Physiology in Latin America. A Critical View

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A region's scientific activity correlates roughly with the quantity and quality of the region-originated publications in peer-reviewed journals. According to recent reports [1–3], in the two last decades Latin America's publications increased considerably their contribution to world science. Percent wise 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; yet, all these publications represent a very low proportion of the total world productivity. Moreover, at the beginning of this decade, the number of publications per Latin American inhabitant was 10-fold lower than in the United States or the European Union [4].

Why is science in Latin America so underrepresented worldwide? This question seems especially relevant when considering the overall size and population of this region[1]. There are many reasons underlying this limited scientific development. Central among them is inadequate and unreliable government funding, which in most Latin American countries is well below 1% of gross national product, a very low number when compared to the over 3% invested by developed nations. Add to this scarcity of public funds, with the consequent lack of modern equipment and infrastructure for research, the very limited funding of scientific activities by the private sector, and include the low salaries of researchers as well. All these factors not only hinder the development of science but make difficult, in many cases, the return to the country of the most talented young Latin American investigators, who after a postdoctoral training period abroad must balance an uncertain future in their home countries with the many opportunities they find to continue their careers in the developed world. Consequently, in many cases Latin American countries, with their limited resources and their vast necessity for science and technology expansion, end up loosing their best-trained scientist to the developed world.

How can Latin American scientists improve their contribution to world science? A recent article [1] proposed some interesting solutions to this problem, including the establishment of effective multidisciplinary collaborations between Latin American laboratories and countries, which could dramatically improve scientific output, as well as incorporation of expatriate scientists to a diverse array of local scientific activities, including their

incorporation as evaluators of local grant proposals. Even more relevant, Latin American countries are beginning to establish first class research centers, such as the newly created Pasteur Institute in Montevideo, Uruguay, which foster collaborative projects among Latin American institutions and investigators, and offer scientific training periods in well-equipped laboratories for graduate students from the region.

The development of Physiology in Latin America reflects the overall development of science in the region[2]. Surprisingly, however, and in spite of the inadequate funding and poor infrastructure, there are a significant number of Latin American scientists who do competitive high quality research. Thus, in the case of Physiology, there are several examples of scientists who work in Latin American countries and who have made a significant impact in world science, as listed in Table 1. In addition, the training of scientists, including physiologists, in the most scientifically active Latin American countries is of high quality, as evidenced by the fact that doctoral graduates from these countries find with relative ease postdoctoral positions in top world laboratories. Yet, as pointed out above, the region runs a high risk of loosing a significant fraction of their most talented researchers if local conditions for scientists do not improve soon in a significant way.

It is clear that the number of highly productive Latin American scientists needs to increase in order to develop successfully science in the region.

Table 1. SOME EXAMPLES OF HIGHLY CITED LATIN AMERICAN PHYSIOLOGISTS

	Total Citations	* Number of Papers	♣ *h* index	CpP
Scientist A	11890	142	52	83.7
Scientist B	9940	471	50	21.2
Scientist C	7743	116	42	66.8
Scientist D	7075	238	48	29.7
Scientist E	5141	185	38	27.8
Scientist F	4397	64	37	68.7
Scientist G	4189	163	32	25.7
Scientist H	3674	207	31	17.7
Scientist I	3487	102	30	35.2
Scientist J	3586	162	33	21.5
Scientist K	3563	122	31	29.2
Scientist L	3079	133	32	23.2
Scientist M	3138	168	27	18.7
Scientist N	2969	76	32	39.1
Scientist O	2503	79	26	31.7
Scientist P	2221	103	25	21.6
Scientist Q	1888	93	26	20.3
Scientist R	1757	64	25	27.5
Scientist S	1676	73	26	23.0

The Latin American physiologists included in this table represent examples of researchers who according to ISI World of Knowledge have accumulated more than 1500 citations in the literature, with *h* index values $\geq$ 25. CpP stands for citations per paper.

* The publications listed do not include meeting abstracts.

♣ The *h* index of a researcher is the number of papers coauthored by the researcher with at least *h* citations each [5].

Moreover, even these highly productive Latin American researchers do not have enough presence in top internationals meetings, a factor which limits the diffusion of their work to wider audiences. As pointed out elsewhere [2] it takes more than publishing good papers to become a well-recognized scientist. By inviting speakers from Latin America to present their work at international congresses, scientific unions such as IUPS could make a big difference in this regard. If Latin American scientists increased their visibility in widely attended world forums, it may become easier to convince the local authorities of the value of the top research done in the region. An increased awareness of the quality of the science done in the country may bring, as a result, an increase in the budget allocated to science, provided the political authorities accept the premise that there is a direct correlation between the development of a country and its level of scientific activity.

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[1]Latin America represents roughly 9% of the total world population, whereas Northern America (not including Mexico) represents about 5%, and Europe 11%.

[2]Antonio Campos de Carvalho, IUPS Council member, will write about the state of Physiology in Brazil in a separate publication in this series.

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