OPENING ADDRESS.

I welcome the participants and guests to our conference *Neurocomputers and Attention,* which is our first international conference.

Some words about the background to this meeting. Our interest in neural networks has passed through three stages. The first stage was a combination of keen interest, and providing help in the statistical analysis of experimental data, such as spike trains. Then came a period of exploration of the dynamic behaviour of models of single neurones. Probably the best result there was an understanding of the relations between the non-linear nature of the mechanisms and random behaviour.

The third stage began with the study of neuronal interactions. Markov fields seemed to provide a good mathematical framework for analysing the behaviour of neuronal ensembles. The importance of bifurcations between and from stationary states, phase transitions between stationary states and the inevitability of complex dynamical regimes became evident.

Our interest in neural networks has deep roots and old traditions. Reading some modern papers makes us feel nostalgic. Some of the ideas and results published now in the West are similar to those we obtained but decided not to publish, as such approaches seemed too primitive to be useful in understanding the physiology of the brain.

There are now a number of publications that sum up the results of our, and our colleagues, research. This romantic period could be characterised by the lines of William Blake:

> To see a World in a grain of sand,
> And a Heaven in a wild flower,
> Hold Infinity in the palm of your hand,
> And Eternity in an hour.

Passing to the modern phase of our science one should remember one peculiarity from the past. That was the time of triumph of vulgar cybernetics. The necessity to protect biology from this attack forced us to describe the "Prometheus complex". This is a severe intellectual disease of a physicist (or a mathematician) who suddenly feels responsible for carrying the light of knowledge to the gray masses of biologists. Since that time the lesson has been learnt, and it is the norm to respect the object of our research. However the recent obvious success of computer science has revived the slumbering virus. The formalisation of the concept of a neural network reveals obvious signs of a divorce from biology. This is , of course, only a symptom, not a complex.

Let me try to explain. There are pairs of biological systems that are dual in the sense that they solve similar problems by contrary methods.For example, a predator (*e.g* a wolf) catching its prey maximises its input of power, and takes very little care for the efficiency of using it. In contrast the prey (hare) maximises the

efficiency of the use of of its energy source "thoroughly chewing its food".

There are similar correlations in nonbiological systems. The calorific value of birch firewood is about an order higher than that of gun powder. In the first case the energy release increases maximally and in the second the power release does.

Biological systems contain such paired components at any level of organisation. Evolution produces the the synthesis of both the principles within the frame of one system. I believe that the brain is organised in just this way. It's right (intuitional) hemisphere provides quick (but rough) search of the required solution (situation, image, idea). The left (logical) hemisphere serves to provide slow but reliable analysis. The regime of chaos seems helpful in speeding up the search. Something not understandable at the level of a single neurones turns out to acquire great meaning at the level of the whole system. However it was Bacon who commented that "nature would not luxuriate in fundamental principles".

If this hypothesis is reasonable it leads to two consequences, one of them concerning neurophysiology. Separation of function between the cerebral hemispheres is not one of the latest gifts of evolution as it is distinguished both morphologically and topologically. Similar subsystems should be found in more ancient structures of the nervous system.. The older the structure, the more difficult will it be to divide its components.

Another consequence concerns computer systems, which may be considered as hypertrophied left hemispheres. The problem is not to substitute computer systems by systems with intuition. We must use a clever synthesis. To my mind our future lies in the development of hybrid (analogue-digital) systems. The analogue subsystem carries out a quick search and the digital system provides the required precision.

Let our conference be a success As well as the traditional useful exchange of ideas I anticipate fruitful comparisons between approaches in the biological and technical fields. Thank you for your attention.

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