$$c_M \times k_I = c_Z \times k_E$$

oder

$$\frac{c_Z}{c_M} = \frac{k_I}{k_E}$$

Das Verhältnis k_I / k_E ist für Kalium 3 mal grösser als für Caesium. Das bedeutet, dass Caesium in der Zelle entsprechend *weniger* angereichert wird als Kalium.

Demnach ergeben unsere Versuche, dass Caesium zwar wie Kalium durch eine Ouabain-empfindliche Pumpe in den Zellen angereichert wird, jedoch ist seine Anreicherung geringer als diejenige von Kalium. Daher kann die am Gesamtorganismus gefundene, gegenüber dem Kalium bevorzugte Anreicherung des Caesiums nicht durch den Austausch zwischen Serum und Zelle erklärt werden. In weiteren Untersuchungen soll deshalb die Ausscheidung dieser beiden Kationen miteinander verglichen werden.

Summary. (1) In rabbit erythrocytes, the rate constant of the influx of potassium is 4.5 times higher than that of cesium ions. The efflux of potassium is 1.5 times higher. (2) The cesium transport into the cells is completely inhibited by 1.36×10^{-5} m ouabain, a concentration which also blocks the potassium transport. (3) It is calculated that cesium accumulates 3 times less than potassium within the red blood cells.

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The Response of Male and Female Rats with Hypothalamic Lesions to Low and High Environmental Temperatures[1,2]

The role of the hypothalamus in the regulation of body temperature has been known since the early work of ISENSCHMID and SCHNITZLER[3]. RANSON et al.[4–7] have elucidated the role of certain hypothalamic areas in the maintenance of body temperature under exposure to hot and cold environments. It is generally agreed that the anterior hypothalamus is associated with parasympathetic autonomic functions and that destruction here results in inability to regulate against heat – 'heat dissipating center'. The posterior hypothalamus is associated with sympathetic autonomic functions, and destruction here results in inability to regulate against cold – 'heat preservation center'. The response of animals with hypothalamic destruction to high and low environmental temperatures may depend also on the time interval between operation and test[4].

The animals reported here were used initially for a study concerning the effects of hypothalamic lesions in weanling rats on subsequent growth and maturity. The present note deals with the response of these hypothalamic-lesioned animals to low and high environmental temperatures at approximately 118 days of life. Both male and female weanling rats received bilateral electrolytic lesions at various loci within the hypothalamus at the age of 25 days with the use of a Horsley-Clarke stereotaxic instrument. Their response to heat and cold stress was tested roughly 93 days later. All animals were housed in individual cages in a room maintained at 24 °C with 12 h light and 12 h dark. A synthetic high carbohydrate diet which yielded 4.2 calories/g and water were available *ad libitum*. Rectal temperatures were recorded with a Tele-thermometer (Yellow Springs Instrument Company Inc.); in all cases the recording thermometer was inserted into the rectum for a distance of 5 cm.

(a) *The response of hypothalamic-lesioned and control rats to a cold environment.* On the 118th day of life the rectal temperatures of both male and female experimental and control rats were recorded and the animals placed in a room maintained at −10 °C. Temperatures were again recorded 1 h after the beginning of cold stress and 1 h after removal from the cold room. The results obtained are shown in the Table. There was little difference in the mean rectal temperatures between any of the experimental groups and the control group at 24 °C. However, male rats with lesions in the arcuate and mammillary regions did show slightly higher mean temperatures. Exposure of male rates to −10 °C for 1 h had little effect on rectal temperature, with the exception of

Location of lesions	No.	Rectal temperature Before cold exposure	After 1 h at − 10° C	1 h after cold exposure
Male controls	24	37.7 ± 0.12[a]	37.2 ± 0.21	37.7 ± 0.22
Ventromedial N.	4	38.1 ± 0.40	37.7 ± 0.47	38.2 ± 0.14
Premammillary N.	3	37.8 ± 0.17	37.5 ± 0.17	38.8 ± 0.17
Dorsomedial N.	—	—	—	—
Arcuate N.	10	38.4 ± 0.13	37.4 ± 0.26	38.3 ± 0.11
Mammillary N.	3	38.5 ± 0.39	37.7 ± 0.31	37.9 ± 0.38
Female controls	18	38.4 ± 0.24	36.1 ± 0.43	38.8 ± 0.09
Ventromedial N.	5	37.7 ± 0.29	37.4 ± 0.62	38.7 ± 0.10
Premammillary N.	6	38.0 ± 0.19	35.9 ± 1.43	37.9 ± 0.51
Dorsomedial N.	2	37.8 ± 0.20	34.8 ± 2.96	37.7 ± 0.85
Arcuate N.	3	38.1 ± 0.00	33.2 ± 6.29	37.4 ± 0.68
Mammillary N.	6	38.1 ± 6.43	36.0 ± 1.01	38.5 ± 0.24

[a] mean ± S.E.M.

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[2] In part taken from a thesis submitted to the faculty of graduate studies, Univ. of Western Ontario, London (Canada) and in partial fulfillment of the requirements for the degree of Doctor of Philosophy (1961).

[3] R. ISENSCHMID and W. SCHNITZLER, Arch. exp. Path. Pharmacol. *76*, 202 (1914).

[4] G. CLARK, H. W. MAGOUN, and S. W. RANSON, J. Neurophysiol. *2*, 61 (1939).

[5] S. W. RANSON, C. FISHER, and W. R. INGRAM, Arch. Neurol. *38*, 445 (1937).

[6] S. W. RANSON and H. W. MAGOUN, Ergebn. Physiol. Biol. Chem. exp. Pharmakol. *41*, 56 (1939).

[7] S. W. RANSON, Res. Publ. Assoc. Res. Nervous Mental Disease *20*, 342 (1940).

those males with lesions in the arcuate and mammillary nuclei. In these latter two groups the rectal temperatures fell approximately 1 °C.

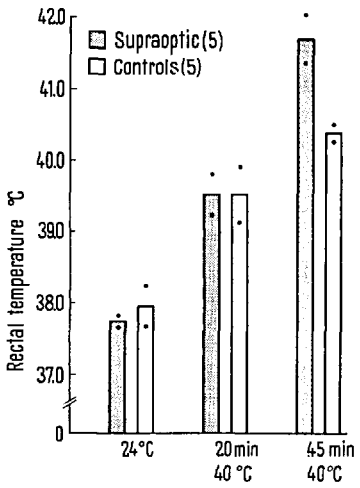
The female rats however showed a marked hypothermic response to an environmental temperature of − 10 °C which was not characteristic of the experimental animals alone. 1 h in this environment resulted in a fall in the mean of the rectal temperatures of the 18 female controls of 2.3 °C. The least response was seen in those rats with ablation in the region of the ventromedial nucleus (− 0.3 °C) and the greatest in those with lesions in the arcuate nuclei (− 5.9 °C). 1 h after the end of cold exposure, the mean rectal temperatures of all groups both male and female had returned to or near to their initial pre-exposure level. Thus a marked inability to regulate against this degree of cold exposure could not be demonstrated in any of the male or female animals with lesions in the middle and posterior hypothalamus approximately 93 days after operation. What is more obvious is the consistent difference between male and female rats. Female rats, whether control or bearing hypothalamic lesions, showed a greater fall in temperature than did their male counterparts.

(b) *The response of rats with lesions in the supraoptic area to a hot environment.* The effect of a high environmental temperature was studied in only one group of hypothalamic animals—that group with lesions placed in the supraoptic area. This was accomplished by placing the rats in individual cages in a large box maintained at 40 °C by means of strong light bulbs and a thermostat. At the end of 20 min the animals were removed, their rectal temperatures recorded and returned to the hot environment for another 25 min. At the end of the second 25 min the animals were removed, and rectal temperatures again recorded.

The results obtained are shown in the Figure. At 24 °C there was no statistical difference between the mean rectal temperatures of rats with supraoptic lesions and their intact controls. At the end of the first 20 min of exposure the mean rectal temperatures of both the experimental and control groups were elevated but there was no statistical difference between the two groups. By 45 min the mean rectal temperature of the experimental rats with lesions in the supraoptic nucleus was statistically significantly higher than that of the controls. These results support the currently held view that the anterior hypothalamus is associated with homeostatic mechanisms which regulate against hyperthermia.

(c) *The response of rats with lesions in the supraoptic area to a cold environment.* The rectal temperatures of the five rats described in (b) with lesions in the supraoptic nucleus and of their controls were recorded at noon and at midnight for six consecutive days at an environmental temperature of 24 °C and at 5 °C. Temperatures recorded at midnight in both experimental and control groups were slightly but not significantly higher than those recorded at noon. At midnight the temperatures were 38.4 ± 0.13 and 38.2 ± 0.07 °C for experimental and controls respectively. The corresponding temperatures at noon were 37.4 ± 0.14 and 37.2 ± 0.17 °C. However, at neither time did the temperatures of these experimental rats differ significantly from those of the controls. These experiments failed to demonstrate any appreciable difference between rats with lesions in the middle or posterior hypothalamus and normal rats in response to severe cold exposure. This is probably due to the relatively small lesions and the length of time between operation and cold exposure. CLARK et al.[4] have reported that in cats with destruction of both mammillary nuclei no disturbance of temperature regulation could be detected by hot and cold exposure tests 30 days after the operation. They concluded that '. . . had these been made within a day or two after the operation transient abnormalities would have been detected'.

What is more striking is the observation that female rats whether normal or bearing hypothalamic lesions did not tolerate cold exposure as well as males. This is a little surprising in view of the fact that females usually have a greater insulation in the form of subcutaneous fat than do males. In spite of this, one explanation may be that the female rats were considerably lighter than their male counterparts of the same age. They would therefore have a greater surface area to mass ratio and would thus lose heat to the environment more rapidly than the males. A difference in spontaneous activity between males and females may also be a contributory factor.



Rectal temperature of normal rats and rats with lesions in the supraoptic hypothalamic nucleus exposed to a hot environment. Solid dots indicate standard error.

Zusammenfassung. Es wird gezeigt, dass normale weibliche Ratten weniger kälteresistent sind als gleichaltrige männliche Ratten desselben Stammes. Dies gilt auch für weibliche Tiere mit elektrolytischen Läsionen in verschiedenen Loci des Hypothalamus. Am 25. Tag in den Nuclei supraoptici lädierte Ratten zeigen eine ausgeprägte Unfähigkeit, Hitze zu ertragen. Dies steht in Übereinstimmung mit der gegenwärtigen Auffassung, dass der vordere Hypothalamus bei der Beseitigung der Überhitzung eine Rolle spielt.

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