universities and learned societies abroad. The officers also reported that six university teachers had been dismissed in Portugal for other than professional reasons. The council decided that there was continuing need for a non-political organization to assist displaced scholars and scientific men, and made plans for the creation of a more permanent body, a Society for the Protection of Science and Learning, to take over its activities. An invitation to join this society will shortly be issued.

DISCUSSION

CORTICAL EXCITATORY STATE AND VARIABILITY IN HUMAN BRAIN RHYTHMS

IN a recent communication to this journal entitled "Temperature Characteristics of the 'Berger Rhythm' in Man" Hudson Hoagland[1] has described experiments which appear to show three temperature characteristics in general paresis patients. We have found in similar experiments on both normal and convulsive (*petit mal*) cases temperature characteristics for both the occipital alpha rhythm (wrongly called the "Berger Rhythm") and the central beta rhythm which were of the same order of magnitude as the lowest of the values reported by Hoagland (7,000 to 8,000 calories). Our control experiments without a temperature change, however, have shown repeatedly frequency changes of the same order of magnitude (1 to 2 cycles per sec.) during the course of one or two hours experimentation. It appears to us that, in the absence of such controls in Hoagland's report and since our experiments indicate a higher variability in some pathological brain conditions, we should suspend judgment in regard to the underlying physicochemical processes controlling these rhythmic activities as determined by apparent temperature characteristics alone in pathological cases.

The cause of variability in the bioelectric activity of the human brain is extremely complex. Some of this complexity may be shown by the following observations: (1) The frequency of the occipital alpha rhythm may be decreased during drowsiness and increased following arousal by an adequate stimulus. (2) Adequate sensory stimulation may diminish or abolish rhythmic activity in a waking person, while the same stimulus may cause bursts of activity to occur in the sleeping person. (2) Sleep itself causes a complex series of changes, involving first a slowing of the rhythmic activity with accompanying changes in amplitude and regularity and then the rhythmic activity being replaced by a predominance of large, irregular, random, usually slow, potential swings, with occasional bursts of rhythmic activity at frequencies of 3 to 6 or 7 per sec. more marked in the occipital region (probably the slow alpha process) and bursts of 12 to 14 cycle rhythm more marked in the central region (probably the slow beta process). (4) Some individuals, upon first examination, appear to show no regular rhythmic activity from any region; the record appearing similar to that obtained after existing rhythmic activity is broken up by sensory stimulation in other individuals. Some of these individuals will show good regular rhythms if they are placed in a sound-proof room and allowed sufficient time for general relaxation or are relieved of some tension or worry. A more or less sustained state of cortical excitation seems to be involved in this absence of rhythmic activity. (5) Frequency changes due to temperature are present but complicated by the variable increase in general excitability in the febrile condition plus associated circulatory changes. (6) States of excitation involving the autonomic nervous system, such as fear, anxiety and worry, affect markedly the frequency and regularity of brain rhythms. (7) The first five or ten beats of the occipital alpha rhythm as it recovers from being abolished by light stimulation are at a higher frequency than those in a period ten or fifteen seconds later. As the rhythmic activity builds up it appears to decrease progressively in frequency (*e.g.*, in one case from about 11 to 9.5 per second). It is as though some sustained effect of the afferent impulses, which might be called the cortical excitatory state, was increased above the level which permits rhythmic activity and then decreases, following the cessation of the stimulus to a level permitting rhythmic activity at first rapidly and then with decreasing frequency until it passes to a lower more constant level.

The rhythmic discharge of a relaxation oscillator as controlled by variations in its driving potential may be an excellent analogy for the control of the rhythmic discharge of cortical cells by the variation in cortical excitatory state. The gas discharge tube in such an oscillator will function rhythmically only when the applied potential is within certain limits (depending upon the time constant of the circuit RC and the tube characteristics). As the applied potential is increased from zero a level may be reached which will cause the tube to discharge in a random manner with occasional regular discharges at a low frequency (as for brain potentials during sleep) and then the frequency of

[1] H. Hoagland, SCIENCE, 83: 84–85, 1936.

regular discharge will be increased with an increase in applied potential up to a limit above which a further increase in potential will cause a constant discharge with little or no rhythmic activity. The appearance of rhythmic activity following stimulation during sleep is explained by assuming a low level of cortical excitatory state during sleep which is brought up to a level permitting rhythmic activity. The level of cortical excitatory state may be already up to such a level in the waking state that a further increase with stimulation causes the excitatory state to pass beyond the level permitting rhythmic activity, perhaps, into the region of constant discharge. Furthermore, it appears as a general rule that the amplitude of brain potentials decreases with their frequency, which occurs also in the relaxation oscillator of proper RC constants.

Variations in the bioelectric activity of brain cells could be due to (1) changes in physico-chemical processes within the cells, such as accompany toxic agents, circulatory changes, temperature, etc.; (2) differences in the physical structure of the cell, as in normal cyto-architectonic structure and pathological cell growth, and (3) changes in the anatomical and function association of one group of cells with another. All these factors, plus the specific effect of centripetal nerve impulses themselves, may affect the cortical excitatory state, which may be considered a major factor in controlling rhythmic activity.

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THE MOISTURE RELATIONS OF PECAN LEAVES

IT has frequently been noted by those familiar with the growth of pecan trees that under orchard and field conditions pecan leaves do not wilt. In periods of drouth leaves lose their "freshness" but do not actually wilt. As the drouth period progresses little change occurs in the appearance of the leaves until seemingly when a critical point in moisture deficit arrives. Then a "drouth necrosis" of sharply marginated areas of the leaflets occurs. This is frequently followed by an abscission of leaflets and leaves. Recently, data have been obtained which may have a bearing upon this phenomena and upon the relation of soil moisture to leaf functioning and to the formation and accumulation of storage carbohydrates in the tree.

In endeavoring to influence the vegetativeness of trees, their carbohydrate storage and the "filling" and maturity of nuts at harvest time, plots varying widely in soil moisture content have been maintained. In the wet plots soil moisture approaches field capacity; in the dry plots moisture is below the wilting point in the first two feet and below optimum at lower depths. Leaves in the drier plots are smaller, thicker, less green and lacking in "freshness." A typical margined "drouth necrosis" of many leaves has occurred, but there has been no wilting. It was presumed that the moisture content of leaves from the wet and dry plots would be significantly different. We have been surprised to find, from many determinations, that the per cent. of moisture in mature leaves is nearly constant, regardless of differences in soil moisture when conditions for maximum transpiration obtain; *i.e.*, between the hours of one and five P.M. on days of maximum brilliance, high temperature and low humidity. During the night or on cloudy and humid days, the moisture content of leaves increases slightly and the increase is greatest in leaves from the wet plots. Subsequent investigations have included trees growing in commercial orchards with highly variable soil moisture.

Using the familiar cobalt chloride method the transpiration of leaves in the wet and dry plots has been studied. No attempt has been made to measure the relative rate of transpiration in the two. However, leaves which show any appreciable drouth necrosis transpire very slowly, if at all, but healthy leaves under wide extremes of soil moisture transpire freely. Apparently a considerable degree of drouth may occur before transpiration ceases or before CO_2 entrance into the leaf and the interruption of photosynthetic processes occurs. This latter has been best shown by microscopic studies which clearly reveal a greater amount of starch and hemicellulose cell wall thickenings in shoots from the dry than from the wet plots. Conversely, the nitrogen content in leaves and other tissues is reduced in the dry plots.

With a reduced nitrogen content and with photosynthetic action but slightly if at all impaired conditions favoring carbohydrate storage are accomplished through moderate drying of the soil. It is suggested that in soil moisture control may lie an important means for regulating the formation and utilization of carbohydrate reserves in the tree. These latter are believed to be of prime importance in that in late summer they are probably converted to sugars, fats and oils and hence influence the filling and quality of nuts at harvest.

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THE "FLIGHT" OF FLYING FISH

IN a recent article in SCIENCE (83: 80, 1936), C. A. Mills discusses the propulsive power used by flying fish. As a Naval Reserve officer I have, during the last twelve years, spent many hours at sea on various naval