fungus. Such trees might be maintained without loss of production, while badly diseased trees must usually be severely pruned to balance the top and the weakened root system.

A detailed account of these experiments will be published.

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A GENETIC STUDY OF CEREBRAL ACTION CURRENTS

ONE thousand, one hundred and ninety-five action currents were obtained from the fore- and mid-brains of the crayfish, frog, snake, pigeon and the rat, by using five stages of vacuum tube amplification, an oscillograph and motion picture film. The animal's brain was exposed under a local and general anesthetic and electrodes fixed on the surface of the brain. The recording was made with the animal well out from under the general anesthetic.

The records were taken from all the main portions of the fore- and mid-brains of the five animal groups under diverse visual, auditory, tactual and pain stimulation and with the animal making "spontaneous" body movements. Care was taken to select stimuli which would produce comparable behavior in the various animal groups. The records were classified with respect to the type of stimulus, the response of the animal, the location on the brain, the amplitude, wave-form and gross pattern of the impulses.

A comparison of the various animal groups leads to the following conclusions: First, all the evolutionary stages are alike in that the activity of the brain under a given stimulus-response condition is differentially distributed over a wide area in the form of a gradation of intensity, or amplitude, and extent of impulses. In no case did a single area or region function alone under a given type of stimulation and response of the animal, even in the case of the eyelid reflex. This fact finds substantiation in Lashley's theory of mass action. Second, in the lower animal forms, the gradients extending across the brain are more unstable than in the higher forms and in fact seem to vary in chance fashion under the same stimulation and response. This fact is consistent with the greater equipotentiality of structure found in the lower animal forms. Third, in the more developed animal forms, under motor activity, the brain exhibited in general two major loci or peaks of nerve potential, one in the motor region and one in the visual region, with gradations toward lower potentials between the anterior and posterior poles. A gradient appeared under visual stimulation, with its peak at the posterior pole. Under sound stimulation a lateral gradient appeared.

Fourth, there was a greater homogeneity of brain function in the lower animal forms, so much so that in many cases the gradient was hardly perceptible. This fact suggests less resistance to spreading in the less differentiated brain. In general, for any given stimulus-behavior situation, the lower the animal form the wider the brain area measurably involved and at the same time the more homogeneous the disturbance. As the animal brain differentiates it takes on greater specialization of function observable in sharper and more definitely outlined gradients, *but the mass is still relevantly involved in all stimulus-situations.* Fifth, in all the behavior situations, except spontaneous activity of the animal, the magnitude of the brain disturbance decreases in the higher animal forms, a fact probably related to the greater mass of the forebrain, which, because of its mass, may exhibit a shunting effect on incoming disturbances. The greater structurization with respect to particular stimulus-patterns is also a probable factor. Cortical evolution may be described as the achievement of that differentiation of structure which protects the brain against the more excessive and more homogeneous expenditure of energy found in the lower forms. Sixth, the only condition found under which activity increases as one proceeds up the animal scale is that of "spontaneous" activity. As the brain differentiates those same patterns of energy which became more structured from the standpoint of outside disturbance function for increased "spontaneous" response. From the standpoint of intensity the large brain mass in the higher animals is more significant for aggressiveness than for fine degrees of sensory differentiation.

Seventh, in the lower forms the brain was involved homogeneously at a maximum level even with the eyelid reflex, while with spontaneous activity the level of potential was very low. Simplicity of integration would seem to depend on wide-spread homogeneity of potentials. The differential necessary for a simple reflex means, *in the more complex brain,* a greater expenditure of energy in delay and in resistance to outside disturbance. Eighth, the greatest magnitude of brain disturbance occurred under pain stimulation. Ninth, it was evident throughout that the different parts of the brain subserve different functions at different times. A sharp distinction between sensory and motor regions seems no longer justified. In general, the results support a dynamic field-theory of brain activity, rather than a mechanistic, summative theory.

Further work is in progress on all the points suggested.

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