Summary. Pyridoxine deficiency was induced in rats by feeding a diet deficient in pyridoxine. Control rats were pair-fed to the intake of the experimental group. Pyridoxine deficiency was demonstrated in the experimental group by increased xanthurenic acid excretion following a tryptophane load and by development of hypertension. Renal concentrating ability, measured as maximum urinary osmolality following dehydration and vasopressin administration, was impaired in both pyridoxine deficient and control rats. Since both groups were protein depleted as a result of the pair-feeding, urea was given to both groups and renal concentrating ability remeasured. The control group now had normal concentrating ability, whereas the maximum urinary osmolality of the pyridoxine deficient rats was significantly reduced. These results suggest that pyridoxine or some aspect of its metabolism is essential for normal renal concentrating ability.

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Received March 22, 1965. P.S.E.B.M., 1965, v120.

Effects of Temperature on Electroencephalogram of the Caiman.* (30553)

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In a previous study made in this laboratory(1) the normal electroencephalographic pattern of the South American caiman, *Caiman sclerops,* for the cerebral hemispheres, optic lobes, and cerebellum was described. The cerebellar hemispheres showed a dominant "beta" rhythm of 18-24 cycles per second with an amplitude of 10-20 μv; superimposed there was an intermittent alpha-like rhythm of 7-12 cycles per second with an amplitude of 20-40 μv. In the optic lobe region the dominant rhythm was 6-8 cycles per second with an amplitude of 20-25 μv and superimposed was a faster 14-18 rhythm

* This study was supported by Public Health Service Research Grant HE 06244.04.

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with a low voltage, 5-10 μv. For the cerebellum the dominant frequency was 6-8 cycles per second with an amplitude of 4-7 μv and superimposed on this slow rhythm was a faster, 14-20 cycle wave of very low amplitude (less than 4 μv). A second group of recordings was made with animals fastened to plastic frames. Restraining animals had very little effect on their electroencephalographic pattern, the only consistent findings being a slight diminution of the amplitude of both slow and fast waves from the cerebral cortex and a little reduction in the faster frequency wave from the cerebellum.

It was thought that a study of temperature influences on the electroencephalogram of a poikilothermic animal might shed light on the activity of the central nervous system under environmental stresses. There was also the common observation which most people handling crocodilians have made, namely, that when these animals are placed on their backs and held quietly for a few moments, they relax and appear to go into a trance-like state. They may remain in this position without restraint for periods of several minutes before recovering and attempting to right themselves. It was believed that this peculiar state might well be reflected in the electroencephalograms of the animals so "entranced."

Materials and methods. Chronic electrode implants were made in 8 caiman, 3 males and 5 females, as described previously(1). One pair of electrodes, #1 and #2, was in contact with the left and right cerebral hemispheres respectively; one pair, #3 and #4, was in contact with left and right optic lobes; and one pair, #5 and #6, was in contact with the cerebellum. Placements were verified by serial sections. Simultaneous recordings were made from various electrode combinations, and both monopolar and bipolar techniques were used. After obtaining control recordings at 22°-25°C under unrestrained and restrained conditions, the animals were subjected on 3 successive days to the following procedures. On the first day the animal was placed in a bed of crushed ice which lowered the cloacal temperature to levels of 2-5°C (30-40 minutes) and recordings were made during the succeeding 15-20 minutes. Twenty-four hours following hypothermia the animal was again restrained and placed in a warming blanket. The body temperature was increased to 34-36°C (40-75 minutes) at which time recordings were made. On the third day animals were placed on their backs in a miniature Stryker frame; after a few minutes of gentle holding no restraint was required to keep them motionless throughout the recording period. The temperature was again 22-25°C. Twenty-four hours after the last experiment a post-experimental control study was made to ascertain whether or not there were permanent electroencephalographic changes which might be attributed to the effects of changes in body temperature. Detailed analyses were made on 2 five-second intervals out of every minute of recording made.

Results and discussion. The overall results of the monopolar recordings are incorporated in Table I. The bipolar recordings did not yield any additional data not shown by the monopolar tracings. Frequencies have been grouped according to standards usually assigned to higher animals. Under hypothermia the spontaneous electrical activity is markedly diminished, and particularly notable is the complete absence of alpha-like activity in any region or from any electrode combination (Fig. 1). In some individual animals no activity was recorded. Recorded from the cerebrum was a fast or "beta" component of lower amplitude than that of the control period (Table I, A) and in addition, a dominant slow or "theta" wave of low amplitude was seen for the first time. In recordings from

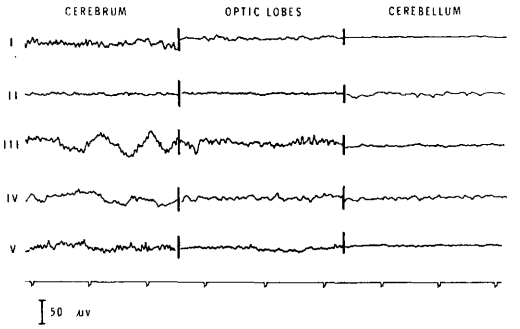

FIG. 1. I. Control conditions; II. Hypothermia 2-4°C; III. Hyperthermia 34-36°C; IV. Supine, trance-like state; V. Post-experimental control.

TABLE I. Analysis of Electroencephalographs of Caiman Under Environmental Stress.

Condition	No. of animals	Electrode No.	Dominant frequency	"Beta" frequency, c/sec	Amplitude, μv	Alpha-like frequency, c/sec	Amplitude, μv	"Theta" frequency, c/sec	Amplitude, μv	"Delta" frequency, c/sec	Amplitude, μv
A. Monopolar recordings from cerebral cortex											
Control (22°–25°C)	8	1 & 2	Mixed	18–24	10 –20	7–12	20–40	—	—	—	—
Hypothermia (2°–5°C)	8	"	"Theta"	15–20	2.5– 5	—	—	5–7	5–15	—	—
Hyperthermia (34°–36°C)	8	"	"Delta"	23–30	5 –10	—	—	5–7	5–15	1 –3	50–75
Supine position	7	"	"	19–27	5 –15	—	—	5–7	15–25	.5–1	50–75
Post experimental control	7	"	Mixed	19–25	10 –20	9–14	20–40	6–8	10–20	—	—
B. Monopolar recordings from optic lobes											
Control (22°–25°C)	8	5 & 6	"Theta"	14–26	4	—	—	6–8	4– 7	—	—
Hypothermia (2°–5°C)	8	"	"	13–20	5	—	—	6–7	5–15	—	—
Hyperthermia (34°–36°C)	8	"	"	18–27	5–10	—	—	5–8	10–15	—	—
Supine position	7	"	"	—	—	—	—	5–7	5–10	—	—
Post experimental control	7	"	"	14–20	5	—	—	5–6	5– 8	—	—
C. Monopolar recordings from cerebellar cortex											
Control (22°–25°C)	8	3 & 4	"Theta"	—	—	14–18	5–10	6–8	20–25	—	—
Hypothermia (2°–5°C)	8	"	"	18–22	10–15	—	—	3–7	5–10	—	—
Hyperthermia (34°–36°C)	8	"	"	18–22	5–10	9–14	10–15	5–8	15–20	—	—
Supine position	7	"	"	14–20	5–10	—	—	5–6	10–20	—	—
Post experimental control	7	"	"	15–21	5– 8	—	—	5–7	10–20	—	—

the optic lobes (Table I, B) under hypothermia a "theta" wave seemed dominant, but there was also a "beta" wave of fairly high amplitude. The cerebellar recordings made under hypothermic conditions actually show more activity than do those made at room temperature, particularly an increased amplitude of the slow waves (Table I, C). This is reminiscent of the finding by Hunsaker and Lansing(2) of a dominant 5 cycle rhythm in lizards during hypothermia. Among homothermic animals electroencephalograms show great depression down to the isoelectric point at 18-20°C(3).

The recordings made while the animals were hyperthermic (Fig. 1) had a great deal of activity with a decided dominant, high amplitude, ultra slow wave from the cerebral area and with some increase in frequency of the "beta" wave above control level. There was also a considerably increased amplitude of both fast and slow waves from the cerebellum. The presence of alpha-like rhythm in records made from the optic lobes was again present. The ultra slow waves are similar to those found by Feitelberg and Pick(4) for frogs placed in hot water baths at temperatures of 38-40°C. It was also the experience of Hunsaker and Lansing(2) that lizards subjected to high environmental temperatures showed a very fast frequency and, although it is not mentioned specifically in their publication, sections of their record indicate a dominant slow wave of 2-3 cycles per second. In chick embryos, which of course are still poikilothermic, there are slow waves of 1-2 cycles per second plus a well-defined fast frequency(5). Several studies have been made using homothermal animals, but it is difficult to make significant comparisons between these studies and those made on the caiman, especially when one considers that at the normal body temperature of most homotherms (37°C) the caiman may show irreversible brain damage.

The trance-like state seen in the supine alligator could be interpreted possibly as similar to the "possum-playing" seen in some snakes or other frightened animals, or it might equally well be quite a different mechanism. Norton, Beran, and Misrahy(6) presented data to indicate that an opossum was indeed fully conscious and alert while "playing possum." The caiman in the trance-like state, however, showed markedly altered form in electroencephalographic recordings which resemble the picture seen in drowsiness in higher animals, including rhythmic ultra slow activity (Fig. 1) and loss of alpha-like activity in the cerebral area. The ultra slow or "delta" wave, 0.5-1 cycles per second, has both "theta" and "beta" activity superimposed. Activity in the optic lobe area is not particularly accentuated but is as great as that seen under control conditions. Activity of the cerebellum recorded by monopolar leads is greater than that seen under any other conditions, but when recorded with bipolar leads to the two sides is completely blocked out.

The post-experimental unrestrained animals yielded recordings which were essentially like their control records (Fig. 1) except that the alpha-like frequency was not recorded from the optic lobes. One animal whose body temperature under hyperthermia exceeded 36°C began to show unusual electroencephalographic activity during that experimental period, and showed such bizarre recordings subsequently that it was eliminated from consideration in both the "trance-like" and the post-experimental control data. This animal died within 2 hours after the last recordings were made. The peculiarities of the recordings and death were interpreted as being the result of irreversible heat damage to the brain. That this is a reasonable interpretation is suggested by data from Fromm, Mascia, and Wu(7) who have shown that the body fat of the caiman has a melting point of 36-37°C.

Summary. Cerebrum. An independent fast frequency of 18-24 cycles per second with an amplitude of 10-20 μv was observed intermittently. Restraint in these animals appears to have little effect on the frequency. Hypothermia, 5°C (3-6°C) reduced the spontaneous electrical activity close to the isoelectric base line in most animals tested. Hyperthermia, 35°C (32-36°C) was characterized by a "delta" wave of 1-3 cycles per second. A "beta" frequency appeared to be superim-

posed. The trance-like state also revealed a dominant delta frequency of 0.5-2 cycles per second. A "beta" wave with an amplitude of 5-10 μv was seen superimposed on the slow wave ("theta"). The alpha-like wave appeared to be essentially absent under conditions of hypothermia, hyperthermia, and supine (trance-like state) position. *Optic lobes.* Electroencephalographs from the optic lobes demonstrated a predominant slow wave of 6-8 cycles per second with an amplitude of 5-10 μv. This frequency and amplitude was markedly depressed under hypothermia. The electrical activity appeared to double in amplitude under hyperthermia. While the animal was in a trance-like state, a well-defined slow wave of 5-6 cycles per second was seen as the most significant change recorded from this area of the brain. *Cerebellum.* Electrical activity as recorded from the cerebellum was most pronounced under hypothermia and in the supine trance-like state; in both states a well-defined "theta" wave of 4-6 cycles per second with an amplitude of 10-15 μv was seen.

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Received June 1, 1965. P.S.E.B.M., 1965, v120.

Transfusion Experiments and Survival Studies in Parabiosis Intoxication.* (30554)

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When F_1 hybrid mice are placed in parabiotic union with mice of one of their parental strains, a lethal wasting syndrome, known as parabiosis intoxication frequently develops in the hybrid partner. This syndrome is characterized by anemia, weight loss, hunched posture, ruffled fur, and early death(1).

There has been some debate concerning the etiology of parabiosis intoxication. Some investigators maintain that a graft-*vs*-host reaction, elicited by passage of parental strain lymphoid cells into the hybrid partner is primarily responsible(2-4). Evidence for this is the clinical similarity of parabiosis intoxication and homologous disease, the fact that both conditions usually occur when the strains involved differ at H-2 histocompatibility locus, and the presence of lymphoid depletion in both(2,5). Hall and Hall expressed the opinion that the anemia, which is due primarily to shunting of blood to the parental strain partner(1), is a sufficient cause of the intoxication syndrome(6). Another line of evidence suggesting that intoxication is not etiologically related to homologous disease is the finding of Eichwald *et al* that intoxicated hybrid parabionts will recover if they are separated from their parental strain partners(7). All attempts to reverse runt disease or homologous disease have been unsuccessful so far when reversal was attempted more than 24 hours after the initiation of the process (8). Additional evidence that anemia is the principal cause of clinical intoxication and death was reported by Hilgard *et al*(1). When parental strain mice, preimmunized against one of their F_1 hybrid strains, were placed in parabiotic union with these hybrid mice, the anemia in the hybrid partners was more severe than in a control group in which the parental strain partners had not been preimmunized. Clinical intoxication also ap-

* Aided by grants from U.S.P.H.S.