

Drastic Changes in the Mating Behaviour of Male Rats Following Lesions in the Junction of Diencephalon and Mesencephalon

Sexual abnormalities including mounting of diverse objects, intense masturbation and homosexual behaviour have been reported to follow lesions in various parts of the limbic system¹⁻⁵. The following describes how a striking increase in the normal sexual activity of male rats was provoked by extensive lesions at the junction of diencephalon and mesencephalon.

Bilateral electrolytic lesions were made in 16 rats with the Horsley-Clarke technique by a d.c. of 1 mA for 30 sec. The lesions included the posterior part of the hypothalamus, the posterior parts of the medial thalamic nuclei, and the rostral part of the central grey matter in the mesencephalon. Reconstruction of a representative lesion is shown in Figure 1.

Prior to the experiment the animals were given 1–2 h of sexual experience. The male was presented with a female brought into oestrus by hormone treatment, and the mating behaviour observed during 30- or 60-min sessions. The sexual behaviour was tested by a standard procedure described in detail elsewhere⁶. The animals were given two preoperative sessions separated by a ten-day period

of rest. The operations were performed one to three days after the last preoperative test.

Postoperative testing was begun ten days after the operation and was continued for 2–6 months. The following behavioural variables were measured: (1) mounting frequency: number of mounts without intromission, (2) intromission frequency, (3) intromission latency: time from the entrance of the female into the cage to the first intromission, (4) ejaculatory latency: time from the first intromission until ejaculation, (5) average intercopulatory interval: average delay between each intromission, computed by dividing the ejaculatory latency by the intromission frequency, (6) postejaculatory interval: time from ejaculation to the next intromission.

¹ H. KLÜVER and P. D. BUCY, *Arch. Neurol. Psychiat. (Chicago)* **42**, 979 (1939).

² J. D. GREEN, D. D. CLEMENTE, and J. DE GROOT, *J. comp. Neurol.* **108**, 505 (1957).

³ L. SCHREINER and A. KLING, *J. Neurophysiol.* **16**, 643 (1953).

⁴ N.-Å. HILLARP, H. OLIVECRONA, and W. SILFVERSKIÖLD, *Exper.* **10**, 224 (1954).

⁵ W. D. HAGAMEN and E. M. LANCE, *Anat. Rec.* **130**, 414 (1958).

⁶ K. LARSSON and L. ESSBERG, *Gerontologia* **6**, 133 (1962).

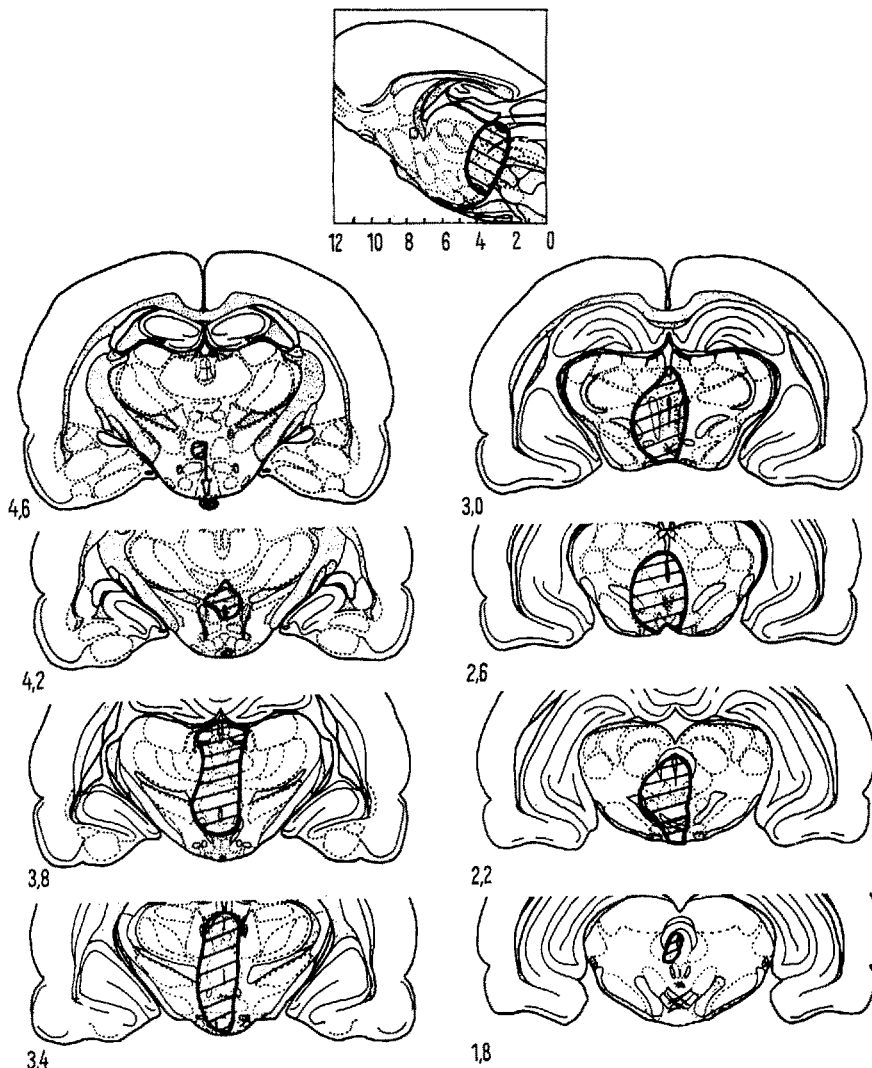


Fig. 1. Lesion at the junction of diencephalon and mesencephalon resulting in an increase in sexual activity. (Reconstructions based upon DE GROOT⁷. The rat forebrain in stereotaxic coordinates.)

Nine rats did not show any deviations in their post-operative sexual behaviour. In seven animals, however, conspicuous changes occurred after the operation. These males tended to ejaculate after relatively few intromissions and with a short latency. The intervals of sexual inactivity following ejaculation were shortened from 5-6 min preoperatively to 1-3 min after the operation. Owing to the shortened latency periods there was an increase in the number of ejaculations achieved in a 30-min test.

The behavioural deviations appeared in the first post-operative tests and no recovery was ever seen. Exceptions to this rule were two males that did not achieve intromission and ejaculation before one or two months after the operation. When presented with the female these males approached her, followed her around the cage, and put the forepaws upon her back without making the mount with a pelvic thrust that characterizes the normal mounting responses. Frequent spontaneous penis erections accompanied by licking of the penis were displayed on these occasions. These two males also showed other abnormal features in their sexual behaviour. During the

weeks following the operation they had frequent spontaneous penis erections. The erections occurred not only when these males were presented with a receptive female but also on other occasions; for instance, when being fed and weighed. The penile erections successively diminished in frequency and completely disappeared after about a month. When able to display complete copulations including ejaculation, both animals showed the same striking deviations in their sexual behaviour as described above. A demonstration of the reduction of the postejaculatory intervals and the accompanying increase in the ejaculation frequency is given in Figure 2. Histological examination of the testes did not reveal any abnormalities in any of the animals showing sexual deviations.

Comparison between the lesions in animals remaining sexually normal and in those showing sexual disturbances did not give any explanation for the behavioural differences observed. Smaller lesions within different parts of the critical region at the junction of diencephalon and mesencephalon, including complete destruction of the habenular complex, have so far not produced any sexual abnormalities⁸.

Zusammenfassung. Umfangreiche Läsionen im Grenzgebiet zwischen Mittelhirn und Zwischenhirn bei Ratten führten zu stark erhöhter sexueller Aktivität. Die Ruheperioden nach der Ejakulation waren abnorm kurz, was die Zahl der Ejakulationen während des Versuches stark erhöhte. Auch 6 Monate nach Operation konnte kein Rückgang des Zustandes festgestellt werden.

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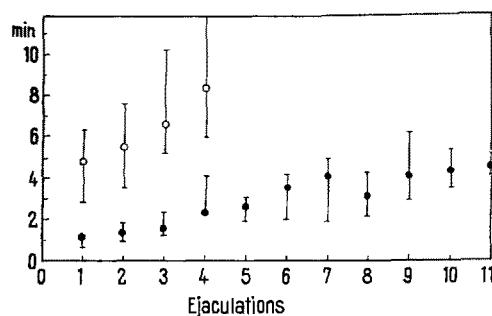


Fig. 2. The figure demonstrates the reduction of the postejaculatory intervals and the accompanying increase in ejaculation frequency in one of the operated animals observed in three 60-min tests approximately four months after the operation. Filled circles represent the median values of the postejaculatory intervals recorded during these tests. Vertical lines represent maximal and minimal values. Open circles show the corresponding performances of a group of 31 intact males.

⁷ J. DE GROOT, *The Rat Forebrain in Stereotaxic Coordinates* (Verhandelingen der Koninklijke Nederlandsche Akademie van Wetenschappen, Afd. Natuurkunde, Tweede Reeks, Del L II, 1959).

⁸ *Acknowledgment.* This study was supported by Public Health Service Research Grant HD 00344-03 National Institute of Child Health and Human Development. Hormones were generously supplied by Pharmacia Inc., Uppsala.

PRO EXPERIMENTIS

Modified *in vivo* Assay for MSH

Introduction. An *in vivo* bioassay for the detection of melanocyte-stimulating hormone (MSH) has been available since 1924, when HOGGEN and WINTON described a technique for hypophysectomy of the frog¹. The interpretation of maximal melanin dispersal (darkening) in dermal melanocytes was aided by staging the melanocyte index (MI). This procedure was introduced in 1924² and altered into its present form in 1930³ and 1952⁴.

A simple modification of the assay is described here. By injection of the test material into the aortic trunk rather than into the classical location of the dorsal lymph sac, a doubling of the sensitivity is achieved.

Methods. Adult male frogs (*Rana pipiens*) weighing 30-60 g were hypophysectomized at least 3 days prior to

assay. The MI in the interdigital web of the left foot was assessed as previously described⁶.

For injection into the aortic trunk, the thorax of frogs anesthetized with ether was surgically exposed with 2-3 cuts of the scissors. Slight tension was placed on the right aortic trunk as a 25-gauge needle was inserted into the left aortic trunk near the base of the heart. One-tenth ml

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⁴ E. THING, *Acta endocr. (Kbh.)* 10, 295 (1952).

⁵ G. T. ROSS and W. D. ODELL, *Ann. N.Y. Acad. Sci.* 100, 696 (1963).