Desynchronized Electroencephalogram in the Deeply Sleeping Cat

Abstract. Electroencephalographic patterns of the different stages of sleep in the cat are shown, with special reference to a desynchronized deep sleep. This sleep stage is characterized by an increase in reticular stimulation arousal threshold and by the reappearance of 5 to 6 spikes per second on the electroencephalogram immediately after threshold behavioral arousal.

After Dement and Kleitman (*1*) first described a low-voltage, fast electroencephalographic sleep cycle in humans, the same type of activity was described in cats by Dement (*2*) and later by Jouvet *et al.* (*3*). We have duplicated this desynchronized sleep electroencephalogram in five of our cats that have been implanted with bipolar electrodes in various deep and surface structures of the brain. These animals have been trained to go to sleep in a sound-proofed room. Behavioral and electroencephalographic arousal thresholds in response to stimulation of the reticular formation are then recorded.

The cats exhibited the normal behavioral and electroencephalographic patterns associated with going to sleep, and after 60 or more minutes of complete isolation they drifted into a very high frequency (40 to 50 per second), low amplitude, desynchronized activity (Fig. 1*B*). As described by Jouvet *et al.* (*3*), the animals were completely relaxed and deeply asleep. Especially noticeable are the occasional convulsive limb twitches. One of the cats slept with the eyes partially open during this phase. She showed marked nystagmic movements of the eyeball under relaxed nictitating membranes.

Although Dement (*4*) states that he cannot detect changes in arousal threshold between the fast- or slow-wave sleep stages, we have found increases in the reticular formation behavioral arousal thresholds of from 1 to 2.5 volts in all of our cats (Fig. 1). This finding confirms Jouvet's report (*3*) of increased auditory and reticular arousal thresholds during this sleep period.

One aspect of this desynchronized sleep stage not yet reported is shown in Fig. 1*C*. Recticular stimulation that was just enough to produce a minimal behavioral arousal (eyes open, head moves briefly) produced an almost immediate 5 to 6 per second activity which drifted into a slow-wave sleep activity and then once again into the 40 to 50 per second deep-sleep pattern.

Since the above-mentioned arousal threshold is higher than that of the slow-wave sleep, and since even minimal behavioral arousal from slow-wave sleep produces a considerable length of aroused electroencephalographic activity (instead of the 5 to 6 per second activity we find in the arousal from fast-wave sleep), we feel that the desynchronized sleep pattern is definitely indicative of a deeper sleep stage than the conventionally described deep sleep during a synchronized electroencephalogram.

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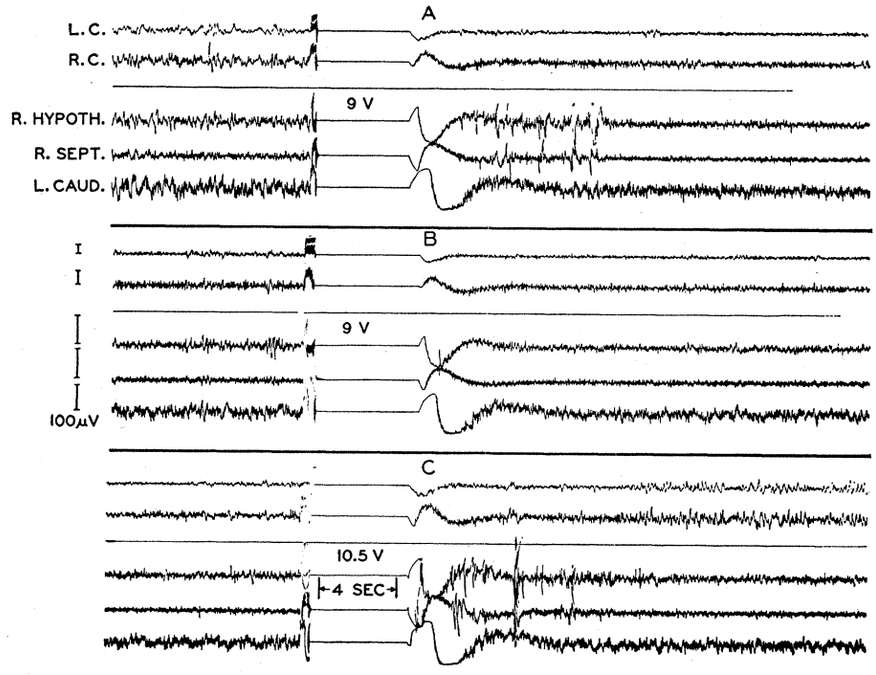

Fig. 1. *A*, Behavioral and electroencephalographic arousal with 9.0 volts at synchronized sleep stage. Notice movement artifact after stimulation. *B*, No behavioral arousal with 9.0 volts at desynchronized sleep stage. *C*, Behavioral and electroencephalographic arousal with 10.5 volts at desynchronized sleep stage. Recording pens off during stimulation (5 sec, 100 cy/sec, 0.1 msec).

References and Notes

1. W. Dement and N. Kleitman, *Electroencephalog. and Clin. Neurophysiol.* **9**, 673 (1957).
2. W. Dement, *ibid.* **10**, 291 (1958).
3. M. Jouvet, F. Michel, J. Courjon, *Compt. rend. soc. biol.* **153**, 1024 (1959).
4. W. Dement, *Science* **132**, 1422 (1960).

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An Unfortunate Event

We have had our attention drawn to several discrepancies in a paper by Pande *et al.* (*1*) which was recently published in *Science* under the title "Toxoplasma from the eggs of the domestic fowl (*Gallus gallus*)."

The discrepancies concern the figures used to illustrate the paper. Figures 1 and 2 represent the same object, although they are described as picturing different forms of *Toxoplasma gondii* from different sources. A point-by-point comparison of the two figures shows beyond doubt that Fig. 1 is merely an enlargement of a part of Fig. 2 and that it is tilted at a slight angle.

The relevant part of the caption for Fig. 1 reads: "Cyst stages of *Toxoplasma gondii* in the impression smear of chorioallantoic membrane"; that for Fig. 2 reads: "Pseudocyst of *Toxoplasma* in the ovary of white Leghorn hen." In addition, the "ghosts" of red blood cells in the background of these figures, professedly of avian origin, appear nonnucleated, and therefore mammalian.

Figure 3 in the same paper, which purports to be an original photograph, is a slightly enlarged copy of Fig. 1 in an earlier paper by Frenkel (*2*), which was entitled, "Pathogenesis of toxoplasmosis and of infections with organisms resembling *Toxoplasma*." Frenkel's caption to his Fig. 1 reads: "*Toxoplasma*, fresh preparation from peritoneal exudate of mouse, showing organism