NEUROPHYSIOLOGICAL SYMPOSIUM*

RECENT ADVANCES IN NEUROPHYSIOLOGY*

JOHN F. FULTON, M.D.

Department of the History of Medicine, Yale University School of Medicine,
New Haven, Connecticut

(Received for publication October 1, 1953)

Several years ago, at a meeting of the American Neurological Association, Stanley Cobb' did us the honor of referring in his presidential address to our work on the frontal lobes, and having his discussion well planned, he produced from his pocket a lantern slide which was thrown on the screen. I recognized it immediately as Becky, our first frontal lobe chimpanzee, and with apologies to Marlowe and Dr. Faustus, Cobb asked

"Was this the face that lopped ten thousand lobes,
And burnt the topless towers of Ilium?"

The gathering was rather taken aback, but even in a gallant audience of neurosurgeons, no one rushed forth to exclaim

"Sweet Becky, make me immortal with a kiss."

However, our colleagues in this Society and elsewhere in the neurosurgical world have been courting Becky ever since and, I am sure, have now lopped another ten thousand lobes without being fully aware of some of the cosmic issues involved. I say this with no desire to be critical, but in the hope that those who are dealing surgically with mental disease will continue to study their patients with the same thoroughness with which chimpanzees are studied, for you have a much finer opportunity to gain insight into some of the basic problems of frontal lobe function than we who are limited to gaining information from inarticulate beasts.

In arranging this program, Dr. MacLean and I have attempted to stress recent neurological advances of the past five years; my remarks will be based in part on a review on the somatic nervous system which appeared in Annual Review of Physiology12 of 1953.

At the San Francisco meeting of the Harvey Cushing Society five years ago I read a paper entitled "The frontal cortex and viscer al pain" in which it was suggested that the reason why intractable pain was relieved by frontal lobotomy stemmed from the fact that the standard lobotomy interrupted a large system of ascending afferents from blood vessels and the hollow viscera. A number of friendly members of the Society assured me that I was generalizing beyond available data (which was of course true) and the com-

munication has remained unpublished. The paper carried the following summary:

“The concept which I have placed before you recognizes somatic pain as pertaining to the spinothalamic system, and it suggests that the autonomic afferents—responsible for visceral pain as well as the other sensory modalities in the visceral sphere—pass up the spinal cord, probably in discrete pathways, and give rise to a true spinohypothalamic system which passes through the medulla and pons alongside the medial lemniscus as the mammillary peduncle. It also recognizes the fronto-orbital cortex as the principal autonomic center of the forebrain.”

Perhaps the most important development in neurophysiology of the past five years has been the clear-cut separation of the limbic system, or “visceral brain” as MacLean has designated it, from the neocortex which is concerned with higher intellectual functions. The limbic system, according to Broca’s original definition, lies within the boundaries of the limbic fissure and includes such midline structures as the pyriform area, the hippocampal gyrus, the hippocampus itself, the parasplenial, cingulate, and subcallosal gyri. While by definition the insula, temporal pole, and the medial and posterior orbital gyri are strictly speaking outside the limbic lobe, these areas are histologically and functionally akin to the pyriform. The limbic system projects to various subcortical areas such as the amygdala, anterior thalamic nuclei, the hypothalamus, the basal ganglia and various pontine structures. Dr. MacLean deals more at length with the reactions that follow upon stimulation and ablation of various elements in the limbic complex.

LIMBICafferents

It is customary to believe that the chief ascending systems in the forebrain pass by the medial lemniscus to the ventral nuclei of the thalamus and thence in precise topographical fashion to the pre- and postcentral convolutions of the cerebrum. Little attention has been given in the past to other possible afferent channels passing to the hypothalamus and related structures. Bronk and his associates showed that stimulation of certain medulary nuclei activates various elements of the hypothalamic complex. Amassian and others found on stimulation of the central end of the splanchnic that the sensory trunk area of the postcentral convolution was activated but that other and slower fibers in the splanchnic activated the hypothalamic area, and that the fibers in question did not pass to the thalamus as such. A detailed study of the afferent paths from the vagus in the forebrain has recently been made by Dell, who finds specific and nonspecific autonomic projections passing to the forebrain in the cat, the specific projections (homologue of the classical projections of the somatic system) passing to the posterior orbital gyrus (latency 8 to 10 msec.), thus confirming Bailey and Bremer—this after relay in the most medial part of the nucleus ventralis posterolateralis (latency 5 to 6 msec.). The nonspecific autonomic projections, passing to regions which they have in common with the nonspecific somatic projections, have been traced to many parts of the brain stem, the