speed up the evolution of Brazilian science.

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