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Brain and Consciousness

A Review of

Brain Mechanisms and Consciousness: A Symposium

J. F. Delafresnaye (Ed.)

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"WHAT RIGHT have we to conjoin mental experience with physiological?" To paraphrase Sherrington's answer to his own question: "No scientific right—only the right of busy common sense." It is by this right that the investigators who participated in this symposium have contributed their research findings toward the understanding of the phenomenon of consciousness.

The book presents neurophysiological and behavioral evidence relevant to a discussion of consciousness. The bulk of the recent neurophysiological evidence concerns the functions of the reticular formation. Therefore, ten of the eighteen papers of the symposium devote themselves to this topic.

H. W. Magoun, G. Moruzzi, and others demonstrate that there exists in the reticular formation of the brain stem a mechanism which seems closely related to the waking and activating functions of the brain. Stimulation of this area results in behavioral arousal from sleep and EEG desynchronization pattern that duplicate the changes seen when passing from the sleeping to the waking state. Destruction of parts of this system produces disturbance of consciousness in various forms—coma, sleep, and akinetic mutism.

H. H. Jasper and others discuss the mid-line and intralaminar nuclei of the

thalamus. They show that these nuclei exert a diffuse effect upon the cortex, being able to control the electrical rhythms in widespread regions of the cortex. Such nuclei are to be contrasted with the specific relay nuclei of the thalamus that transmit afferents to relatively well-localized projection areas in the cortex. Stimulation of the unspecific nuclei produces the recruiting response of E. W. Dempsey and R. S. Morison; i.e., successive increase in amplitude of cortical response with repetitive stimulation at frequencies close to the frequency of the spontaneous rhythms of the cortex. It is possible, according to Jasper, that the elaboration of response of sensory cortex to afferent impulses over the sensory pathways can be regulated by existing activity in the unspecific system.

On the behavioral level, W. R. Hess presents evidence that, in a region of the diencephalon partly overlapping with that producing the recruiting response, electrical stimulation causes sleep. Hess takes this as evidence for a diencephalic sleep center, antagonistic in function to the arousal system postulated by Magoun. Frederic Bremer, on the other hand, believes that the process of falling asleep may be explained, without recourse to the postulation of a sleep center, by a neuronal de-activation resulting from synaptic fatigue and reduction of sensory stimulation.

Wilder Penfield and his co-workers at Montreal have obtained data by use of electrical stimulation of the cortex in patients suffering from epilepsy. Stimulation of the temporal lobe evoked a reproduction of past experience or a sudden alteration in the interpretation of present experience. Both types of response, experiential and interpretive, according to Penfield, point to the existence of a permanent ganglionic recording of the stream of consciousness. These findings have caused him to hypothesize the existence of a centrencephalic system with equal functional relationships with the two hemispheres which seems to be located in the diencephalon.

IT IS heartening to see the accumulation of evidence about areas of the brain that have remained inaccessible for so long. The recent development of histological and electrophysiological techniques have given a big push to research upon subcortical functions, and show promise of uncovering information relevant to higher processes. However, it is still premature to pair brain mechanisms and consciousness. The molecular nature of most of the neurophysiological data do not help much in understanding complex patterns of brain function. They point out which areas seem to interact, but do not shed much light on the nature of that interaction. We have here a situation where a great many combinations of single-

neuron events are conceivable. The paucity of facts about complex mental processes, however, provides little guide to the types of integrative combinations which must be involved.

The fact is that we know practically nothing about variations in the phenomenon of consciousness. We have no names for the states which lie between complete consciousness and coma. In the attempt to relate EEG patterns to consciousness, we make consciousness the independent variable and let the EEG record be the dependent variable; but it is practically impossible to point to discrete variations in the state of consciousness, other than the fact that the subject is asleep or awake. Consequently, practically all the EEG records tell us is that slow waves of large amplitude characterize sleep and that disruption of these waves signifies alertness and attention to a particular stimulus. Although H. Gastaut, for instance, asserts that different EEG patterns reflect different personality types, it is apparent that as an index of the molar electrical activity of the brain the EEG is still not suitable for fine differentiation of patterns of brain activity. W. Grey Walter, recognizing this fact, has developed his toposcope, which is intended to provide a more adequate picture of the relation of incoming patterns of stimulation to the existing activity in different areas of the cortex. Perhaps this technique may be able to go further than the EEG has thus far.

Although the title suggests that the reader will find a general discussion of brain function in relation to the problem of consciousness, the book is largely a detailed presentation of evidence concerning the reticular formation. As such, it will appeal to but a limited segment of the people who will be attracted by the title. There are, however, several papers of more general interest. A. E. Fessard analyzes the problem of conscious experience, and discusses the implications of the phenomenon for localization of function and the types of operations which the brain must perform to achieve experienced integration. K. S. Lashley discusses the mechanisms which determine the perception of stimuli, since he considers the process of awareness to be basic to conscious processes.

Whether it pays to invoke the concept of consciousness is still a debatable point. As D. O. Hebb has pointed out in the symposium, consciousness as a phenomenon can only be hypothesized from behavior. By explicitly describing the acts which make up the higher behavior of animals and men—acts which involve, for instance, awareness and attention to stimuli, discrimination of motivational states, transposition in learning behavior—we spell out the basis of our belief that

consciousness as a phenomenon does exist. But when we have fully described such higher functions, it may well turn out that the concept of consciousness as such will have become superfluous.