

RECOLLECTIONS OF A CONTEMPORARY NEUROANATOMIST

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During a long life I have had the luck to meet and get to know a fair number of contemporary leading people in the neurosciences. It early struck me how many of them were not only first rate scientists, but also very fine human beings. Later I have had this experience over and over again. Of course, scientists — as other people — differ enormously in their personal character and behavior, but common to most and the best ones is a marked modesty on behalf of themselves and their achievements. Inborn personal characteristics contribute to this attitude, but there can be little doubt that a lifelong occupation with the brain, in any field of the neurosciences, will give the researcher a profound awe for the wonderful complex and intricate organization of our finest organ that makes man unique in the animal kingdom.

Giuseppe Moruzzi undoubtedly belonged to the type of scientist I have referred to above. I first met him at the International Congress of Physiology in Oxford in 1947 (where I was working with professor Le Gros Clark). Moruzzi presented his findings of cerebellar influences on vegetative functions, among them inhibition of cardiovascular changes on stimulation of the cerebellar vermis. I have always been convinced — and still am — that any function is in the end dependent on a morphological substrate. I found it difficult to accept Moruzzi's observations since at that time we did not know pathways which might mediate the phenomena that he had observed. Moruzzi, who was born in the same year as I was, impressed me as being a far more experienced and mature scientist than I. Whenever I have met him, I always looked upon him as being my senior! In 1947 modern neurophysiology was in its late infancy. In anatomy at that time we were just beginning to come a step further in studies of the fiber connections of the brain with the use of silver impregnation methods. These made it possible to trace degenerating axons and not only myelin sheaths.

As to cerebellar influences on vegetative functions, further research with new anatomical techniques has shown that there are indeed several routes along which this influence may occur. This, by the way, is only one of many examples, where electrophysiological findings have suggested the presence of unknown connections, and which only later have been visualized and shown to be actually existent by anatomical methods. On the other hand, with such methods new connections are incessantly discovered. They are not massive and impressive, but represent additions to — and refinements of — previous knowledge. They bring forth details in the morphological organization of the brain and demonstrates its extreme com-

plexity. Indeed, it appears that almost every — even minor — part of the brain must have the possibility, under certain conditions, to influence any other part of the brain.

After this digression, in which I could not resist the temptation to air my personal opinion, let me return to my main theme. As time passed, I felt that I ought to be better acquainted with neurophysiological methods and views. In 1954 I applied for and got a stipend for staying in a physiological laboratory for some weeks. I was in no doubt that I would prefer, if possible, to spend my time with Moruzzi, whose studies I had followed in the literature, especially his works on the cerebellar control of muscular tone, and on the ascending activating system. I was happy to be accepted as a guest, and my wife and I set out for Italy at the end of February. Arriving in Pisa late in the night (due to train delays) we were met by Moruzzi and led to the Istituto di Fisiologia Umana, where he had reserved a guest-room for us in the basement (the stipend did not permit hotel accomodation!). Guarded behind decorative iron fences in front of a large window we established our own household there. Admittedly, at the time of the year, it might be rather chilly, especially when one had to step out in the morning on the tiled floor, but the Moruzzis kindly provided carpets, an electric stove and other items which were very welcome.



Fig. 1. — *Giuseppe Moruzzi and his wife Maria Vittoria.*

We spent five happy weeks in Pisa. Moruzzi and his wife Maria Vittoria took very good care of us. We often had dinner or tea with them in their spacious and nice flat on the top floor of the institute and got to know also their two boys, Giovanni and Paolo, at that time approximately 7 and 3 years, respectively.

Moruzzi impressed us by his extensive knowledge of history and culture, as we especially learned on the excursions, where he took us to churches, villas and historical buildings and places in Toscana. In our discussions of scientific matters I recognized what is evident from his numerous publications: he was a true scientist in the best sense of the word. He never jumped at conclusions, but was very critical in evaluation of findings and their interpretations. Logical reasoning and clear thinking were for him necessary criteria of good research. I remember well his thoughtful, almost inquisitive, look when he was asked a question, and the small pause which followed before he answered and had evaluated the problems concerned.

At that time some years had passed since Moruzzi and Magoun had published their epoch-making paper on the "ascending activating system" (1949). As is well known, this was the starting point of an intense research activity which has yielded much new insight and information of the working of the brain, not least of the little understood functions, consciousness and sleep. Naturally, most studies concerning these matters were made with physiological techniques, but anatomists as well were active in order to elucidate their possible anatomical substrate. Not all findings reported in either field were reliable, however. It may be appropriate to quote a typical remark from Moruzzi's Harvey Lecture in 1963. In this, discussing sleep mechanisms, Moruzzi mentions that the acceptance of the existence of an ascending reticular system made possible an understanding and correlation of physiological, pharmacological, and clinical data which had so far appeared to be unrelated, and adds: "It was probably because of this success that the distinction between direct experimental proof and suggestive evidence, a distinction which should always remain clear in our minds, was frequently forgotten".

Naturally, also in the Istituto di Fisiologia Umana, research in 1954 was to a large extent devoted to the reticular formation and its functional relations to other parts of the brain, such as the cerebellum, the thalamus and the cerebral cortex. Activity and enthusiasm flourished. I came to be chiefly attending the work of Ottavio Pompeiano, Gian Franco Rossi and Mila and Arnold Scheibel. I was especially thrilled by their ongoing study of single units in the reticular formation and the convergence and interaction of afferent impulses on them (published in 1955 in the *J. of Neurophysiology*). The results supported the view that the reticular formation is not an entity, but that it is a conglomerate of a number of minor units and cell types, which differ in functional (and presumably also in structural) respects.

How much did I assimilate of neurophysiology? I am afraid, not as much as I might have done. The enthusiastic research attitude of the workers at the institute was stimulating and gave rise to many interesting discussions, not least devoted to possible structural-functional correlations. I gave a few lectures, but

most of all my focussing on scientific matters was interrupted by visits paid to other sites than Pisa. For several days Mila and Arne Scheibel and we were exploring Rome by foot; we were a few days in Firenze, and one day Wiletta and Bob Dow from Oregon, who were then in Pisa, drove us to San Geminiano. When, after such excursions it happened that we overslept in the morning, we were awakened by an Italian baritone, walking along the corridor and singing: "il gatto! il gatto!". It was the custodian who carried the day's experimental animal to the operating room.

Both Inger and I lost our hearts to Italy and to our Italian and American colleagues. I am happy to have been able to keep in contact with Italy. After our visit to Pisa the Scheibels, Rossi and Pompeiano spent some time in the Anatomical Institute of the University of Oslo. They all worked with me on anatomical items (the Scheibels and Fred Walberg on the inferior olive, Gian Franco Rossi — who was accompanied by his wife Anna-Lidia — chiefly on the reticular formation, and Ottavio Pompeiano on the vestibular nuclei and the red nucleus). This collaboration was not only satisfactory scientifically, but has also laid the bases of lasting friendships.

I may mention here that in 1962 Moruzzi was elected a foreign member of the Norwegian Academy of Science, and in 1965 he received the degree as honorary doctor at the University of Oslo.

Whenever I met Moruzzi after the first stay in Pisa, most often at meetings or symposia in Italy, my opinion of him as a first rate scientist and a fine personal character was confirmed. As a final demonstration, Moruzzi, in spite of his illness, was present at the Symposium in Pisa in 1980, arranged in his honour on his 70th birthday. This was the last time we had the good fortune to meet Giuseppe Moruzzi and his charming wife, Maria Vittoria.

Addendum of the Editors. - Professor Alf Brodal died on February 29, 1988. We mourn his loss as we do that of his longtime friend and colleague, Professor G. Moruzzi.