The large number of geologic, physiographic and paleographic maps, together with many well-chosen sections and diagrams, aid materially in making clear the author's conception of the development of this great sub-tropical belt of our Western Hemisphere. No attempt has been made to illustrate the faunas and floras upon which the greater part of geologic chronology and correlation is naturally based. Here as elsewhere, in using the vast amount of material assembled from others the author has accepted their work "at its face value" unless "contradicted by later work or not borne out by interregional correlation." The aid Dr. Schuchert has given us in interpreting American geology is clearly that of a Lyell, of whom Ramsay once remarked "We collect the data and Lyell teaches us to comprehend the meaning of them."

This work will at once assume an outstanding place in geological literature, and its value as a work of reference for decades to come can scarcely be overestimated.

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SPECIAL ARTICLES

NATURAL GLASSES OF THE INSOLUBLE RESIDUES OF THE PENNSYLVANIAN LIMESTONES OF TEXAS

DURING the course of some preliminary investigations of the insoluble residues of certain Pennsylvanian limestones of central Texas it was found that some of the formations contain a relatively conspicuous amount of fragments of natural glasses. This statement should not be construed, however, to mean that any large amount of the fragments may be found in these formations.

The method of investigation, during the progress of which such fragments were noted, was essentially that developed by McQueen[1] for the study of insoluble residues. In this method the rock is first crushed in a mortar and screened. Twenty-five to thirty grams of the material passed through the 8-mesh screen and retained on the 16-mesh are successively digested with 50 cc of 6 M hydrochloric acid until the sample ceases to show any effervescence. The residue remaining is then separated from the acid by decantation and washing or by means of an elutriator. It is then dried and is ready for examination under the microscope.

If the residue is small, which was generally the case with the rocks in question, a constituent may appear to be conspicuous, although in reality it composes only a small part of the original rock. This is the case with the natural glass fragments, which, because of their peculiar properties, are very easily noticed in such residues.

Appreciable amounts of natural glass fragments were noted in samples from a number of formations but particularly from the Marble Falls formation, Adams Branch limestone member of the Graford formation, and the Gunsight limestone member of the Graham formation.

Occurring in different formations with fairly wide separation in the geologic column these natural glasses are, therefore, manifestly of no value in geologic correlation, but it is thought that their presence is worthy of note, even though no practical application can be made.

The fragments vary in size from pieces measuring 0.736 mm × 0.480 mm and 0.928 mm × 0.352 mm to the very smallest of fragments.

Some pieces examined showed perlitic cracks and globulites. Conchoidal fracture is a conspicuous character. The isotropic nature of the material as shown under crossed Nichols is of course a conspicuous characteristic.

All the fragments studied for their refractive indices by means of immersion oils showed indices between 1.515 and 1.520.

George[2] has made a study of the relation of refractive indices of natural glasses to their chemical composition. Reference to George's curve of the indices of refraction and chemical composition indicates that these fragments have a chemical composition of approximately 65 per cent. silica.

No generalization from this study is attempted, except the notation that it probably indicates a more wide-spread distribution of natural glasses in such sediments than may generally be thought to be the case.

Fragments of natural glasses are more or less resistant to destruction during transportation and deposition so that their wide-spread distribution might be expected.

In sediments like sandstone a few fragments included among many pieces of insoluble material would not be noticed during an ordinary examination, while an equal distribution in limestone would be easily noted because of the greatly reduced residue.

The occurrence of the fragments in the formations noted is probably more related to the wide-spread distribution of this kind of material than to any fact of

[1] H. S. McQueen, "Insoluble Residues as a Guide in Stratigraphic Studies," Missouri Bureau of Geology and Mines, 56th Biennial Report, 1931.

[2] William O. George, *Jour. Geol.*, 32: 5, 353–372, July–August, 1924.

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.