PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Introductory Remarks

H. B. Barlow and R. M. Gaze

Phil. Trans. R. Soc. Lond. B 1977 **278**, 243-244
doi: 10.1098/rstb.1977.0039

Phil. Trans. R. Soc. Lond. B. **278**, 243–244 (1977) [243]
Printed in Great Britain

Introductory remarks

By H. B. Barlow, F.R.S.* and R. M. Gaze, F.R.S.†
* *The Physiological Laboratory, University of Cambridge*
† *National Institute for Medical Research, Mill Hill, London N.W.* 7

In every day usage to say that something shows plasticity implies that it can be moulded or readily made to assume a new shape. In relation to the nervous system, we commonly imply a further restriction of meaning when using this term; plasticity in the nervous system means an ordered or patterned alteration of organization – one which makes some sort of sense biologically. We do not mean just any alteration; for instance, a massive and disorganized malfunction associated with extensive injury would not be called plasticity. To qualify for this term an alteration has to show *pattern* or order, and we would normally imply that the structures or functions under discussion alter in some way to compensate for the deficit. When the plasticity takes the form of learning or memory, the functional alteration resulting from the input experience must also be organized, this time in a functional sense; functional or structural changes that were chaotic would qualify neither for the term plasticity nor the term learning.

Plasticity of neural structure is discussed in several papers at this meeting. Horder, Keating, and Mark consider some of the very dramatic alterations that may be induced in the nervous systems of lower vertebrates, while Rakic, Raisman, and Wall describe structural changes in mammals. Some of the work discussed, notably that on amphibians and fishes, as well as the comparable mammalian work of Lund and Schneider which was unfortunately not represented at the meeting, merges at the edges into the sort of changes normally considered embryological. The question how closely mechanisms underlying structural plasticity are related to those underlying, for instance, embryological regulation, remains unanswered. The nature of neither phenomenon is yet understood.

Plasticity of neural function has been under-represented at this meeting. No one would disagree with the statement that plasticity of nervous function requires the ability to *store* information; yet astonishingly little is known of the biophysical, biochemical or cellular mechanisms involved. This is the more surprising when one considers how much progress has been made on the problems of the *transmission* of information in the nervous system. For the problem of information storage we cannot even point to an anatomical structure, microscopic or macroscopic and say, 'that is where information is stored'.

The problem of plasticity can be attacked at many levels: psychologically, behaviourally, by destructive lesions of the nervous system, biochemically, and so on. We think that the most promising approach to the problem is at the level of intercellular connections, for two reasons. First, from our general knowledge of the nervous system it seems that its organization principally resides in the pattern with which cells are connected to each other. This is not the only property that determines the function of the nervous system, but it is a very important one; it is subject to modification by the environment and most of the papers at this meeting will be found to relate to this topic.

The second reason for emphasizing intercellular connectivity is simply that this is a middle level. One can approach at a more microscopic or molecular level; one paper (Rose) in fact

describes an analysis of examples of plasticity using biochemical methods, but we feel that these techniques will become fully effective only when the location and nature of the changes is known at the cellular level. Alternatively, one can approach the problem behaviourally, and again one paper (Melvill Jones) describes the behavioural analysis of a plastic change of function. This suggests a promising model at a cellular level, which awaits detailed testing, and we think the paper illustrates the potentially fertile relationship between the behavioural and cellular approaches.

Having stated our positive prejudices about the general level at which the problem of neural plasticity should be approached, we now wish to explain that there was a large capricious element in the detailed selection of papers for this meeting. To accommodate all those qualified to speak authoritatively on the topic of our choice would have required a much longer meeting and larger budget, so many had to be eliminated. We hope that this collection of papers will none the less be of wide interest to those concerned with the most important property of the nervous system – its plasticity.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES