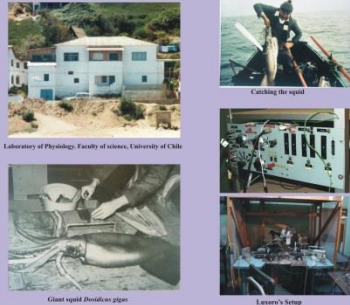


**Abstract** After graduating at MIT, the prominent Chilean Biophysicist Mario Luxoro returned to Chile with the idea of forming a research center where experimental work on membrane excitability could be performed. The presence of unusually large squids in the central coast of Chile (*Dosidicus gigas*, ~1 m head-to-tail, excluding tentacles), offered a superb source of giant axons. At that time was the favorite preparation for membrane biophysicists, and the giant axon of this species was particularly large (~1 mm width). Luxoro was able to convince the University of Chile to purchase a two-story house by the shore, some 5 Km north of Viña del Mar, and in 1965 he turned it into the Laboratory of Cell Physiology of Montemar. With a group of bright young scientists (E. Rojas, F. Vargas, M. Canessa and S. Fischer), Luxoro enthusiastically initiated a biophysical studies on the giant axon. Shortly the work generated in Montemar made that lab known worldwide, attracting renowned investigators from all over the world to this distant little laboratory, where so interesting discoveries were coming out. L. Taskar, R. Taylor, C. Armstrong, R. Keynes, G. Ehrenstein, H. Lecar, and many others traveled to Montemar to do research and share experiences with the Chilean scientists. A remarkable number of young investigators came out of the highly motivating scientific atmosphere existing in Montemar, such as Pancho Bezanilla, Julio Vergara, Ramon Latorre, Cecilia Hidalgo and several others. These scientists are now at prestigious universities or research centers in Chile and around the world. The Laboratory of Montemar had a profound and long lasting impact in Chilean Science, thanks to which this country is well known in Neurobiology.



Laboratory of Physiology, Faculty of Science, University of Chile

Giant squid *Dosidicus gigas*

Luxoro's Setup

## The Laboratory of Montemar

In the United States it is often asked why there are so many Chileans working on channels and on active transport. There are probably a number of reasons for this, but surely prominent among them is the existence of a small laboratory in Montemar, near Viña del Mar, Chile. How did it start, what happened, and who did it? It started because Mario Luxoro got his Ph.D. with Francis O. Schmitt at MIT in Cambridge, Massachusetts in 1957. Luxoro and Schmitt were interested in the axoplasm of the giant axon of the squid that were available in Massachusetts. In 1955, Schmitt and friends had caught specimens of the large squid, *Dosidicus gigas*, off Liqueu, in northern Chile. With the cooperation of Dr. P. Yancey, a unit was set up in the Estación de Biología Marina in Montemar for the procuring, processing, and shipping of chilled as well as frozen and dried axoplasm to Cambridge. On his return to Chile, Luxoro was involved in this arrangement. That year, the Chilean scientist, Mario Luxoro, and his wife, Veronica Nassar, came to Montemar as a medical student, spent some time in Montemar, and Pancho Huneus-Cox went to MIT for 2 years.

The idea of the facilities of the Estación in Montemar being used as merely a source of axoplasm for someone at MIT was not too attractive to the Chilean scientists. Luxoro worked with Eduardo Rojas in the summer of 1959-60 on the microinjection of trypsin into squid axons. Huneus-Cox returned in 1962 and worked in Montemar on squid, studying S-S bonds, and in 1963 Mitya Canessa returned from postdoctoral work in the United States to become involved in studies of the biochemistry of the axon membrane with Sigmund Fischer. Fernando Vargas was there, and Ichichi Tasaki went to Montemar in 1964 and

introduced internal perfusion with Luxoro. In November of 1963, a group consisting of Clay Armstrong and Daniel Gilbert, from the Laboratory of Biophysics at the NIH in Bethesda, along with Clara Franzini-Armstrong, Rita Guttman, and Werner Loewenstein joined Luxoro in Montemar for a few months. This arrangement grew out of discussions that Luxoro had had with Dr. Kenneth S. Cole, who wanted to take advantage of the availability of the large squid in Chile. Cole was not able to go, and the administration devolved on me. I went to Chile in February of 1966 and continued to spend part of each Chilean summer until 1972. That is basically the reason why I am the one who is writing this. By the summer of 1964-65, Eduardo Rojas was completing his Ph.D. in Chicago and was working at the NIH biophysics laboratory, and with Gerard Ehrenstein of that laboratory, he went to Montemar to perfuse the axon of the giant squid. About this time various problems arose between the workers and the administration of the Estación, and the Chancellor of the University of Chile provided some money to buy an old house across the street, and the Laboratorio de Fisiología Celular was born; it was in operation when I first went there in 1966. The many students who appeared in the lab in Montemar from time to time make an impressive list. The ones I got to know well include Ramon Latorre, Cecilia Hidalgo, Julio Vergara, and Veronica Nassar. There were others like E. Zambrano, Cristian Bennett, and many more until 1972. It is important to remember that the axon of the giant squid, available only in Chile during the period of about 1957 to 1971 was of great

importance to our understanding of channels. Not only was it a superb preparation, mainly because of the absence of branches, but it served to gather people together with common interests. Some people worked on the voltage-dependent ion movements, some on the biochemistry of the membrane, and some were, and still are interested in the role of the axoplasm. We might recall that in the 1960s it was not known for sure that there were individual ionic channels, and that they were composed of protein (or lipid-protein-carbohydrate complexes). Many people thought so, but the pioneering work of Luxoro and Huneus-Cox and the Mitya Canessa with Sigmund Fischer and later the work of Rojas, Armstrong, and Awaizer with internally perfused pronase was all important in focusing attention on the proteins.

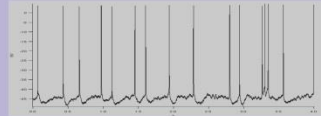
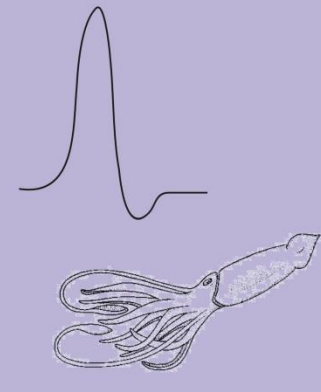
These are only a few comments about this small but important laboratory. Perhaps someone will write a proper history that would include the work of Mario Luxoro, Veronica Nassar, Francisco Bezanilla, Julio Vergara, Juan Bacigalupo, Cecilia Vergara, Elizabeth Bosch, Rafael Torres and Victor Corvalan since there have been no giant squid. Some of these people are still associated with this laboratory, and many are spread about the world, but the work goes on. Most of the great ideas are probably wrong, but by training students and fighting about the ideas, progress occurs.

Robert E. Taylor

Foreword to "Ionic Channels in Cells and Molecular Systems" Edited by Ramon Latorre. Plenum Press, NY, 1986.

# The Laboratory of Montemar: A Remarkable Chilean Scientific Odyssey Around the Squid Giant Axon

Bacigalupo J. Department of Biology, Faculty of Sciences, University of Chile. e-mail bacigalu@uchile.cl



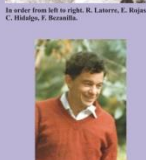
Latinamerican researchers in an advance course in Montemar. E. Ehrenstein, O. E. Rojas, I. Alvarez, V. Nassar, G. Alvarez.



In order from left to right: R. Latorre, E. Rojas, C. Hidalgo, F. Bezanilla.



G. Ehrenstein and E. Rojas



C. Armstrong



In order from left to right: R. Taylor, P. Canessa, C. Vargas, J. Bacigalupo, M.L. Bezanca



Lovers at work



Mitya Canessa

## Visitors to Montemar

- Robert Taylor, NIH
- Richard Keynes, Cambridge University
- Trevor Shann, Cambridge University
- Peter Baker, Cambridge University
- Ichichi Tasaki, NIH
- Werner Loewenstein, NIH
- Susumu Hagiwara, UCLA
- Gery Diamond, UCLA
- Dan Gilbert, NIH
- Gery Ehrenstein, NIH
- Harold Lecar, NIH
- Clay Armstrong, University of Pennsylvania
- William Adelman, NIH
- Kenneth Cole, NIH
- Anna Grinell, UCLA
- Helmuth Tribach, University of Heidelberg
- N. Lakshminarayanaiah, University of Pennsylvania

## Quotations about Montemar

"I first met Professor Luxoro over 30 years ago, and my subsequent visits to him in Santiago or in Montemar were always an inspiration to me. His scientific contributions in membrane biophysics are very highly regarded by the international community, and he played a vital part in the establishment of the distinguished School of Chilean biophysicists with whom so many of us have collaborated." Richard Keynes, Cambridge University

"In the Laboratory of Montemar Professor Luxoro formed and inspired several generations of biophysicists, physiologists and neuroscientists of international level, to whom he offered an example of a cultivated, laborious, imaginative and rigorous master." Hersh Gershenfeld, Ecole Normale Supérieure

"Mario Luxoro was able to form a group of biophysicists that have obtained scientific successes recognized as exceptional by the rest of the world. Nowadays the group of Chilean biophysicists initially formed by Mario Luxoro can be considered a jewel of biomedical research." Carlos Izaguirre, University of Utah

"He was responsible for starting the use of the squid giant axon in Chile. He chose a group of researchers and students which attracted the attention of the most prominent foreign biophysicists. Very soon these biophysicists came every year to work with Luxoro's group at Montemar during the squid season. Chile quickly became part of the cutting edge of world Biophysics. I am often asked why are there so many Chilean biophysicists? And the answer is very clear: Mario created a group and an environment that attracted the best students." Francisco Bezanilla, UCLA

"I have known and admired Professor Luxoro for many years, and he had a strong influence on me both directly and through his many distinguished students. It is impressive to read again through the list of his published papers, which are great contributions to biophysics." Clay Armstrong, University of Pennsylvania

"The accomplishment on the study of ion channels can be traced to the efforts of Mario Luxoro. He founded the laboratory of Montemar, which has been an important facility for the study of the basic properties of nerve fibers in the squid. He was the teacher of all the Chilean electrophysiologists that are so well known in the United States." John Losman, Brandeis University.

## Publications

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