

Biochemistry in Chile

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The beginnings of biochemistry in Chilean Universities can be traced to the foundations of the first chair of 'Physiological and Pathological Chemistry' at the Medical School of Universidad de Chile around 1900. Professor Adeodato García V., who had done some research work under Hoppe Seyler, was the first person to occupy this position.

Since then, biochemistry or physiological chemistry has been taught in medical, dental, veterinary, pharmacy and agricultural schools. Consequently by the mid-fifties, people with backgrounds in medicine, pharmacy or dentistry, were mainly responsible for the teaching of biochemistry and biochemical research. Now, biochemistry is also taught as a subject at teachers colleges and at paramedical schools.

Training programs for biochemistry first began in 1957, at the Faculty of Pharmacy of the Universidad de Chile¹. Today, of the thirteen Chilean Universities, only the (State) Universidad de Chile and the private, but state supported, Pontificia Universidad Católica de Chile and Universidad de Concepción offer formal training programs in biochemistry. The aim is to train, in five years, plus one year of thesis work, biochemists with a strong chemical background, who could be active in clinical and industrial laboratories and in basic research.

Training starts with six semesters of course work in mathematics, physics, physical chemistry, analytical chemistry, organic and inorganic chemistry and is followed by four semesters which include two of biochemistry with emphasis on chemical aspects and bio-organic chemistry, and two composed of courses such as plant biochemistry, physiological chemistry, molecular biology, physiology, microbiology, nutrition etc. Thesis research is based on the work being done in the sponsoring laboratory. The title obtained at the end of training is 'Bioquímico' and the final level has been recognized by scientists in the U.S.A., Canada, and Europe to be equivalent to a strong M.S. Only about 50 students per year are admitted to the program.

At the present moment, the 'Bioquímicos' are the largest professional

group doing biomedical research in Chile, and some of them have achieved the rank of professor in Chile and elsewhere. Between 70 and 73% of these graduates are engaged in basic research¹.

Graduation of the first 'Bioquímicos' in 1962 was co-incident with a nationwide (and perhaps worldwide) expansion of academic activities. New Universities, Faculties and Departments were created, as the demand for academics was generally larger than the output of graduates from the Universidad de Chile and Universidad de Concepción.

By the mid-seventies, however, the situation had changed, and now it is difficult for 'Bioquímicos' to find an academic position of their choice, although they may find temporary jobs replacing staff members engaged in further training abroad. The lack of permanent academics jobs has caused about 30% of the 'Bioquímicos' to look for, and often find, positions in other countries.

On the other hand, this lack of job opportunities has been partially relieved by some new employment trends. Clinical Laboratories, both private and from the National Health Service, are beginning to absorb more 'Bioquímicos'. More encouraging, there is a trend to employ them in private enterprise related to the production of food, pharmaceuticals, enzymes and chemicals, or as sales advisers and promoters. This is illustrated by the case of a 'Bioquímico' in the poultry industry, who has carried out a disease prevention program for livestock and is now planning to devise a method to determine the nutritional value of chicken meat by means of amino acid analysis.

At first glance it may seem that six years

of serious training is wasted in the activities described. However, the presence of trained professionals will improve the quality of the products, and even in sales activities, the scientist or engineer customer finds it more reassuring to deal with someone who is thoroughly familiar with basic principles. As Justus von Liebig's said about his students who '... never had anything to do with the process of making soda, sulphuric acid or dyes', but upon entering a factory became familiar with the method '... during the first half hour; the next hour brought many most efficient improvement'. We also hope that the presence of 'Bioquímicos' in private industry will carry an 'amplification factor', i.e. that they will probably create new jobs for similarly trained professionals.

In the early seventies the Faculty of Sciences of Universidad de Chile and the Institut of Biological Sciences of the Pontificia Universidad Católica de Chile developed PhD programs in Biochemistry and Cell Biology, respectively. About fifteen students have already received PhD degrees and several will follow soon. More recently, M.S. programs have been introduced at the Universidad Austral de Chile and at the Universidad de Concepción.

Due to the relatively small number of professors involved in each program, scientists from academic units throughout the country collaborate and provide both undergraduate and PhD programs with lectures, full courses and thesis supervision.

This collaboration has been backed during the last five years by a PNUD-UNESCO* program to strengthen training in the biological sciences. This program, as well as an earlier O.A.S. (Organization of American States) sponsored project, has allowed young staff members from Bolivia, Colombia, Perú and Argentina to be trained in Chile and they are now con-

*PNUD: United Nations Development Program.



Fig. 1. The state-run Universidad de Chile where training programs for biochemistry first began in 1957.

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tributing with teaching or research in their home institutions.

Full-time research in the biological sciences became significant only in the late forties, thanks to the efforts of the German-trained physiologist, Professor Francisco Hoffman. The finance for this came mainly from the Rockefeller and Guggenheim Foundations, who provided funds in the form of fellowships and laboratory equipment. It is interesting to note that since 1949 five Chilean biochemists have been trained with Professor Lipman under different sponsorships, and that they are still working in Chile. Later, NIH grants became available, but these were severely curtailed by financial restrictions in the U.S.A. From 1965 to 1975, the Ford Foundation financed an exchange program between the Universidad de Chile and the University of California, which led to training and research associations which have continued after termination of Ford support².

In 1967 a National Research Council (CONICYT) was created, which provided funds for research projects on a competitive basis. It was very successful supporting Chilean science in face of vanishing foreign assistance. Unfortunately, CONICYT came under political management in 1971 and since then it has not been able to support science.

In 1975 a large group of scientists and technologists was convened by CONICYT authorities to give the council new guidelines. Among the recommendations proposed by this committee were the following: (a) there should be a set of

priorities, the development of basic science being one of the foremost; (b) as in 1967, a council of about fifty active scientists and technologists should advise the government-appointed President of CONICYT in policies and details; and (c) the investment of 0.4% of the gross national product in research was to be raised to 1.5% within a five year period. Unfortunately, none of these recommendations were carried out. The main reason has been the reluctance of the government to make a significant investment (of the order of US\$10 million per annum) in scientific research and manpower training. However, there may be some hope now, as the new Chilean Constitution explicitly states (Chapter III, article 19/9) that the state has the duty to promote and encourage the development of scientific and technologic research.

The lack of nationwide financial support for science has led the Universities to create central offices to administer, finance and promote scientific research. Each University in Chile now has such an organization. Funds are awarded on a competitive basis for research projects, publications, travel or the organization of local scientific meetings, based on evaluations made by study sections or referees from foreign or Chilean Universities. These procedures have earned the respect of the scientific community, and University support is practically the only national source of funds for biochemical research.

The Chilean Academy of Sciences has two biochemists among its 18 members. However, it does not have the funds to support science, and its role has been mainly to give guidelines and to fight for the advancement of science in Chile.

The research topics that are presently being pursued in the biochemical laboratories which participate in PhD programs include: regulation of protein synthesis, lipid and carbohydrate metabolism, biosynthesis of natural products, enzyme mechanisms, gene and protein structure, nucleic acid enzymology, metabolic regulation, molecular pharmacology, mechanism of hormone action and bio-organic chemistry.

These topics could be related to nutrition, the prevention or treatment of virus disease, the improvement of the utilization of biomass, exploration of natural products with medical potential, etc., but at the present moment, the connection between basic and applied science is rather weak. About 60 per cent of the projects financed by the Universidad de Chile and the Pontificia Universidad Católica de Chile are in basic science and 40 per cent in Medicine,

Agriculture, Engineering, etc. This may seem advantageous for the basic sciences, but it must be kept in mind that the combined research budget of both universities (salaries not included) is about US\$3.0 millions, whereas CORFO, the Chilean Industrial Development Corporation, invested about 23 million in 1980 for so-called 'research', which was almost exclusively production oriented.

If scientific productivity is measured by the number of publications in first rate journals, the contribution of Chilean biochemists may seem modest. However, considering its size, Chile does fairly well. In 1977 Chile had an output of 40 scientific publications per million population, as compared with an average of 13 for the rest of Latin America. According to a recent survey based on data provided by the Institute for Scientific Information (U.S.A.), about a hundred papers were published last year in disciplines related to Biochemistry³. Another criterion that may serve as a reference point on the measure of scientific productivity is the participation of Chilean scientists in international meetings. Eleven communications were presented to the Congress of the International Union of Biochemistry held in Toronto in 1979 as compared to four at the New Congress in 1964, numbers certainly significant amongst third world countries. The Chilean Society of Biochemistry was accepted in 1979 as a full member of IUB, a recognition of the level attained by its 150 members.

Undoubtedly, being involved in any field of basic science in a developing country, one encounters serious difficulties due to the low priority assigned to non-applied science. In Chile this situation is more critical due to its geographical isolation. However, thanks to the illuminating and fruitful legacy of the pioneers, the future can be seen as a challenging heritage to the younger generations.

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Fig. 2. The private but state-supported Pontificia Universidad Católica de Chile.