cating that the organism is not the etiological factor in the exudate, because the infection with the exudate itself did not always protect against reinjection. It seems more logical that the pathogenicity of the organism has been reduced by cultivation so that it is incapable of producing a high degree of immunity.

The clinical manifestations of the disease under discussion closely resemble those described by Delaplane, Stuart and Bunyea[3] of a similar disease of chickens in Rhode Island and it seems not unlikely that the two may be identical. There are also points of similarity between the disease and the coryza studied by Nelson,[2] particularly his type III. The organism that has been isolated and which is believed to be an etiological factor of the disease appears to differ in some aspects from the one identified by Nelson[2] as the cause of a coryza of chickens. Further studies, however, may show that the two belong to the same species.

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THE TREATMENT OF DECIDUOUS FRUIT TREES AND NUT TREES INFECTED BY PHYMATOTRICHUM OMNIVORUM WITH AMMONIUM COMPOUNDS

THE disease known as cotton (or Texas) root-rot causes serious losses in most of the dicotyledonous crop plants grown throughout its rather restricted range in the semi-arid Southwest. One of the most serious aspects of its depredations is the destruction of many valuable long-lived perennials, such as deciduous fruit trees, nut trees and ornamental trees and shrubs. The root-rot fungus persists in the soil and, starting from one or more points in the orchard, advances in ever-widening circles until the whole planting has been destroyed. Rotation with resistant or immune species, the most successful method of control in case of field crops, is not practical in the case of tree crops.

For the past five years the author has been experimenting with visibly infected trees, using a variety of chemical and other treatments. Many of the early results were not particularly encouraging, as the root system of attacked trees is usually very seriously damaged before symptoms are clearly visible in the foliage. Some promising treatments have proven disappointing in the field because the chemicals used were too active when applied to our soils and quickly became converted to relatively insoluble and innocuous forms.

Results of the past two years, however, indicate that two of the treatments will prove successful in checking and overcoming the ravages of root-rot in some tree crops. Whether they will be effective in case of our most susceptible trees remains to be seen. The two treatments which have proven most successful are rather heavy applications of ammonium sulfate or ammonium hydrate diluted to a safe concentration with water. Ammonium hydrate was reported by Neal *et al.*[1] to be successful in killing the root-rot fungus without killing the host plant (cotton). Various workers have tried different nitrogenous commercial fertilizers in moderate amounts without finding any definite benefit.

Since both chemicals, especially the hydrate, are very toxic to the trees if applied in too great a concentration, a special method was evolved for the safe and accurate applications of these chemicals under field conditions. The choice of these two chemicals seems particularly fortunate, as they are relatively inexpensive and easily obtained, and both leave a large residue of quickly available nitrogen in the soil, for nitrification of the ammonia in either case is well advanced in three or four weeks. The strong stimulating effect of the nitrogen appears to be essential to recovery, as trees visibly affected by root-rot have greatly weakened and decayed root systems, which must be quickly replaced if the tree is to survive. The ammonium hydrate has proven somewhat disagreeable to handle on account of its volatile nature, but it is perhaps somewhat better for treating very badly diseased trees.

The outstanding success has been in treating affected pecan trees in the Yuma Valley. Pecan trees are usually visibly affected a year before they die from root-rot, while deciduous fruit trees often succumb without warning. The largest number of the treated trees were in two orchards. In the first orchard no treated trees were lost; in the second grove about 40 per cent. of the treated trees died, but many of the others showed great improvement. The higher mortality is accounted for by the fact that the very worst trees were chosen for treatment and the general condition of the grove was less favorable. Experiments on deciduous fruit trees in Yavapai County (altitude 3,000 to 3,500 feet) have been complicated by the great variability of the orchard soils of that district and the difficulty of treating a sufficient number of affected trees to secure reliable data, but results have been mainly encouraging.

While experiments have been conducted largely with badly diseased trees, it is obvious that the effect of treatment should be much more valuable to the commercial grower if applied to trees only slightly affected or standing in the path of the advancing

[3] J. P. Delaplane, H. O. Stuart and H. Bunyea, *Jour. Amer. Vet. Med. Assoc.*, 82: 772, 1933.

[1] D. C. Neal, R. E. Wester and K. C. Gunn, "Treatment of Cotton Root-rot with Ammonia," SCIENCE, n. s., 75: 139–140, January 29, 1932.

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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