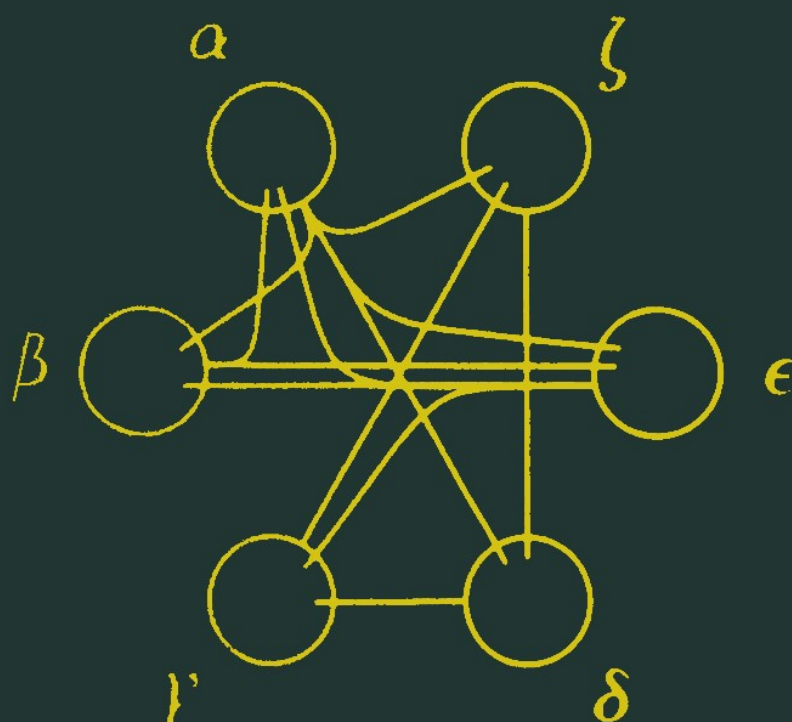


A. Aertsen V. Braitenberg (Eds.)

# Information Processing in the Cortex

Experiments and Theory



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## Preface

There is a tradition of theoretical brain science which started in the forties (Wiener, McCulloch, Turing, Craik, Hebb). This was continued by a small number of people without interruption up to the present. It has definitely provided main guiding lines for brain science, the development of which has been spectacular in the last decades. However, within the bulk of experimental neuroscience, the theoreticians sometimes had a difficult stand, since it was felt that the times were not ripe yet and the methods not yet available for a development of a true theoretical speciality in this field. Thus theory remained in the hands of a fairly small club which recruited its members from theoretical physicists, mathematicians and some experimentalists with amateurish theoretical leanings. The boom of approaches which go by the name of 'computational neuroscience', 'neuronal networks', 'associative memory', 'spinglass theory', 'parallel processing' etc. should not blind one for the fact that the group of people professionally interested in realistic models of brain function up to the present date remains rather small and suffers from a lack of professional organization.

It was against this background that we decided to organize a meeting on Theoretical Brain Science. The meeting was held April 18 - 20, 1990 and took place at Schloss Ringberg, West-Germany, a facility sponsored by the Max-Planck-Society. There were of course precursors, notably a meeting in Ravello on Neural Networks in 1967, organized by E. Caianiello<sup>1</sup>, a small meeting in 1972 and a more extensive one in 1978, both organized by Güttinger at the Center for Theoretical Physics in Trieste<sup>2</sup>, a meeting in Tübingen (1977), organized by Heim and Palm<sup>3</sup>, a meeting in Palo Alto (1983), organized by Gerstein and Perkel, and several informal meetings at the MPI Göttingen, organized by Christoph von der Malsburg, as well as several others in the U.S. and Europe.

The present meeting was the third in a row organized by a group who met for the first time in October 1984 at the International Center for Theoretical Physics in Trieste<sup>4</sup>. The same group with some variations met again in Bad Homburg<sup>5</sup> and, as an offshoot, a group partly overlapping with the first, organized a meeting in Nijmegen<sup>6</sup>, and in Irvine (Shaw, 1988).

The group was held together by an interest in theoretical models that actively seek confrontation with experimental data from the functioning brain, and by a didactic effort aimed at experimentalists to present their data in a format that makes them more amenable to theory.

Since in the preceding meetings some more general questions of brain theory had been in the foreground it was decided this time to focus on a single topic, the cerebral cortex. There were three aspects which we wanted to highlight in the three days of the meeting. On the first day statistical aspects of cortical connectivity were discussed both from an anatomical and a physiological point of view. The second day was dedicated to the part of the cortex which has been studied most, the visual cortex. The third day concerned itself with the question at what level of resolution in space and time cortical activity makes sense.

Since this subdivision of items proved to be successful during the meeting, and since the sequence of presentations undoubtedly influenced contributions, even in their written version, in this book on the whole we followed the same pattern. Finally, in a fourth part we included two contributions not directly related to any of the three main topics.

Margarete Ghasroldashti not only had a crucial part in the organization of this meeting but equally in the preparation of this book. Hubert Preißl and Stefan Rotter provided valuable assistance, especially where it came to the layout of mathematical formulas.

The meeting at Schloss Ringberg was sponsored jointly by the Deutsche Forschungsgemeinschaft, the Reemtsma-Stiftung, and the European Commission. The facilities at Schloss Ringberg and financial support for members of Max-Planck-Institutes was provided by the Max-Planck-Society. The generous support by all these institutions is most gratefully acknowledged.

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*Valentino Braitenberg*

## References

- <sup>1</sup> Caianiello ER (ed): Neural Networks. Berlin: Springer, 1968
- <sup>2</sup> Conrad M, Güttinger W, Dal Cin M (eds): Physics and Mathematics of the Nervous System. Berlin: Springer, 1974
- <sup>3</sup> Heim R, Palm G (eds): Theoretical Approaches to Complex Systems. Berlin: Springer, 1978
- <sup>4</sup> Palm G, Aertsen A (eds): Brain Theory. Berlin: Springer, 1986
- <sup>5</sup> von Seelen W, Leinhos U, Shaw G (eds): Organization of Neural Networks: Structures and Models. Weinheim: VCH Verlag, 1987
- <sup>6</sup> Johannesma PIM, Eggermont JJ, van Gisbergen JAM (eds): Activity patterns of neural populations. Brain and Behaviour Report Nr. 4. Nijmegen, The Netherlands, 1985