

Il moruzzatore

L. NICOTRA

San Giuliano Terme, Pisa, Italy

ABSTRACT

I describe here the activity during 43 years as head of the electronic laboratory of the Institute of Physiology of Pisa directed by professor Moruzzi: designing, building and servicing electronic and mechanical equipment for the benefit of neuroscience research.

Key words

Giuseppe Moruzzi • Neuroscience research • Biophysical instruments

When Giuseppe Moruzzi took charge of the Institute of Physiology of the University of Pisa, at the end of the 1940s, it was evident that the state-of-the-art neurophysiological research he had in mind, called for the collaboration of somebody arriving from physics. This discipline had in fact reached a level of development capable of providing even biology with indispensable instruments and technologies, since at that time the most sophisticated electronics was in physicists' hands.

Thus towards 1950, Edoardo Amaldi, Director of the Institute of Physics in Rome (and one of Enrico Fermi's "via Panisperna's boys"), was addressed by Professor Moruzzi with the request of an electronic stimulator for electrophysiological research. Amaldi gave to Ettore Pancini, Franco Lepri and myself the task of designing and building such a device.

When in 1951 the stimulator (jokingly nick-named "il moruzzatore") was ready, I was to carry it to Pisa and to collaborate with Professor Moruzzi in organizing the technical services and supervising the restructuring of the laboratories of the Institute, according to the needs of modern electrophysiological research. In Pisa, I first met Professor Moruzzi in the garden before the Institute's entrance where he was boarding his bicycle. Since then I was to collaborate with him and his assistants for 43 years until my retirement in 1994.

Prof. Moruzzi then briefed me on the organizational needs of the electrophysiological laboratories. I was soon aware of the various shortcomings and of the work from scratch that was necessary with the existing structures, electric plants, screenings, groundings, etc., not to mention updating of the mechanic workshop (the tools were part of Austrian compensations after World War I...!!). Those days responsible of electronics was a student graduating in physics, Mr. Bonferroni, who had been constructing a complex electronic stimulator, never to be completed, since he left before long.

In that period Prof. Moruzzi was granted generous funds by the Rockefeller Foundation, funds that were utilized for the purchase of a number of electronic apparatuses and for two fellowships Rossi and Nicotra. The electric plants (220 V and 117 V for the North American devices) were fixed by technicians of the Italian Military Navy, as Moruzzi had also a research contract with the Italian Navy to study the hyperbaric syndromes (Cerchia et al., 1955; see Moruzzi, 1955) (they had installed a hyperbaric chamber for humans and a smaller one for animals). At the same time it was necessary to enlarge and rationalize the mechanical and particularly the electronic workshops, as well as to prepare more technicians, for the Institute of Physiology and subsequently for the nearby laboratories of the National Research

Council, also directed by Moruzzi. Altogether, during nine years, six electronic and three mechanical technicians were trained.

The demands I had to meet were manifold and not related only to electronic apparatuses, part of which were initially purchased in the US, besides an Italian Galileo electroencephalograph, and a few devices from Germany (Tönnies-Freiburg). An electroencephalograph, a stimulator, and a preamplifier (all Grass) had been brought by Moruzzi on his return from US, in 1950, and were the first modern items of the laboratory. Given the particular needs of the pathfinding neurophysiological research, many apparatuses with special characteristics that were not for sale were designed, built and tailored *ad hoc* in our laboratory, for instance:

- gas-expansion and Peltier cooling needles for cortical areas,
- micro wire capacitor discharging spot welder,

- many Faraday cages, one still existing (Fig. 1),
- vibration insulating tables,
- glass microelectrode pullers (Cangiano, 1977),
- tilting tables (Fig. 2),
- electrodynamic muscle stretchers (Morelli et al., 1970; Nicotra & Pompeiano, 1965),
- many radio frequency (RF) and subsequently optically coupled stimulus insulation units,
- implementation of the apparatuses of the silent room (built in the backyard) for acoustic stimulation (Bruel & Kjaer sound analyzer, Ampex tape recorder),
- devices necessary for the fire-fly research (photomultiplier system) and for tarantula behavior monitoring (Magni, 1967),
- custom connections necessary for registration in the hyperbaric chambers, in collaboration with the Italian Navy,
- software for computers in their early applications in neurophysiological research (Morelli et al., 1975).



Fig. 1. - Faraday cage.

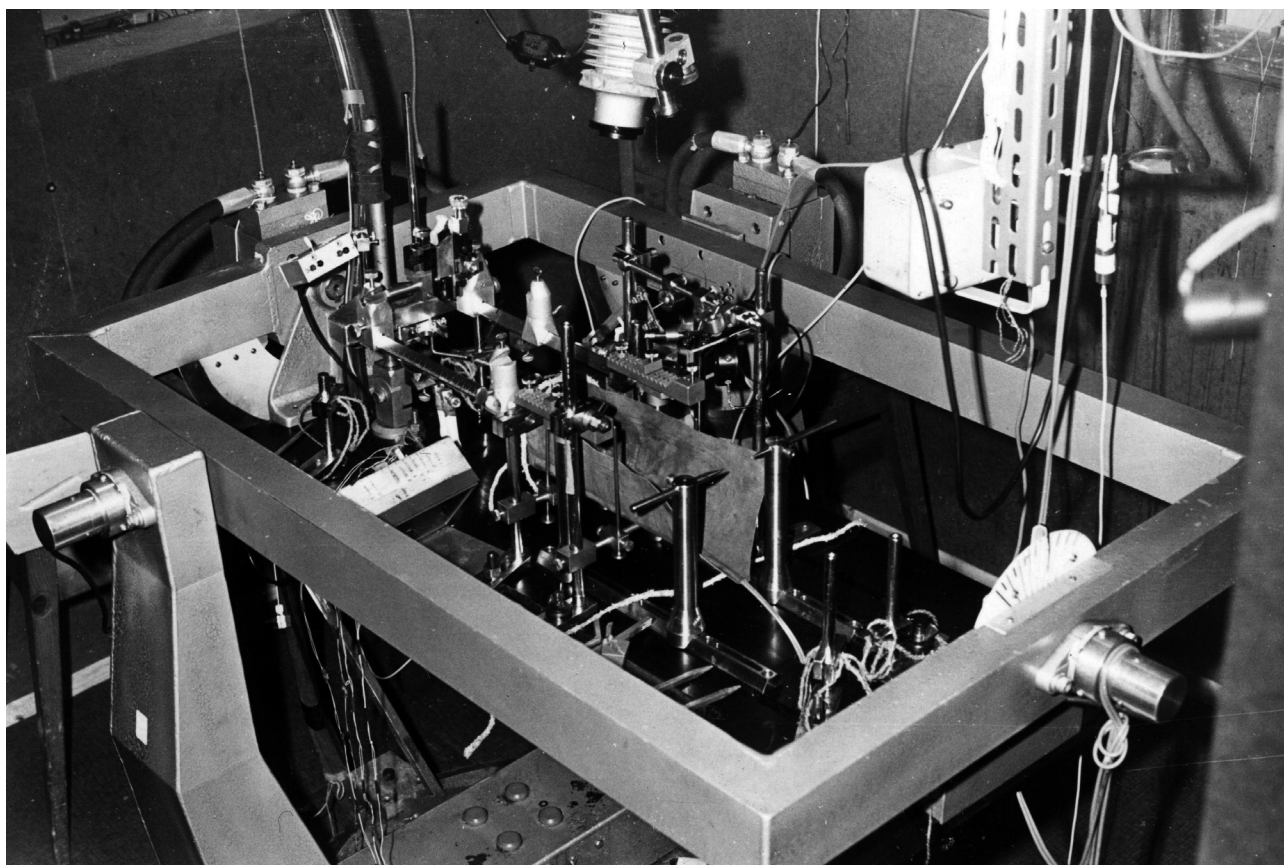


Fig. 2. - Tilting table.

We had to update our knowledge of the progress of electronic technologies with the introduction of transistors and integrated circuits and all that was necessary to keep abreast with the continuous evolution of electronics.

Availability of electronic components and spare parts for the apparatuses purchased or specially home built, was no minor problem but crucial for the smooth running of the experiments. Pisa was not supplied at all with what was needed, so we had to address traders in Livorno, Florence or Milan, and couriers were very slow too.

Through the Rockefeller grant we were able to receive from the US (without custom-duties) and to build up a huge stock of parts. It was thus possible to service the maintenance of the devices in house, without wasting time and money in sending the apparatuses around and thus guarantee the smooth continuity of the experiments.

Moruzzi's loving care for the library (see Mammini and Jannucci, 2011, this volume) was known to

everybody. Besides neurosciences the library was supplemented with items in the field of physics and technology (Fig. 3) as a necessary support to research.

Subscriptions were made to:

- Journal of Scientific Instruments,
- Revue of Scientific Instruments,
- Journal of Acoustical Society,
- Journal of Optical Society,
- Electronics,
- Elektronik,

Also, many textbooks of physics, applied electronics, biophysics etc. were purchased (Fig. 3).

It was Moruzzi's desire to provide students with some elements of physics, electronics, and technologies applied to biology: therefore he gave me the task, during the laboratory practices, to illustrate some topics like theory of wave forms, Fourier analysis, principles of piezoelectricity, outlines of electronic circuits used in the electrophysiological research, etc.



Fig. 3. - Part of the electronics library.

Incidentally, since my office for a while was next to the lecture hall (the old-fashioned “aula” built in the Institute) I had the chance to listen through a side door to Moruzzi’s lectures and to enjoy his wonderful way of teaching, so much so that I, who had almost no knowledge in anatomy and physiology, could appreciate everything!

Professor Moruzzi offered me the opportunity to take part in various conferences on medical electronics and to visit important research laboratories abroad, obviously estimating that contacts and comparisons with outstanding environments and leaders in the field would be profitable for his institute. So I went to international conferences on medical electronics, held in Paris, June 1959, and in New York, July 1961; to a meeting in Stresa (where I met Walter Rosenblith (M.I.T.) and Norbert Wiener). I was also allowed to visit laboratories at M.I.T., Bell Lab., Karolinska Institutet (where I got fundamental suggestions from the local electronic engineer for the project of the high input resistance ampli-

fiers, used to record neuronal electrical activity with microelectrodes), Philips Research Labs. in Eindhoven and Aachen, Bruel & Kjaer (producer of the sound analyzing devices used in the silent room experiments, see above) Denmark, and other laboratories in Canada and Germany.

Moruzzi advised me to work with Moise Goldstein (From M.I.T.) for a year on a project in silent room, built on purpose (Goldstein and Nicotra, 1961).

I had the opportunity to know some outstanding personalities in the field of neurophysiology, just to mention a few: Lord Adrian, Sir John Eccles, Jonathan Magnes, when they were visiting the Institute.

Moruzzi collaborated with everybody at the Institute and supervised the experiments and the development of the teaching skills of younger colleagues, not to mention the quality and flawless draft of papers to be published.

It was for me intellectually both stimulating and gratifying to be able to participate in neurophysiological state-of-the-art research with the available up-to-date technological tools, and what was really unique, under the direction of an exceptional mind like Professor Moruzzi’s and the example of his scientific integrity.

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