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Electroencephalographic Changes Induced by Intravenous Sodium Amytal.*

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Observations were made on the human electroencephalogram prior to and following the intravenous administration of sodium amytal. For this study, young dementia praecox patients were chosen as the experimental subjects.

Method. Thirty-six electroencephalograms were made on 25 individuals. The minimum recording time for each record was 30 minutes. Ten tracings were made with a single-channel, push-pull amplifier of our own construction. The characteristics of this instrument have previously been described.[1] For the remainder of the records, a three channel electroencephalograph was used. This instrument, basically similar to the one-channel apparatus, was obtained from Mr. Albert M. Grass of Boston. These matched amplifiers and recording systems show an essentially flat frequency-response of from 1 to 48 cycles per second for a sinusoidal signal. The over-all discharge time of these amplifier systems, for a D.C. pulse, is approximately 0.3 of a second. The time-axis was maintained at 30 mm per second by a synchronous motor. In all experiments, the recorders were electrically over-damped, so as to reduce the high-frequency oscillations of extra-cortical origin. This over-damping is evident from the character of the pulse-calibrating signal. Records taken with the one-channel and with the three-channel instrument do not differ in any essential detail.

Each test was performed with the subject resting on a couch placed inside a copper-screened enclosure. Electrodes consisted of flattened solder pellets measuring approximately 4 mm in diameter. The electrodes were placed on the scalp along symmetrical parasagittal lines. Both bi-polar and uni-polar recordings were made. The different methods of derivation gave rise to essentially similar findings.

In 3 of the experiments, continuous records were made while sodium amytal was slowly injected. In the other 33 experiments, electrographic recording was discontinued during the actual time of

* This work is in part aided by the Supreme Council, 33° Scottish Rite, Masons of the Northern Jurisdiction, U. S. A.

1 Cohn, R., and Katzenelbogen, S., *U. S. Naval Med. Bull.*, 1939, **37**, 596.

injection. The average dose of sodium amytal was 0.3 g; the extremes were 0.1 and 0.5 g.

Results. The preinjection, or control, wave-patterns ranged from a dominant, well-modulated, 8-12 wave per second type, to a pattern distinguished by random-frequency, low-amplitude oscillations. Irrespective of the type of presodium amytal record, the electrophysiologic response to the intravenous drug was grossly similar in 32 of the 36 records. The characteristic change in the wave-pattern evoked by sodium amytal is the appearance of sequences of higher-frequency waves, whose duration ranges from 40 to 50 milli-seconds (20-25 waves per second). In Fig. 1 the dominant alpha-pattern in

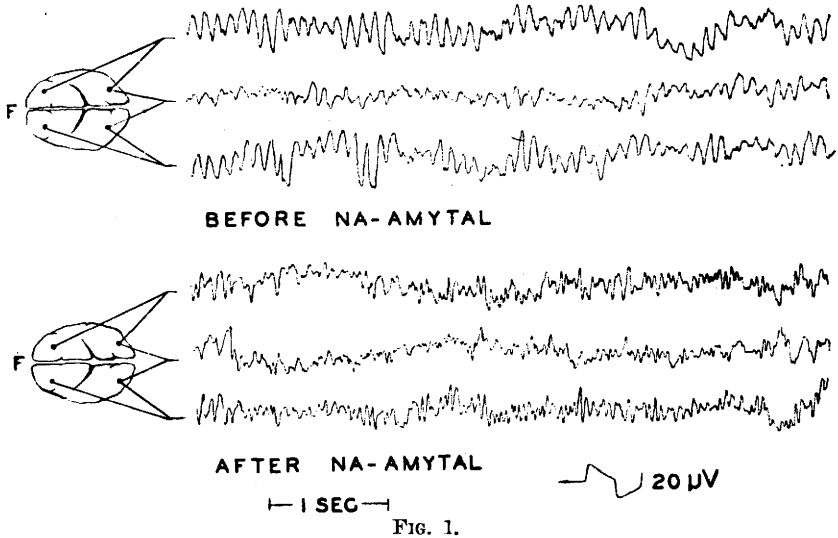

FIG. 1.

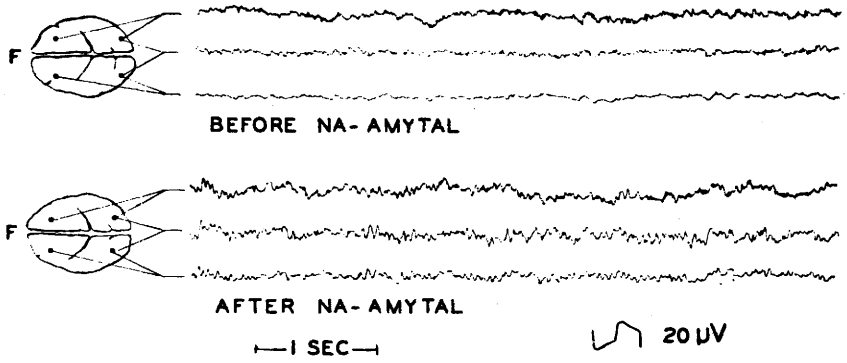

FIG. 2.

the simultaneous leads is almost completely replaced by the characteristic higher frequency pattern.

Fig. 2 shows the development of a rhythmic wave-pattern, following the intravenous injection of sodium amytal, in a previously low-voltage, random type of electroencephalogram. In this illustration, despite the lower amplitude as compared to the first figure, the frequency band is again closely regulated between 20 and 25 waves per second.

In the continuous records, that is, those made while actually administering sodium amytal, it was observed that short but definite sequences of approximately 20-wave-per-second discharges occurred within two minutes after the end of the injection. In all the records showing the characteristic sodium amytal response the maximum of the 20-wave-per-second activity occurred from 5 to 15 minutes after the drug was introduced. The wave-pattern returned to its "control" type in from 30 minutes to one hour. This recovery time appears to be a function of two main variables: the dosage, and the susceptibility of the individual to the drug.

In no instance did the slow intravenous administration of sodium amytal give rise to a more prominent alpha-pattern. However, in a few experiments the 20-wave-per-second pattern disappeared, or became inconspicuous, upon the appearance of the low-frequency pattern associated with sleep.

Discussion. A characteristic change in the electroencephalogram has been observed in 32 of 36 records after the intravenous administration of sodium amytal. This characteristic change is recognized by the appearance of a rhythmic wave-pattern whose frequency closely approximates 20 waves per second. This relatively high frequency pattern manifests itself irrespective of the type of the "spontaneous" electroencephalogram.

Several workers,[2-5] studying the effect of various barbiturate derivatives on the corticogram of animals, observed the appearance of higher frequency wave-forms in stages of light anesthesia. The frequencies noted by these workers ranged from around 15 to 30 waves per second. On the other hand, high frequency waves have not been reported in the brain potential patterns of human beings sub-

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jected to intravenous sodium barbiturates.[6-9] In fact, it is stated or implied that there is really an enhancement of the basic alpha pattern following the use of sedatives. This phenomenon, as previously noted, has not been observed in our experiments.

The characteristic wave pattern of approximately 20 waves per second which results from the intravenous injection of sodium amytal is apparently not specific for the barbiturate derivatives. Similar rhythmic, high frequency, electric activity has been observed in certain phases of cyclopropane anesthesia,[10] and in early sleep.[11, 12]

Conclusion. There is a definite and characteristic change in the human electroencephalogram following the slow intravenous administration of sodium amytal. The change is marked by the early appearance of a rhythmic oscillation, with a frequency of approximately 20 waves per second, in place of the individual's "spontaneous", or control, pattern. This action is not specific for the barbiturate derivatives. It is a general concomitant of early "depressed" cortical activity.

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Cine-Photomicrographic Apparatus With Constant Temperature Chamber for Tissue Culture Studies.*

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Sano and Smith[1] reported a simplified technic for tissue culture,

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* Aided by a grant from the Clinical Research Foundation of Philadelphia.

We are indebted to Dr. Lawrence W. Smith and Dr. George C. Henny for their valuable suggestions and help.

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