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Peter CROWCROFT

Note on the Sexual Maturation of Shrews (*Sorex araneus* Linnaeus, 1758) in Captivity

Uwagi o dojrzewaniu płciowym ryjówek (*Sorex araneus* Linnaeus, 1758) w niewoli

[With 2 Tables & Plate VIII]

I. INTRODUCTION

Part of the work Professor August Dehnel planned to carry out in the new laboratories of the Mammals Research Institute at Białowieża was an investigation of factors controlling the breeding of the common shrew, *Sorex araneus* L. His initial success in producing laboratory conceived litters (Dehnel, 1952), has not been readily repeated and the facilities for carrying out a systematic study were not available until the year of his untimely death.

An obvious step in the investigation was to repeat classic experiments carried out with rodents; for instance to test the effect of increased "day-length" in the laboratory, using artificial light (vide Baker & Ranson, 1932). Professor Dehnel and I had planned collaborative work in this field, and as the new laboratories neared completion, a pilot experiment was carried out in the British Museum (Natural History). The results of this preliminary work, of great interest to Professor Dehnel, seem a fitting, although inadequate, tribute to his memory.

The breeding cycle of *Sorex araneus* was described by Brambell (1935) who confirmed the observation of Adams (1910; 1912) and Middleton (1931) that individuals do not become sexually mature until the Spring following the Summer in which they are born. The overwintering population consists entirely of sexually immature animals. The males become fecund in early March and the females in April (Wales and southern England).

The breeding cycle has also been studied by Dehnel (1949), Crowcroft (1956), and Shillito (1963). Pucek (1960), has shown by examination of a vast number of specimens, that a small proportion of females do attain sexual maturity in the year of birth. In general, however, the later work has confirmed Brambell's account of the normal reproductive cycle.

The object of the experiment described here was to supply overwintering shrews with increased day-length using artificial illumination, and

observe the effects, if any, on the onset of sexual maturity. It was only possible to work with small numbers because of the limited facilities available for keeping shrews in captivity.

II. MATERIAL AND METHODS

Live-trapping at Fetcham, Leatherhead, Surrey, on 16th January, 1961 produced six immature common shrews. Although the determination of the sex of immature specimens is difficult, firm pressure in front of the genital papilla produces a partial eversion of the tiny penis in the males, and enables them to be distinguished. By this means the sample was found to consist of three animals of each sex.

The shrews were individually housed in open sheet-metal boxes with walls 25 cm high. The floor was covered with a thick layer of peat-moss, which was moistened daily. Dry hay was supplied for nest building, and an excercise wheel provided in an attempt to prevent the usual excessive deposition of subcutaneous fat. The food was entirely meal-worms (*Tenebrio* larvae) raised upon whole-meal flour and green vegetables. The drinking water was fortified with a vitamin compound designed for domestic pets. The meal-worms were supplied in a known quantity and the pen searched for stored food daily, in order to record actual consumption.

All of the shrews were initially kept under the same conditions. The room was centrally heated and illuminated by daylight through large translucent windows. On 31st January 1961, one male and two females (chosen by tossing a coin) were moved to an identical room and provided with artificial light from overhead cold-cathode tubes from 06.00 to 22.00 hours daily.

All animals were killed on 4th March 1961. The female reproductive tracts, and the males' testes were fixed in alcoholic Bouin's fluid, sectioned at 10μ, and stained with haemotoxylin and eosin.

III. RESULTS

F e m a l e s: Dissection showed marked differences in the development of the reproductive tract between No. 5, (control) in which the vagina was still thread-like, and Nos. 2 and 6, (experimentals) in which it was enlarged and exhibiting the strong ventral flexure of sexually mature individuals. The apparent differences in development were confirmed by histological examination.

Figure 1 is a photomicrograph of a transverse section of the vagina of No. 5. The vagina measures only 0.72 mm in greatest diameter, and the epithelium is inactive. This condition corresponds with a later stage than that shown by B r a m b e l l (loc cit. Fig. 40) as representative of the prepubertal vagina. The vagina of No. 2, on the other hand (figure 2) is 1.76 mm in diameter, and shows intense cornification of the epithelium, which is deeply folded longitudinally. The condition is similar to that described by B r a m b e l l (loc cit. Fig. 43) in the oestrous vagina. Female No. 6 was in an identical state.

Marked differences are also obvious in transverse sections of the uteri. Figure 3 shows the typical immature condition found in No. 5, and

figure 4, that typical of oestrous females with enlarged mucosa and muscularis and prominent uterine glands.

The ovaries of all three females measured approximately 1.0 mm in smallest cross section, and appeared to be in similar condition. Follicles as large as 0.25 mm with antra and follicles up to 0.7 mm in diameter occurred in No. 5 as well as in Nos. 2 and 6. Thus, follicular development was more advanced than would be expected in an animal showing no enlargement of the reproductive tract, and in all three it was more advanced than in animals taken by Brambell in Wales in early March.

Males: It was clear from the external signs of sexual maturity and from its behaviour when placed with a female, that No. 1 (experimental) was ready to mate. In addition, this male had developed a very strong musky odour. The enlarged penis could be fully extruded, and the

Table 1.

Growth of *S. araneus* in captivity.

	Extra light			No extra light		
No.	1	2	6	3	4	5
Sex	M	F	F	M	M	F
Weight in gm. 31/I/61	7.0	5.8	6.6	8.0	7.2	6.8
Weight in gm. 4/III/61	7.8	8.7	9.3	7.6	7.6	6.6
H & B length in mm. 4/III/61	74	70	73	73	72	73

inguinal region was distended by the testes. These measured over 3.0 mm in smallest diameter. The seminiferous tubules measured 0.15 mm in diameter and contained mature sperms, as did the enlarged epididymes.

Males Nos. 3 and 4, (controls) on the other hand, were unchanged in external characters and behaviour, and dissection revealed the minute testes and penis typical of immature males. In No. 3, the testes measured only 1.3 mm in smallest diameter, and the tubules 0.07 mm. In No. 4, the testes were slightly larger (1.6 mm) but similar in condition. No sperms were present.

Growth: The weights at the beginning and end of the experiment. and the head and body lengths at the end are shown in table 1. No significant difference can be seen between the two groups in relation to length, all individuals being near the upper limit for juveniles and the

lower limit for sexually mature animals. The animals with extra light, however, appear to have increased in weight to a significantly greater degree.

Food consumption: The mean daily food consumption is shown in table 2. There is considerable variation within both groups and no discernable difference between the two. The total food intake fell off slightly in successive five-day periods, but the reduction was less striking than previously observed in captive shrews. This may have been due to the provision of exercise wheels, which were intensively used.

Table 2.

Food consumption of *S. araneus* in captivity.

Days	Extra light			No extra light			
No.	1	2	6	3	4	5	Total
Sex	M	F	F	M	M	F	
0— 5	22.8	23.0	16.9	22.6	20.3	20.7	126.3
5—10	22.9	20.3	15.8	22.3	16.9	17.0	115.2
10—15	17.9	21.6	18.4	20.8	18.1	14.3	111.1
15—20	18.0	19.5	20.2	18.6	15.8	14.0	106.1
0—20	81.6	84.4	71.3	84.3	71.1	66.0	
Mean in gm.	4.1	4.2	3.6	4.2	3.5	3.3	

IV. DISCUSSION

The results cannot be regarded as more than suggestive, as such small numbers of animals were used. They are consistent, however, in that sexual development was more advanced in all three experimental animals than in all three controls. Thus, increased artificial illumination may be regarded as a factor worthy of futher investigation in seeking techniques for breeding common shrews in captivity.

REFERENCES

1. Adams, L. E., 1910: A hypothesis as to the cause of the autumnal epidemic of the Common and the Lesser shrew, with some notes on their habits. Mem. Proc. Manchr. Lit. Phil. Soc., *54:* 1—13.
2. Adams, L. E., 1912: The duration of life of the Common and the Lesser shrew, with some notes of their habits. Mem. Proc. Manchr. Lit. Phil. Soc., *56:* 1—10.
3. Baker, J. R. & Ranson, R. M., 1932: Factors affecting the breeding of the Field Mouse (*Microtus agrestis*). Part I.—Light. Proc. Roy. Soc. Lond., *110* B 1932: 313—332.

4. Brambell, F. W. Rogers, 1935: Reproduction in the Common Shrew (*Sorex araneus* Linnaeus). I — The oestrus cycle of the female. Phil. Trans. B *225*: 1—49. Pls. 1—9.

5. Crowcroft, P., 1956: On the life span of the Common shrew (*Sorex araneus* L.). Proc. zool. Soc. Lond., *127:* 286—292.

6. Dehnel, A., 1949: Studies on the genus *Sorex* L. Ann. Univ. M. Curie-Skłodowska, Sect. C, *4*, 2: 17—97. Lublin. (in Polish, with English summ.).

7. Dehnel, A., 1952: The biology of breeding of the Common shrew (*Sorex araneus* L.) in laboratory conditions. Ann. Univ. M. Curie-Skłodowska, *6*, 11: 359—376. (in Polish, with English summ.).

8. Middleton, A. D., 1931: A contribution to the biology of the Common shrew, *Sorex araneus* Linnaeus. Proc. zool. Soc. Lond., 1931: 133—143.

9. Pucek, Z., 1960: Sexual maturation and variability of the reproductive system in young shrews (*Sorex* L.) in the first calendar year of life. Acta theriol., *3*, 12: 269—296. Białowieża.

10. Shilito, J., 1963: Field observations on the growth, reproduction and activity of a Woodland population of the Common shrew *Sorex araneus* L. Proc. zool. Soc. Lond., *140:* 99—114.

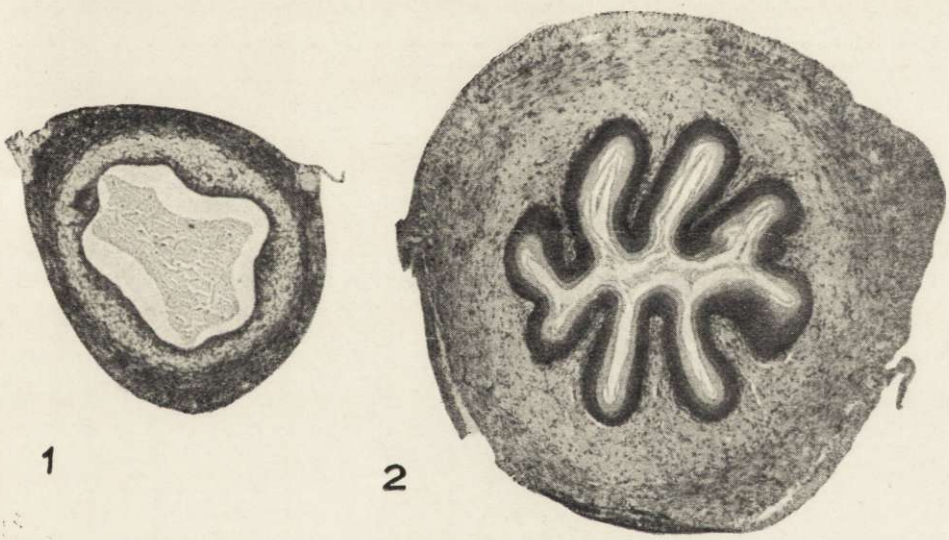
South Australian Museum,
Adelaide.

STRESZCZENIE

Sześć ryjówek (*Sorex araneus* Linnaeus, 1758) trzymano podczas zimy w warunkach laboratoryjnych. Trzy z nich (2 ♀♀ i 1 ♂) były poddane działaniu sztucznego oświetlenia od 6 do 22 godzin na dobę. Po czterech tygodniach zwierzęta te okazały się płciowo dojrzałymi. Trzy kontrolne okazy pozostawały płciowo nieaktywne. Zaleca się używanie dodatkowego oświetlenia przy próbach rozmnażania ryjówek w niewoli.

EXPLANATION OF PLATE VIII.

Fig. 1. Photomicrograph of transverse section of vagina of *Sorex araneus* control. 0.72 mm diameter.
Fig. 2. T.S. vagina of *S. araneus* with extra light. 1.76 mm dia.
Fig. 3. T.S. uterus of *S. araneus* control. 0.69 mm dia.
Fig. 4. T.S. uterus of *S. araneus* with extra light. 0.97 mm dia.



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P. Crowcroft *auctor phot.*