TECHNICAL PAPERS

Variations in the Normal Electroencephalogram During a Five-Year Period

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In the course of a variety of experimental studies during the past five years numerous electroencephalograms were obtained on three individuals who served as subjects. During this time these subjects were exposed to high altitude, decompression sickness, vasodepressor syncope, abdominal distension, anoxia, hypoglycemia, acapnia, fatigue, alkalosis from ingestion of large quantities of sodium bicarbonate, alcohol, and toxic doses of atabrin. Reversible changes were produced by many of these procedures. Two subjects during this period had several episodes of migraine with scintillating scotomata, during which focal slowing in the occipital region occurred. A large number of control records were obtained before and after recovery from these experiences. This mass of data on three individuals offers a good opportunity to study the variability of the electroencephalogram in the same individual over a five-year span.

METHODS

A Grass three-channel electroencephalograph was used, and bipolar fronto-occipital tracings were obtained. Five to 10 minutes of record were obtained on each occasion. The records were analyzed by the technique already described in earlier publications (*2*), a frequency spectrum and mean frequency being derived for each record.

The subjects were all males, aged 29, 33, and 36, respectively, at the time of the first observations. The level of sugar in antecubital vein blood was measured at the time of each electroencephalogram, and in about one-third of the experiments rectal temperature was also recorded.

RESULTS

There was no change in the gross appearance of the control electroencephalograms of any individual during the five-year period. No variation in regularity and no unusual wave forms or frequencies appeared. The amount of uncountable low-voltage fast activity ranged between 0 and 5 per cent. The changes produced by the experimental procedures noted above and during the scotomata of migraine were apparently completely reversible.

The spread of mean frequencies over the five-year period for each individual was as follows (Fig. 1): Subject A, 8.8–9.6 cycles/second (39 observations); Subject B, 8.3–9.3 cycles/second (32 observations); Subject C, 8.8–9.3 cycles/second (25 observations). Subject B showed some suggestion of an increase in frequency with successive years, but such a trend was not apparent in the records of the other subjects.

Blood sugar values varied as follows: A, 80–119 mg./100 cc.; B, 80–137 mg./100 cc.; C, 75–126 mg./100 cc. There was no consistent correlation between the daily fluctuations in mean frequency and in blood sugars.

Rectal temperatures ranged from 98° to 99.8° F. among the three subjects at different times, and there was no correlation between body temperatures and the small daily fluctuations in mean frequency.

DISCUSSION

These results indicate that at least among three normal males in the fourth decade with very regular EEG's there

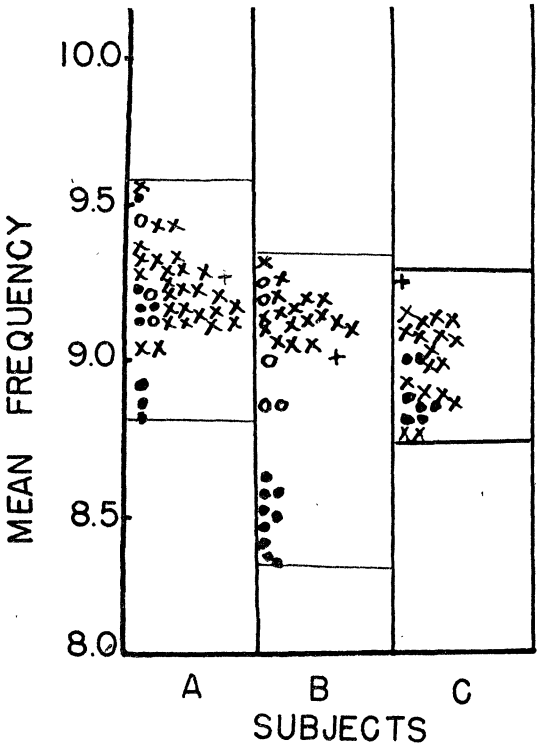

FIG. 1. 1942-●; 1943-○; 1944-×; 1946-+.

was remarkably little change in mean frequency over a five-year period. We hesitate to attach any significance to the apparent slight increase in frequency in one subject. These findings are particularly noteworthy when one considers the variety of experimental conditions affecting the electroencephalogram to which these individuals were subjected.

The stability of the EEG for the same individual is well known, but few quantitative and long-term observations are available. Davis and Davis (*1*) recorded EEG's of a number of subjects over four years and found no change in the gross appearance of the records. Loomis, Harvey, and Hobart (*4*) found the range of 16 mean alpha-frequency determinations in one subject over an eight-month period to be about 1

cycle. Jasper and Andrews (*3*) report a variation of only 1–2 per cent between measurements made on six normal individuals over a period of 6–18 months. Rubin (*5*), whose method of calculating mean alpha frequency corresponds closely to ours, found a variation of less than 1 cycle/second in the mean alpha frequency of a number of normal subjects and schizophrenics observed over periods up to four months. Thus, our results confirm and extend earlier observations.

The failure to find any correlation between the mean frequency and blood sugar level is of some interest, since we had previously reported variations in mean frequency with changes in blood sugar (*2*). However, in those studies the change was produced by the intravenous injection of sugar or insulin and was rapid. Evidently, at any given frequency level rapid changes in blood sugar will produce shifts in frequency, but the day-to-day variations in mean frequency must be accounted for on some other, as yet unknown, basis. This does not appear to be body temperature.

These results also give some indication of the reliability of this method of frequency analysis of the electroencephalogram. For clinical purposes, changes in mean frequency of greater than 1 cycle/second may be considered significant.

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Ordovician Chazyan Classification in Vermont

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Middle Ordovician limestones of west-central Vermont have been described and mapped by Cady (*1*), who included the Crown Point, Beldens, and Middlebury formations in the Chazy "group." Inasmuch as the first-named formation is structurally separated from the Crown Point limestone of the type locality and other outcrops in New York and is succeeded by the Beldens formation rather than by the Valcour limestone, it is proposed that the "Crown Point" formation east of the Champlain thrust in west-central Vermont be designated the Burchards limestone, named from a stream that enters the Lemon Fair River three miles west of the type locality in the belt of outcrop between Cornwall village and The Ledges, Addison County; the formation consists of about 150 feet of somewhat magnesian limestone that has a species of *Maclurites*. The Burchards and succeeding Beldens limestones and dolomites comprise a lithologic sequence that contrasts with the succeeding thinner-bedded Middlebury limestone. This sequence of Burchards and Beldens is designated the Chipman group from Chipman Hill, which lies in the belt of outcrop north of Middlebury village.

The "Chazy" rocks of northern Lake Champlain have been studied by Kay, who has described the Carman quartzite and Youngman formation of northwestern Vermont and southeastern Quebec as succeeding the Beldens in the Highgate Springs slice (*3*). The type Carman consists of about 120 feet of quartz sandstone. The Youngman, more than 300 feet of argillaceous, thin-bedded limestone grading up into dark slate having dense limestone lenses, has *Lonchodomas halli* (Billings) persisting, *Christiania* sp. common in basal beds, *Maclurites* sp. present higher, and *Rostricellula* sp. near the top; the section is somewhat incomplete in the type exposure because of a thrust fault. Kay believes it probable that the Carman quartzite is essentially equivalent to the quartzite in the lower Day Point formation that, with the succeeding Crown Point and Valcour, is the Chazy sequence in New York. It is proposed that the Carman and Youngman formations comprise the Maquam group, named from Maquam Bay, six miles south of the type sections at Highgate Springs, Vermont.

Inasmuch as all these sequences have been called Chazy for nearly a century or longer, it is recommended that the Chazyan series consist of the Chipman and Maquam groups, as well as the Chazy limestones of eastern New York. This use of Chazy is considered to have priority over the Chazyan of Grabau, which added the Black River group (*2*), and of Ulrich, which was for a composite of widely scattered stratigraphic units (*4*).

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A Study of the Inner Bark and Cambial Zone of Black Spruce (*Picea mariana* B.S.P.)[1]

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The inner bark and cambial zone of a tree contain living cells that are active in its life processes and growth. These cells take part in the conversion of sugars and other compounds, synthesized elsewhere, into wood and bark. A study of the composition of the living areas of the tree should help greatly in understanding the genesis of materials present in mature woods. Hitherto, relatively few investigations of this type have been undertaken, and, to the best of our knowledge, these have been limited to European woods (*1*). With this in mind, a study of the inner bark and cambial zones of freshly cut trees was begun during the summer of 1946.

Six layers were separated from a black spruce log, approximately 65 years old, which was cut on June 3, 1946. These layers were: (1) the outer bark, (2) the inner bark, (3) the cambial zone, (4) the young sapwood, (5) the sapwood, and

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