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Physiology in Brazil : Past and Present

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Although physiological research in Brazil started long before the Brazilian Physiological Society (Sociedade Brasileira de Fisiologia) was created in August of 1957, this date marks the beginning of institutionalized physiological research in our country. Thus we could say that Physiology is rather young in Brazil, a little over 50 years. The Society is a learned society and an association of students and professionals in physiology in Brazil, having currently over 300 affiliations. It is a member of the Brazilian Federation of Experimental Biology Societies (FeSBE) and of the Brazilian Society for the Advancement of Science (SBPC). Internationally, it is the country's representative at the International Union of Physiological Sciences (IUPS) and at the Latin American Association of Physiological Sciences. The Society has an official journal, the Brazilian Journal of Medical and Biological Research, which is published on-line by SciELO. Among the founding members was a host of important Brazilian scientists of the last century, such as Wilson Teixeira Beraldo, M. R. Covian, Carlos Chagas Filho, Carlos Ribeiro Diniz, Hiss Martins Ferreira, Aristides Pacheco Leão, Thales Martins, Erasmo G. Mendes, José Ribeiro do Valle, Fernando Ubatuba, Amadeu Cury, Haiti Moussatché, Paulo

Sawaya and Mauricio Rocha e Silva. Many of these scientists dedicated their careers to different areas of physiological sciences that prospered and gained national and international recognition. Basically, the history of Physiology in Brazil can be traced back to their work and the Institutions and research groups that many of them founded and nurtured to prosperity. Typical examples are the Biological Institute of the University of São Paulo where Paulo Sawaya and Erasmo G. Mendes created the group of Comparative Physiology, the Biophysics Institute of the Federal University of Rio de Janeiro, where Carlos Chagas Filho, with help from Aristides Pacheco Leão and Hiss Martins Ferreira created the first graduate program in Physiology and Biophysics, and last but not least the Basic Sciences Departments of the Medical School of the University of São Paulo in Ribeirão Preto, where Maurício Rocha e Silva had a leading role. To these three Institutions one can trace most of the research groups working in Physiology nowadays in Brazil.

After this short historical overview, we will explore the overall contribution of Brazilian scientists to world science, specifically examine their contribution to biological and biomedical sciences, and then focus on physiology. As mentioned by

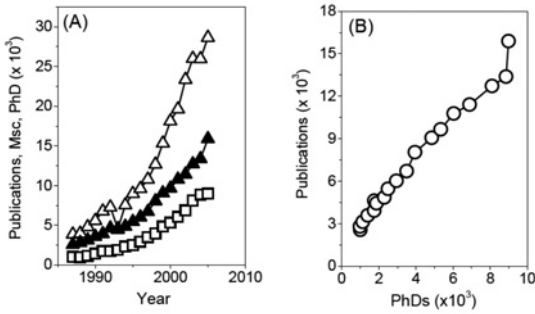


Figure 1- Number of Brazilian scientific publications, Msc (Master) and PhD between 1987 and 2005-(A) Publications (▲), Msc (△) and PhD (□). These data were obtained from “Brazilian Federal Agency for Support and Evaluation of Graduate Education” (CAPES) (B) The correlation between Brazilian publications and PhDs. Publications in this and subsequent figures correspond to full papers, letters and reviews indexed by the Institute of Scientific Information (ISI). From DeMeis, Arruda and Guimarães in *The Impact of Science in Brazil* [2].

Cecilia Hidalgo (*Physiology in Latin America. A Critical View*) [1] the total publications originating from the most scientifically active Latin America countries (Argentina, Brazil, Chile, Colombia, Cuba, Mexico, Venezuela) increased from about 1.5% in 1980-1981 to 3% in 2000-2001. Between the years of 1981 and 2005, the Brazilian contribution to Latin America science has raised from 33.2% to 46.6% and its contribution to the global science, from 0.42% to 1.75%. This expressive 4 fold increase in 25 years was certainly a consequence of a well structured national graduate program which in 2006 reached a total number of 130,000 students enrolled; 88,000 as master and 42,000 as PhD students (see Figure 1). Currently, the Brazilian graduate program forms 10,000 PhDs/year.

In the areas of Biological and Biomedical Sciences progress followed similar lines. In Biology the total number of indexed articles increased

from 245 to 934 and in Biomedical Sciences from 497 to 2390 in a 20 year period from 1981-2000. More importantly, the increase in quantity was followed by an increase in quality, as judged by the number of citations received which in the period of 1981-1998 increased approximately 8 fold in both areas. Impact factor confirmed the trend increasing from 0.94 to 1.65 in Biology and from 1.86 to 3.42 in Biomedical Sciences within the same period. Figures 2, 3 show the evolution of science in Brazil by knowledge area in a 20 year period from 1981-2000 [3]. As seen from the graphs Biomedical sciences had a very positive evolution during the period and certain areas of Physiology contributed importantly for this outcome. Among the areas that contributed most, neural, immunological, cardiovascular and endocrine physiology should be cited.

But this extraordinary increase in quantity and quality of our scientific production still represents a very small proportion of the world's scientific output and reflects the need for greater and better investments in science and education in our country. Fortunately, during the past decade we have experienced an unprecedented increase in the science budget which now is close to 1.2% of our GNP.

Recent years have also shown an increasing level of international collaboration, mainly with the USA and Europe. This reflects that many post-doctoral programs which in preceding decades stimulated the young scientists to go abroad and upon return maintain collaborations with the host laboratory. In contrast to what happens in many other South American countries, the majority of the young Brazilian scientists return to the country and the brain drain is much less intense.

Despite this favorable scenario productive Latin American researchers do not have enough presence at top international meetings, as has al-

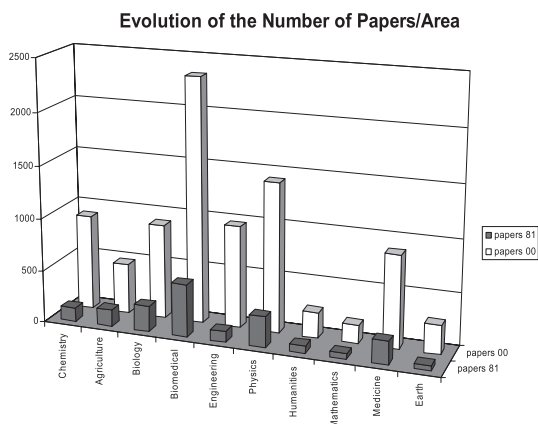


Figure 2- Number of indexed papers (ISI) published in the years of 1981 and 2000 with the participation of a Brazilian Institution as determined by area.

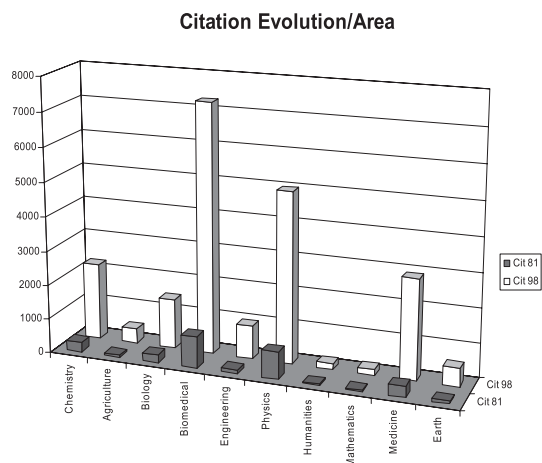


Figure 3- Variation in citation of indexed papers published in 1981 and 2000 with the participation of a Brazilian Institution as determined by area.

ready been pointed by Hidalgo. International scientific societies should play an active role in promoting the work of these scientists, inviting them to lecture at these meetings. This will certainly increase the public and government awareness of science, for the simple reason that in most developing countries international recognition comes before national praise. Brazil has contributed importantly in such areas of physiology as memory and learning, salt and water balance regulation, electrophysiology, control of blood pressure, metabolism and energy production. Naming scientists responsible for these contributions goes beyond the scope of this article, but many could be listed both in past and present times. The Table published by Hidalgo [1] shows

that there are scientists of the utmost quality in Latin America. They deserve international recognition by the simple fact that they have excelled in science under conditions where most others would have failed.

References

1. Hidalgo C : Physiology in Latin America. A Critical View. *Journal of the Physiological Society of Japan* 71 (2), 2009
2. De Meis L, Arruda AP, Guimarães JA : The impact of science in Brazil. *IUBMB Life* 59 (4-5) : 227-234, 2007
3. Campos de Carvalho AC, Almeida Campos D, Bevilacqua L Eds : Science in Brazil, Academia Brasileira de Ciências, pp 1-320, 2002