factors. The report by Dill and Zamcheck (5) give quantitative experimental evidence of the effects of adding carbon dioxide to inspired air deficient in oxygen at sea level. These authors concluded that the addition of carbon dioxide to inspired renders a low partial pressure more tolerable by increasing arterial saturation. The results presented herewith are in agreement with these authors. They also show the rapidity of the response to hypoxia and hypercapnia, and something about the interaction of these two factors. These results would seem to indicate that the potency of the hypoxic stimulus is not fully manifested when man breathes ambient air at altitude. In Fig. 1, curve A shows the ventilatory response to breathing ambient air which involves both hypoxic and hypocapnic stimuli. Curve B, shows the ventilatory response to hypercapnia at the same altitude but with adequate oxygen for full saturation of blood. Curve C, shows the additive effect of hypoxia and hypercapnia. It would seem that the difference in the ventilatory response shown in curves B and C must be due to the hypoxic stimulus since the concentration of carbon dioxide in inspired air is the same. Of course the p CO_2 of alveolar air will be slightly lower in C due to the increase in ventilation and the p O_2 will be slightly higher. Thus these two interacting factors appear additive in their effects.

Summary. When man breathes ambient air at high altitudes an hypoxic stimulus causes a rapid increase in pulmonary ventilation. The full effect of this hypoxic stimulus is counteracted, however, by concomitant hypocapnia. With the addition of carbon dioxide to inspired air a more effective response to the hypoxic stimulus is manifested. It is concluded that hypoxia and hypercapnia are separate stimulating factors and additive in their effects and that regulation of respiration at altitude depends upon the manner of their interaction.

5. Dill, D. B., and Zamcheck, N., *Am. J. Physiol.*, 1940, v129, 47.

Received October 25, 1951. P.S.E.B.M., 1951, v78.

Effect of Electroconvulsive Shock on Body Temperature of the Rat. (19147)

RUTH HOYT AND H. ENGER ROSVOLD.* (Introduced by Donald McEachern.)
From the Department of Psychology, McGill University.

Rosvold(1,2) suggested that elevation in body temperature may have contributed to the disruptive effect of electroconvulsive shock on nest building behavior in rats. The present study was designed to demonstrate the effect of electrically induced convulsions on the temperature of the rat.

Subjects and method. Twenty male hooded rats 150-180 days of age were divided evenly into a control and an experimental group. They were placed 2 to a cage size 8" x 9" x 11" in which fox chow and water were available at all times, and were housed in a room in which the temperature was maintained between 70-80°F. A convulsion was induced in the experimental animals at 9 a.m. daily during the shock periods by administering a 50 milliampere current for 0.2 second through clip electrodes attached to the ears. The electrodes were fastened to the ears of the control animals, but no current was delivered. By inserting a thermometer eight and one-half centimeters into the rectum of the restrained rat for 2 minutes, temperatures were taken on 2 different animals from each group at 9 a.m., 12 n., 3 p.m., 6 p.m., and 9 p.m. The temperature of any particular animal was taken at a different time on successive days, no animal being examined at the same time in a 5-day period. The following schedule was followed:

* Now at the Yale University School of Medicine, Department of Physiology.

1. Rosvold, H. E., *J. comp. and physiol. Psychol.*, 1949, v42, 118.

2. Rosvold, H. E., *J. comp. and physiol. Psychol.*, 1949, v42, 207.

1. 5 days of no shock for either group to establish a base line.
2. 10 days during which the convulsed group received daily shocks.
3. 10-day recovery period. No shocks.
4. 10-day period of daily shocks.
5. 10-day recovery period. No shocks.

Results. Fig. 1 shows the mean temperature at the specified hours for the shocked and for the non-shocked animals during the shock and no-shock periods. The difference between the means of the temperatures of the shocked animals and the control animals during the shock periods at 12 noon, 3 p.m., and 6 p.m., is significant at the .01 level of probability; at 9 a.m., the .05 level; and at 9 p.m., the .75 level. The difference between the means of the temperatures of the shocked animals in the shock and no-shock periods at 3 p.m. and 6 p.m. is significant at the .01 level of probability; at other times at less than the .05 level.

The differences in the mean temperature of the shocked and non-shocked animals are reliable only at those times during the day when rats are normally inactive. Instead of dropping, the temperature of the convulsed rats remains at the high level of the active period suggesting that the electroshock results in decreased variability in temperature. That this is indeed the case is apparent from a comparison of the variances of the mean temperatures of the shocked and control animals during the shock periods. The F ratio for this comparison is 14.9, which is significant at the .02 level of probability indicating the variability of the mean temperature of the shocked rats to be significantly less than that of the non-shocked rats.

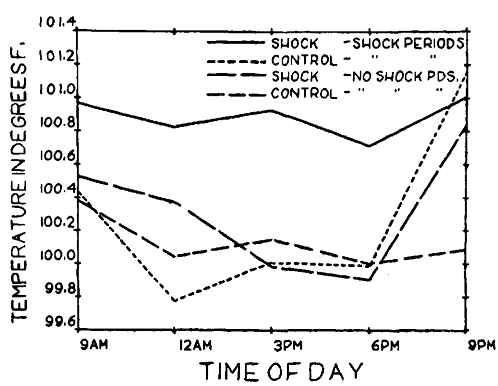

FIG. 1. Differences in mean temperature of shocked and non-shocked rats.

In order to rule out the possibility that increased activity in the shocked rats was maintaining the temperature at this high level, activity in revolving drums was measured in 5 hooded rats age 150-160 days of age. Readings were taken for 30 days at the same hours as temperatures were taken in the groups above. For 10 days no shock was administered, then for 10 days one shock was administered daily at 9 a.m., then for 10 days no shock was administered. During the shock periods there was a depression of activity significant at the .01 probability level as compared with the no-shock periods. These findings are substantiated by those found for the white rat by Winder and Stone(3). Since inactivity would tend to decrease temperatures, the elevated temperatures in the shocked rats cannot be attributed to changes in the activity cycle.

Conclusion. A series of electroconvulsive shocks results in decreased variability of the temperature of the rat. This decreased variability is probably not the result of increased activity, but is more likely attributable to a failure of a temperature regulation mechanism.

Discussion. Ranson(4) has shown temperature regulation, and Nauta(5), maintenance of activity, to be controlled in the hypothalamus. Since both these functions are disturbed by electroconvulsive shocks, it is reasonable to suppose that the electroshocks affect the hypothalamus.

Summary. The normal variation of rectal temperature in the hooded rat has been shown to be decreased during periods of electroconvulsive shocks. It is suggested that electroconvulsive shocks may affect the temperature regulation mechanism of the hypothalamus.

3. Winder, C. L., and Stone, C. P., PROC. SOC. EXP. BIOL. AND MED., 1946, v63, 19.

4. Ranson, S. W., *Res. Publ. Ass. nerv. ment. Dis.,* 1940, v20, 343.

5. Nauta, W. J. H., *J. Neurophysiol.,* 1946, v9, 285.

Received September 11, 1951. P.S.E.B.M., 1951, v78.