AMERICAN EEG SOCIETY

D22

SYMPOSIUM

THE RHINENCEPHALON

Chairman: ROBERT S. SCHWAB

1. **Concerning three rhinencephalic systems.** — KARL H. PRIBRAM, Department of Neurophysiology of the Institute of Living, Hartford, Conn. and Department of Physiology, Yale University, New Haven, Conn.

Because of the recent interest in the possible role in emotional behavior of parts of the forebrain which previously had been thought to serve olfaction, the author has reviewed and made an attempt to systematize observations and experiments concerning the anatomy and functions of those neural systems which might usefully be classified as "rhinencephalic". Profitably included are all morphological formations either totally or partially cortical, which do not definitely pass through a six-layered stage in ontogeny. Transitional (juxtallocortical) formations are thus subsumed under "rinencephalon". Since in mammals, and especially primates, the increase in isocortical (definite six-layered ontogenetic stage) relative to allocortical (definitely no such six-layered stage) formations is shared by the increased development of juxtallocortical ones, the classical distinction between neocortical and older formations is abandoned in favor of the distinction between isocortex on the one hand and allo- juxtallocortex on the other.

Three allo- juxtallocortical systems have been distinguished. The first (made up of olfactory tubercle, area of the diagonal band, prepyriform cortex, and the corticomedial nuclei of the amygdala) is considered a "primary" olfactory system on the basis of its direct connections with the olfactory bulb. A second system (made up of subcallosal and frontotemporal juxtallocortex, the septal nuclei and basolateral amygdaloid nuclei) is connected with the primary system but not with the olfactory bulb and contains subcortical as well as cortical components. The lack of differentiation between cortex and subcortex in this system is found whether phylogenetic, histogenetic, axonographic, physiological, or behavioral data are considered. This system has been implicated in diverse functions: metabolic and socio-emotional. Future investigation must determine whether some unitary function underlies the others,

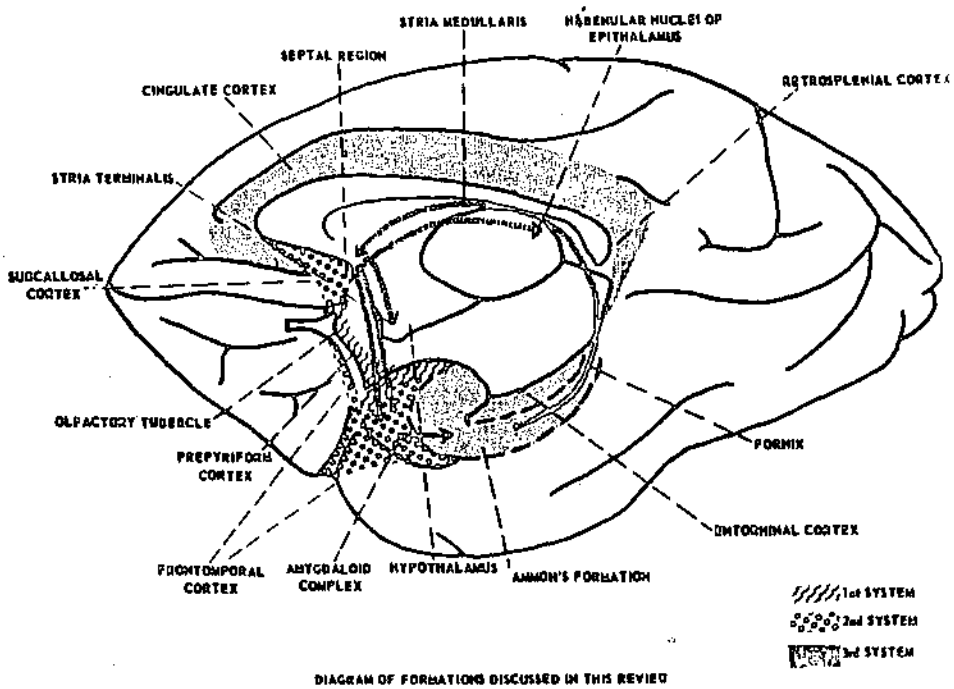

Fig. 1

Diagramatic representation of the mediobasal aspect of the cerebral hemisphere of monkey outlining the three rhinencephalic systems and some major connections. From Pribram and Kruger, *Ann. New York Acad. Sci.*, 1954, *58*: 109-138.

whether the multiplicity of functions reflects a multiplicity of subdivisions within the second system, or whether this system is, under different conditions, part of one or another larger system. Finally, a third system connected with the second, but not the first (made up of the remaining allo- juxtallocortical structures: Ammon's formation, entorhinal, retrosplenial and cingulate cortex) can be distinguished from the others on a histogenetic, axonographic, and electrographic basis. The hypothesis that this system is the neural base of emotion has so far failed to receive conclusive experimental confirmation. This may be due in part to the lack of quantitative behavioral studies of the effects of stimulation or ablation of portions of this system and to their surgical inaccessibility. These shortcomings are being overcome and relevant data should be forthcoming. One example of the type of study needed was shown. This experiment demonstrated the selective effects of second and third system resections on the extinction of a postoperatively acquired conditioned avoidance (possibly a response based on "fear"). Caution in interpreting the results was urged, however, pending the accumulation of a wider range of data.

We must end with the thought that the "olfactory brain", as defined, is not primarily olfactory though parts of it serve olfactory functions. Nor is the current conception of a "visceral brain" more tenable though viscero-autonomic functions are also served. It is clear that the formations in this portion of the brain, though they share several characteristics, are not, at this time, usefully thought of as a brain serving any one function. Since at least three distinct systems can be delineated, each might profitably be investigated separately before an attempt is made to define what functions they have in common.

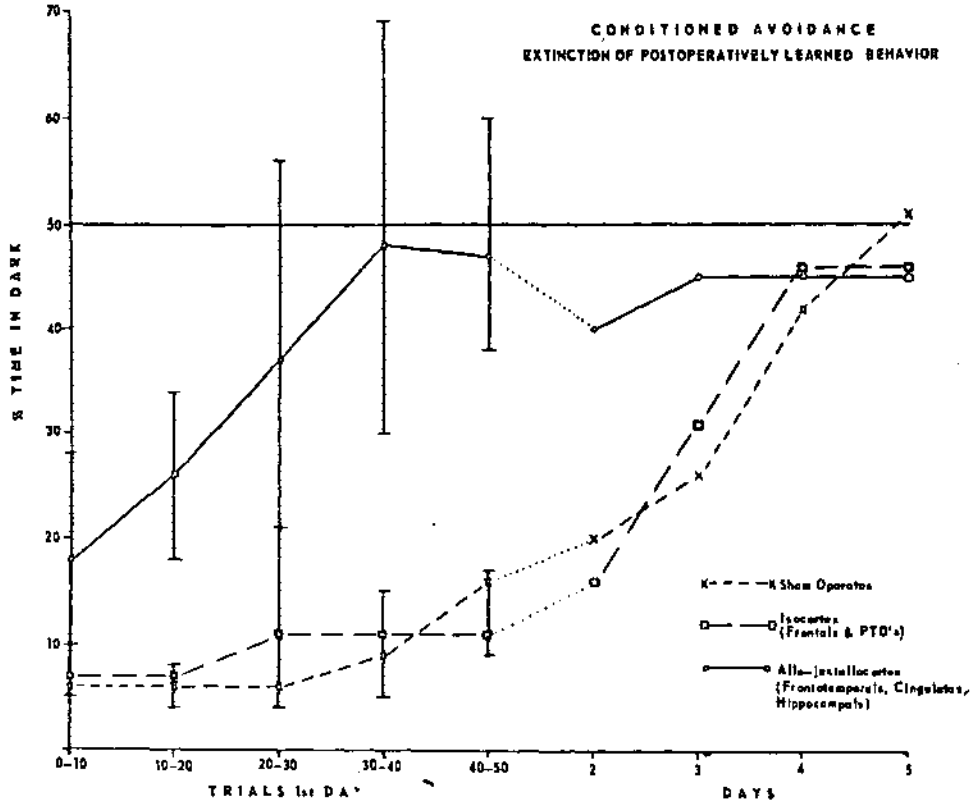

Fig. 2

Results showing differential extinction rates of a postoperatively acquired conditioned avoidance (of shock) in a two-compartment shuttle box. Each subgroup made up of two animals. Mean performance and range are graphed. Extinction is indicated when animals spend approximately 50 per cent time in the dark compartment — the compartment they have been conditioned to avoid. Each trial 30 sec.; UC-CS interval during conditioning: 4 sec. Note the clear separation between animals with isocortical (and sham) and those with "rhinencephalic" resections. From Pribram and Weiskrantz, in preparation.

REFERENCES

This report is abstracted from "Functions of the Olfactory Brain" by Pribram and Kruger, *Annals of the New York Academy of Sciences, 58*: 109-138, March 24, 1954. A detailed bibliography can be found with the original article.