grows in amplitude from the 10th to the 18th min of dark adaptation. Therefore, the time course of the increase of the VER in the dark is similar to that of scotopic vision.

Zusammenfassung. Eine visuell evozierte Antwort kann durch Stimulation der zentralen retinalen Anteile mit skotopischen Reizen nach Dunkeladaptation aufgenommen werden. Die spektrale Empfindlichkeit wurde für eine konstante Antwort (Latenz = 210 msec) gemessen und stimmt mit der dunkeladaptierten Empfindlichkeit des menschlichen Auges in der spektralen Verteilung überein. Der zeitliche Verlauf der Amplitudenzunahme des VERs während der Dunkeladaptation ist der sensorischen Empfindlichkeit ähnlich. Das VER ist eine Antwort der zentralen retinalen Anteile, kann aber neben photopischen auch Eigenschaften des skotopischen Systems aufweisen.

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Sleep in the Giant South American Armadillo *Priodontes giganteus* (Edentata, Mammalia)

Knowledge of the biological role of sleep remains obscure despite intensive research. Very few of the existing hypothesis about it have been derived on the basis of evolutionary deduction. One of the reasons of this situation is that existing knowledge is still very scarce in spite of the considerable number of reports from different species of mammals. We think that any new report on the characteristics of the sleep patterns of mammals has special importance, because often the most crucial clues about the survival value of a function come from data about in which species it is present. We also think that the possibility of finding variations in the above-mentioned patterns must always be kept in mind. These eventual variations could lead to new discoveries. This report makes a contribution to the comparative physiology of sleep, with a lower eutherian mammal, the giant South American armadillo *Priodontes giganteus*. This is the world's largest surviving species of armadillo. It is hardly captured because of its rarity. The danger of extinction is not negligible. The last two facts, together with the philogenetic position of the order Edentata, increases the intrinsic interest of the study of its sleep characteristics. The observations were made in the only two specimens that we could obtain after long searchings.

Method. The animals weighed 46 and 50 kg, respectively. They were chronically implanted with bipolar electrodes, fixed on the surface of the armour that covers the cranium. The EKG was taken by means of 2 silver discs also chronically implanted over the chest. The EMG of the muscles of the neck and of the flexor digitorum of the hind limb was studied by means of bipolar concentric electrodes deeply inserted into the muscles.

The animals were placed in a Faraday cage, and left free and unanesthetized. They were studied at 2 different environmental temperatures: below 28 °C (between 23° and 28 °C) and above 28 °C (between 28° and 33 °C). The experimental animals were left at least 30 min exposed to those temperatures, before the beginning of the electrical recordings. The temperature of 28 °C was critical in relation to the appearance of tremor during the phase of slow sleep. The observation of the animal's behaviour was prolonged over a period of 96 h, in order to find its bioelectrical correlates.

Results. The electrical activity recorded from neocortex showed the following features: A) during wakefulness. The EEG showed low voltage, fast and irregular activity (Figure 1, A). The EMG of the neck muscles revealed varying degrees of activity with the movements of the neck. The EMG of the flexor muscles of the hind limb always showed powerful bursts with walking move-

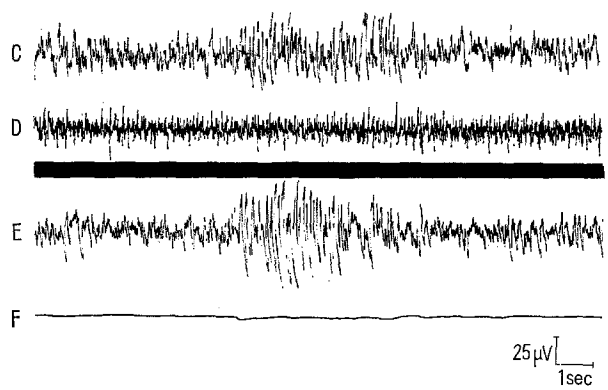

Fig. 2. Slow sleep. C) EEG below 28 °C. D) EMG of limb muscles below 28 °C. E) EEG above 28 °C. F) EMG of limb muscles.

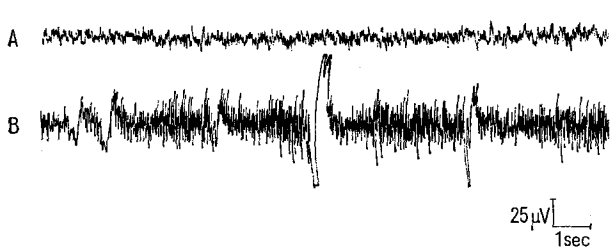

Fig. 1. Wakefulness. A) Neocortex. B) EMG of limb muscles.

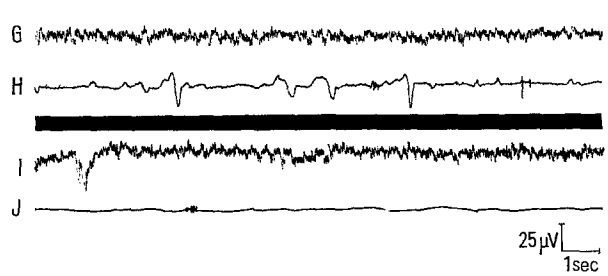

Fig. 3. R.E.M. sleep. G) EEG below 28 °C. H) EMG of limb muscles below 28 °C. I) EEG above 28 °C. J) EMG of limb muscles below 28 °C.

ments and finger flexion (Figure 1, B). The heart beat, evidenced by the EKG, was regular and with a frequency ot 42/sec.

B) During slow sleep. The EEG showed slow waves and spindles similar to those described in other mammals (Figure 2, C and E). The EMG activity of the posterior limb muscles varied greatly according to the environmental temperature. When it was below 28 °C, an intensive tremor of many muscles of the body was observed. This tremor was particularly noticeable in the limbs. This was the reason why, at temperature below 28 °C, a high degree of EMG activity of the flexor muscles was seen (Figure 2, D). When the environmental temperature was above 28 °C, the tremor disappeared completely and there was complete absence of EMG activity, in the flexor digitorum (Figure 2, F). The EMG activity of the neck muscles did not show significant variations in relation to the temperature.

C) During REM sleep. The EEG showed an activity very similar to that observed during wakefulness (Figure 3, G). The EMG of the flexor digitorum did not show different patterns, in relation to the environmental temperature. Both above and below 28 °C, there was complete absence of EMG activity (Figure 3, H and J). The EMG activity of the neck muscles was similar to that of slow sleep. No tremor was observed during this phase. Only the classic muscular twitches already described in mammals were seen.

Discussion. From the above mentioned results, we can conclude that the EMG activity of the flexor muscles of the hind limbs is extremely useful, below 28 °C, for the diagnosis or REM sleep, since the disappearance of the EMG activity is an unequivocal sign. The EMG activity or the neck muscles is obviously not useful. It is very probable that the exploration of other muscular groups will also reveal equally useful signs. All the above results, including the critical temperature of 28 °C for the disappearance of the tremor, are comparable to those found by AFFANNI et al.[1] in the small edentate *Chaetophractus villosus*.

Résumé. Les auteurs mettent en évidence l'existence d'un sommeil R.E.M chez le *Priodontes giganteus*, le plus grand Tatou actuellement vivant. A une température ambiante inférieure à 28 °C, on observe un tremblement intense au cours du sommeil lent, qui disparaît complètement lors du sommeil R.E.M.

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[1] J. M. AFFANNI, L. GARCIA SAMARTINO and E. MORITA, Revta Soc. argent. Biol. *44*, 189 (1968).

Induction of Ingestive Responses by cAMP Applied into the Rat Hypothalamus

It is very likely adenosine-3′, 5′monophosphate (cAMP) is an important factor in nervous system function[1]. Recently it has been reported that dibutyryl-cAMP (Db-cAMP) injected at high doses into some cerebral areas of several animal species[2,3] may induce overt behavioral effects. In acute experiments[2] Db-cAMP produced on rats motor hyperactivity, catatony and convulsions, whilst in chronic experiments[3] hyperphagia, hyperthermia and prolongation of the oestral cycle.

This note reports the results obtained with stereotaxic microapplications of Db-cAMP into some areas of rat diencephalon, where Acetylcholine and Nor-epinephrine are known to modify feeding behaviour[4–9].

Materials and methods. A double-cannula was implanted stereotactically into the brain of 23 male Wistar rats (230–260 g of body weight) by the method described by GROSSMAN[8]. The sites implanted (Figure 1) were the lateral hypothalamic area (LHA), the ventromedial hypothalamus (VMH) and the reticular formation (RF), following the stereotaxic coordinates of DE GROOT's atlas[10].

After implantation, the rats were housed individually in a temperature, humidity and lighting controlled room, and had food and water ad libitum. One week later, when the rats had regained their preoperative weight, the inner cannula was removed, washed in ethanol, dried and replaced without any substance added into it. The rats were then returned to their cages and after 1 h (control period) the amounts of food and water consumed were measured.

This procedure was repeated about 1 h later. However, at this time, the cannula was replaced after tapping into the tip 5–10 µg of one of the following substances: Db-cAMP, cAMP, Adenosine-5′-monophosphate (AMP), Adenosine triphosphate (ATP), Carbamoycholine (Carb), N-isopropyl-nor-epinephrine (NIE), Na-butyrate and NaCl[11]. Food and water consumed during the next 1 h (test period) were again measured.

The above procedure was repeated on 5 consecutive days and followed by 2 days rest until the end of the experiments. In order to check the cannulae placement (Figure 1) all rats were killed and their brain perfused and fixed in 10% formalin solution. After freezing, 25 µm sections were cut and stained with Luxol blue and Cresyl violet[12].

Results. Stereotactical application of Db-cAMP into diencephalon of satiated rats significantly increased

[1] P. GREENGARD and E. COSTA, *Advances in Biochemistry and Psychopharmacology* (Raven Press, New York 1970), vol. 3.
[2] G. L. GESSA, G. KRISHNA, J. FORN, A. TAGLIAMONTE and B. B. BRODIE, Adv. Biochem. Psychopharmac. *3*, 371 (1970).
[3] B. MCL. BRECKENRIDGE and R. D. LISK, Proc. Soc. exp. Biol. Med. *131*, 934 (1969).
[5] S. P. GROSSMAN, Science *132*, 301 (1960).
[4] A. E. FISHER and J. N. COURY, Science *138*, 691 (1962).
[6] N. E. MILLER, K. S. GOTTESMAN and N. EMERY, Am. J. Physiol. *206*, 1384 (1964).
[7] J. N. COURY, Science *156*, 1763 (1967).
[8] S. P. GROSSMAN, Am. J. Physiol. *202*, 872 (1962).
[9] B. G. HOEBEL, A. Rev. Physiol. *33*, 533 (1971).
[10] J. DE GROOT, *The Rat Forebrain in Stereotaxic Coordinates* (N. V. Noord-Hollandsche Uitgevers Maatschappij, Amsterdam 1963).
[11] Db-cAMP was supplied by Maggioni S.p.A. (Milan, Italy) and Boehringer (Mannheim. Germany); cAMP, ATP, AMP by Boehringer (Mannheim, Germany); Na-butyrate by B. D. H. (Poole, England); Carb, NaCl by Merck (Darmstadt, Germany) and NIE by Mann Res. Lab. (New York, USA).
[12] H. KLÜVER and E. BARRERA, J. Neuropath. exp. Neurol. *12*, 400 (1953).