peculiar significance concerning the origin of these formations.

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TEMPERATURE CHARACTERISTICS OF THE "BERGER RHYTHM" IN MAN

RECENT work from several laboratories has shown that various groups of cells in the mammalian brain exhibit what appear to be "spontaneous" electrical activity, producing rhythmic waves of potential variations at characteristic frequencies. The most readily detectable of these rhythms (the "Berger rhythm") has been shown (Adrian and Yamagiwa)[1] to arise in a localized region of the occipital cortex. In man these occipital fluctuations of from 50 to 100 microvolts may be obtained when the subject is in a resting condition with the eyes closed by directly applying pad electrodes to the head. The waves from the occipital cortex of a resting human subject have been shown to occur at a remarkably constant frequency, about 10 per second. For a recent review of the literature dealing with electrical brain waves *cf.* Kornmüller, 1935.[2]

It is reasonable to suppose that the Berger rhythm may be due to relaxation oscillations resulting from continuous, entirely non-rhythmic metabolic events going on in the cortical cells. The frequency of the rhythm, therefore, might be expected to be directly proportional to the speed of these local metabolic events (*cf.* Hoagland).[3] To test this hypothesis I have examined the Berger rhythm as a function of temperature in subjects who were given hyperpyrexia treatments. The resources of the Physical Therapy Department at the Worcester State Hospital were made available through the kindness of Dr. Clifton T. Perkins and his technician, Miss Alice Sheahan. This paper is a brief preliminary report of the findings.

If the frequency of the rhythm were a direct measure of the velocity of determinative chemical events, the Arrhenius equation should fit the data. This equation may be conveniently used in the form

$$\text{Frequency} = k\,v = e^{-\mu/RT} + c$$

where v is the velocity of the underlying chemical mechanisms, e is the base of natural logarithms, R the gas constant, T the absolute temperature, k and c are constants and μ the critical thermal increment, or temperature characteristic, in calories per gram mol of activating energy of the reacting system.

The subject was placed on a bed, thoroughly wrapped to prevent heat loss, and his temperature elevated in most cases to 105.0° F. by passing high frequency alternating currents through his body. Rectal temperatures were taken every 15 minutes with a clinical thermometer during the 1½ to 2 hours that were necessary to elevate the temperature. In some experiments the rhythm was also recorded with descending temperatures. Immediately after recording each temperature the Berger rhythm was recorded continuously for some 50 seconds by means of an amplifier and ink-writing undulator recording on paper tape.

So far six subjects have been studied. Five of these were patients suffering from general paresis and the sixth was a multiple sclerosis patient, a professional man, entirely normal mentally, who comes to the hospital weekly for diathermy treatments. This last patient's temperature was not elevated above 102.0° F.

The Berger rhythm records in a given experiment were averaged for each temperature by obtaining the mean value of the number of oscillations per second for the 50 ± seconds during which each record was made. In this way mean frequencies to four figures were obtained of approximately 500 Berger cycles at each of some seven temperatures between the normal body temperature and the peak temperature. Since each of the general paresis patients receives a number of daily diathermy treatments it was possible to obtain an average of four complete sets of data from each one. Three experiments were performed with the non-resident patient. The experiments on a given individual were all done on different days. Some 70,000 Berger cycles were thus obtained as a function of temperature.

When the logarithms of the mean Berger frequencies for each patient were plotted against the reciprocals of the absolute temperatures, straight lines of negative slopes were found in all the experiments, indicating the adequacy of the Arrhenius equation to describe the data. The mentally normal patient and the least seriously affected of the five general paresis patients yielded mean μ values of 8,000 ± calories. Two of the other patients gave mean values of 11,000 ± calories, while two gave values of 16,000 ± calories. The Berger rhythm was found to be increased roughly from 9 or 10 to 13 beats per second for a rise of 6° F. (about 3.5° C.) in patients yielding this last value. The increase was, of course, proportionately less with the other patients. While it is possible that the higher values of μ may be related to the greater extent of cortical damage due to the disease, the data at present are obviously quite inadequate to warrant such a clinical generalization, although the continuance of the work has interesting possibilities along these lines. The magnitudes of the μ values are, however, very suggestive in that they are identical with those found re-

[1] E. D. Adrian and K. Yamagiwa, *Brain*, 58: 323, 1935.
[2] A. E. v. Kornmüller, *Biol. Rev.*, 10: 383, 1935.
[3] H. Hoagland, "Pacemakers in Relation to Aspects of Behavior." The Macmillan Company, New York. 1935.

peatedly by other workers to be associated with respiratory phenomena in cells (*cf.* Crozier[4] and[5]).

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THE ISOLATION OF CRYSTALLINE TOBACCO MOSAIC VIRUS PROTEIN FROM DISEASED TOMATO PLANTS

THE isolation of a crystalline protein possessing the properties of tobacco mosaic virus has recently been described.[1] This protein was obtained from Turkish tobacco plants infected with this virus, by fractionation of the globulin in the plant extract with ammonium sulphate, celite and lead subacetate. The same general procedure with certain improvements[2] has been applied to extracts from tomato plants infected with tobacco mosaic virus and an active crystalline protein has been obtained from this host plant.

The protein from mosaic-diseased tomato plants and that previously isolated from mosaic-diseased Turkish tobacco plants have the same crystalline form, optical activity and chemical composition. They likewise give the same protein color reactions and are precipitated from solution under the same conditions. When solutions of the protein from diseased tomato plants are made more alkaline than about pH 11 or more acid than about pH 1, the protein is denatured and the virus activity is lost. It is completely coagulated and the activity lost on heating to 94° C. These results are similar to those obtained with solutions of active crystalline protein from diseased tobacco plants. Cataphoresis experiments, carried out by means of the Northrop-Kunitz apparatus, on the crystals obtained from tobacco plants and on those obtained from tomato plants show that the isoelectric point of each is about pH 3.2. At hydrogen-ion concentrations more alkaline than pH 3.2 the crystals from both sources migrate to the positive electrode, whereas at more acid reactions they migrate to the negative electrode.

No significant difference between the infectivity of protein from tobacco plants and protein from tomato plants was detected in several tests in which the half leaf method of inoculation was used. One cubic centimeter of a solution containing but 10^{-9} grams of the crystalline protein from either source has usually proved infectious. The crystalline protein from mosaic-diseased tomato plants, when present in solution at a concentration of 10^{-5} or more grams per cubic centimeter, gives a precipitate when mixed with the sera of animals previously injected with either the crystalline protein obtained from diseased Turkish tobacco plants or with the juice from such plants.

The isolation from a different host plant of a protein possessing the same physical, chemical and biological properties as those previously found for the protein from mosaic-diseased tobacco plants offers additional evidence for the identity of the protein with the agent responsible for the tobacco mosaic disease.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

"KARO" AS A MOUNTING MEDIUM

IN recent years "Karo"[1] has been used as a mounting medium for zoological and botanical material by a number of investigators. It is a mixture of maltose, dextrose and dextrin.

The writer has found it useful for mounting algae. With delicate forms, it is necessary to concentrate the solution gradually, as in the glycerine jelly technique. Finally when the "Karo" is concentrated a hard mount is obtained which is as firm, and seems to be as permanent, as a balsam or damar mount. It is also useful in mounting pollen grains. The preparations are more permanent than those made with glycerine jelly, and the advantage of the glycerine jelly method is retained in that the grains, when so mounted, may be studied in their expanded condition. It is also a speedy, efficient medium for making whole mounts of insects. Clearing the animal, which is often a difficult process due to the presence of air in the tracheae, is not necessary. Animals which are mounted in "Karo" have a more natural appearance than those mounted in damar.

Ordinarily ringing the cover glass is not necessary. It is advisable only if the slides are exposed to very moist conditions or when thick whole mounts are made. The addition of a few crystals of Thymol or any preservative of this type prevents the growth of fungi, although fungi rarely develop, even when the preservative is lacking. "Karo" has the advantage over balsam or damar in that material may be mounted into it directly from water or the lower alcohols. Thus the hardening and shrinkage, which often occur with the use of alcohols and clearing agents, may be prevented. The sugars present do not crystallize. Slides which were made six years ago are still in perfect condition.

[4] W. J. Crozier, *Jour. Gen. Physiol.*, 9: 531, 1925–26.
[5] W. J. Crozier, *Jour. Gen. Physiol.*, 7: 189, 1924–25.
[1] W. M. Stanley, SCIENCE, 81: 644, 1935.
[2] W. M. Stanley, *Phytopath.*, 26, No. 2, (Abst.), 1936.

[1] "Karo" is a white corn syrup produced by the Corn Products Company.