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The effect of temperature on the sexual activity of non-migratory birds, stimulated by artificial lighting.

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How exposure to the daily period of lighting, and the strength and quality of light, affects the sexual cycle of birds has been experimentally examined, thoroughly and from many angles (compare only BISSONNETTE 1936 a, b; ROWAN and later KIRSCHBAUM a. RINGOEN; RILEY).

Besides lighting one can also presume that of external natural factors temperature may especially affect the annual sexual cycle chiefly of non-migratory birds, for they clearly experience the comparatively regular and considerable annual rhythm of changes in temperature. The annual changes in temperature experienced by migratory birds are in most cases naturally much less and more variable. The effect of changes in temperature on the sexual cycle of birds has been studied less, usually only as a secondary matter in other tests. This is, however, principally due to the fact that in all investigations the temperature has been found to be of no significance with regard to migratory birds, chiefly ROWAN (compare only 1936, pp. 142—146) with *Junco hyemalis connectens* Coues, as well as with regard to the non-migratory birds hitherto examined, chiefly BISSONNETTE a. CHAPNICK (p. 328) also BISSONNETTE (1931, p. 293—294; 1936 a, p. 177) with *Sturnus v. vulgaris* L. and KIRSCHBAUM a. RINGOEN with *Passer d. domesticus* (L.).

Taking as a basis the above-mentioned, with continuous artificial lighting artificially produced, strong development in the sexual activity of the birds' gonades, I performed tests in the winter of 1937 in regard to the effect of temperature on the sexual cycle of non-migratory birds. The test object used was the great titmouse, *Parus m. major* L. The bird material, comprising 25 individuals,

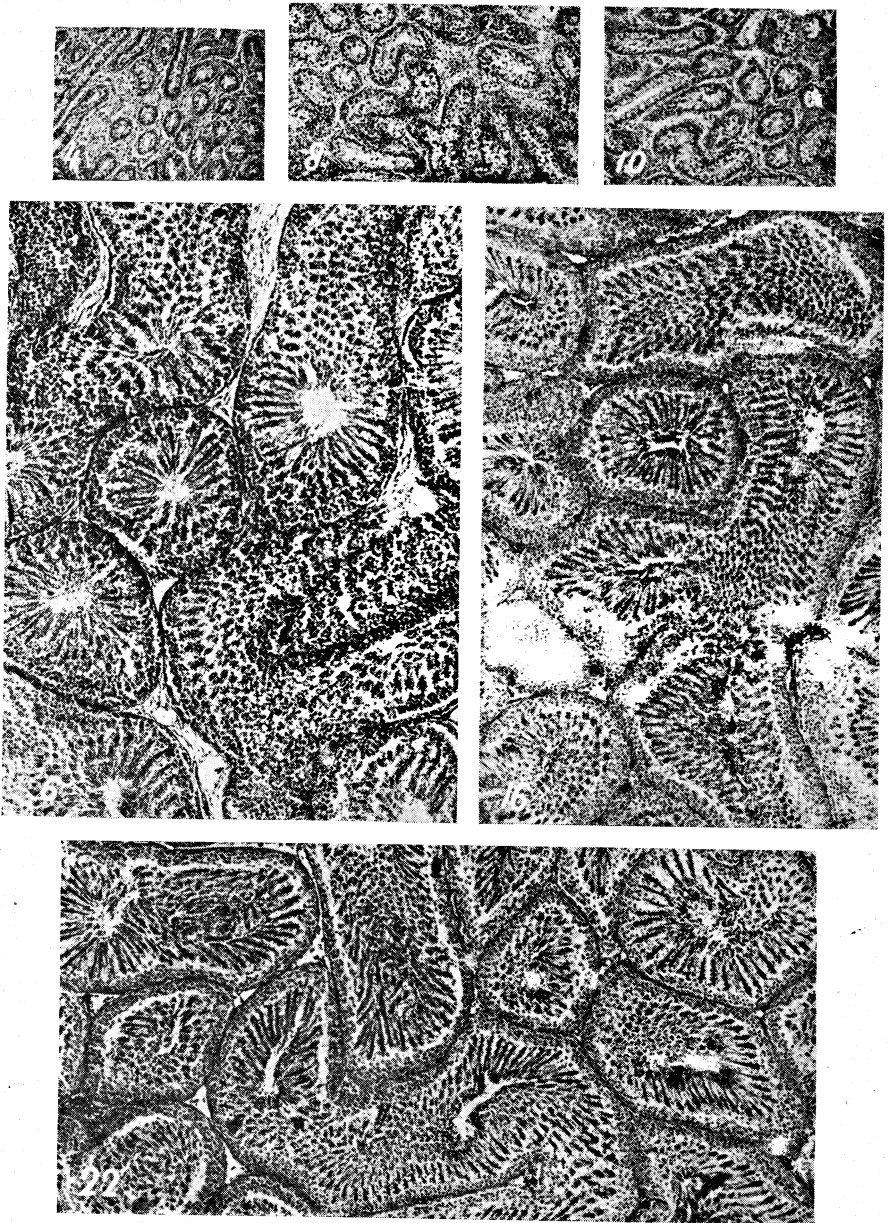


Photo O. Jonasson

Fig. 1—6. Microphotographs of the testes cuts, thickness $10\ \mu$, of great titmouse, *Parus m. major* L. The test individuals number is marked on the photographs. The testes of test birds Nos. 4, 6 and 8 are fixed with La Cour 2BD, those of the test birds Nos. 10, 16 and 22 with Zenker. All cuts are coloured with Heidenhain's iron hematoxylin. $\times 60$.

was caught immediately before the commencement of the test series in Helsinki or its surroundings.

Four test series were arranged, i. e. two groups, each consisting of two parallel series: The first group of series (test series 1 and 2) was arranged in daylight, test series 1 also in outdoor temperature (compare test series 1 a!), while test series 2 was performed in a considerably higher temperature. Thus in test series 2 the temperature factor ought to have stimulated the gonades towards sexual activity. The second group of series (test series 3 and 4) was arranged in continuous artificial lighting, test series 4 at a considerably higher temperature than test series 3. Thus in test series 3 the lower temperature ought to have retarded or prevented the artificial development of the gonades. Further, in order to facilitate comparison, the temperatures were kept as nearly equal as possible on the one hand in test series 1 and 3 and on the other hand in test series 2 and 4.

Tests were performed during the period 9. I.—1. III. The titmice were kept in cages measuring $45 \times 50 \times 50$ cm³, 3—2 individuals in each. They were fed with ground nuts and hemp seeds. For the artificial lighting milk glass Osram glow lamps of 40 watts were used, two of them were placed at the same side of and at a distance of 65 cm from two cages, set side by side. The minimum and maximum temperatures of the days, from which the average temperatures were obtained, were noted in the morning.

Test series 1. Average temperature — 6.3° C; min. — 16.75° C, max. + 2.5° C. The cage was outofdoors in a rather shady and comparatively sheltered spot. Test birds 2: ♂, ♀. — The test series was performed principally to make sure that life in cages did not in itself affect the birds (compare also *BISSONNETTE* 1931, p. 302).

Test series 1 a. During the test period for purposes of comparison 5 birds ♂♂ were shot in the immediate proximity of Helsinki, at Huopalahti: Munkkiniemi.

Test series 2. Average temperature + 15.7° C; min. + 11.25° C, max. + 19.0° C. Cages in daylight, placed in a room at a big window (that ultraviolet rays have no effect compare *BISSONNETTE* a. *WADLUND*, p. 346). Test birds 6: 2 ♂♂, 4 ♀♀.

Test series 3. Average temperature + 1.9° C; min. — 3.25° C, max. + 7.0° C. Cages artificially lit up all day and all night. Test birds 6: 4 ♂♂, 2 ♀♀.

Test series 4. Average temperature + 19.3° C; min. + 17.75° C, max. + 20.75° C. Cages artificially lit up all day and all night. Test birds 5: 3 ♂♂, 2 ♀♀.

The test results obtained are in the main shown in the attached table and illustrations (table 1 and fig. 1—7).

	9. I.	After approx. 4 weeks: 7. II.	After approx. 5 weeks: N:o 14 14. II. a. N:o 16 15. II.	After approx. 6 weeks: 22. II.	After approx. 7 weeks: 1. III.
Test series 1 a (and 1: N:o 10)	1. 10×16 ; 10×17 2. 9×14 ; 8×13.5	4. 12.5×18 ; 11.5×17.5 5. 17.5×19.5 ; 14×20 10. 13×15 ; 12×18			24. 17×19 ; 14×21
Test series 2		8. 12×15 ; 10×17	14. 11.5×13 ; 9×14		
Test series 3		6. 55×64.5 ; 51×69 12. 55×65 ; 49×72		22. 54×64 ; 51×69 (21. 21×24 ; 18×23) ^{*1}	
Test series 4		7. 53×58 ; 49×65 13. 55×72 ; 51×72	16. 55×64 ; 55×65		

Table 1. Showing the development of the testes of *Parus m. major*-♂♂ into sexual activity. The gonades were measured by the micrometre immediately after the test individual was killed; measurements in mm. The measurements of the right testes are given first.

*1 The bird was found dead in the cage.

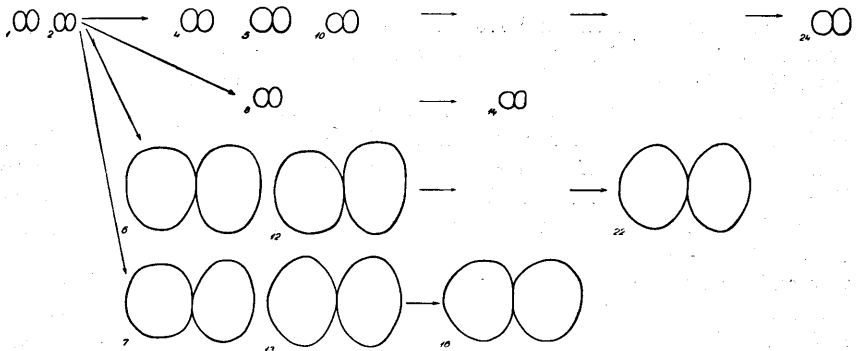


Fig. 7. Schematic picture belonging to table 1.

The results of the tests with great titmouse, *Parus m. major* L., one of our most typical non-migratory birds, show that:

1. The testes' rapid, strong development of sexual activity, caused by continuous artificial lighting, occurred in the middle of the winter, during January—February.

2. The considerable, approx. 20° C differences in temperature had no visible effect on the artificially caused sexual cycle of the testis. The considerable, rapid increase in temperature could in no way develop sexual activity in the testes, nor, on the contrary, did the lower temperature retard their development — within the temperature limits mentioned. As KENDEIGH (p. 313) has even stated: „Provided they have plenty of food, adult birds have considerable resistance to a lowering of their body temperature even under conditions of extreme cold.“ — One can also refer to RILEY's tests regarding the effect of temperature on the spermatogenesis of the house sparrow, *Passer d. domesticus* (pp. 336—338).

3. The influence of continuous artificial lighting and temperature on the development of the ovaries and the testes into sexual activity was the same.

Literature: BISSONNETTE, THOMAS HUME, 1931, Studies on the sexual cycle in birds. IV. Experimental modification of the sexual cycle in males of the European starling (*Sturnus vulgaris*) by changes in the daily period of illumination and of muscular work. The Journal of Experimental Zoölogy 58: 281—319. — 1936 a, Sexual photoperiodicity. Influence of varying quantities and qualities of light on sexual activity in plants and animals an example of the interaction of genetic and environmental factors in conditioning the expression of characters. The Journal of Heredity 27: 170—180. — 1936 b, Sexual photoperiodicity. The Quarterly Review of Biology 11: 371—386. —

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Lintuhavainnot Raja-Karjalasta kesältä 1937.

O. HYTÖNEN.

Viime kesänä olin tilaisuudessa oleskelemaan eri puolilla Raja-Karjalaa seuraavasti: Suojärvi, Suvilahti 5 ja 7. VI., Kaitajärvi 6. VI., Salmi, Tulema 7—8. VI., Lunkulansaari 8—12. VI., Mantsinsaari 10. VI., Pitkäranta 13—14. VI.

Seuraavassa esitän systemaattisessa järjestyksessä havaintojani lintulajeista sikäli kun ne sisältävät oleellisesti uutta ennen julkaisuun. Päivämäärä mainitaan vain niistä tilapäisistä havaintopaikoista, jotka eivät esiinny ylläolevassa luettelossa.

Sturnus v. vulgaris L. Suojärvi, Suvilahti: Pesä jossa poikaset, metsäseudussa korkealla haavassa. Suojärvi, Kaitajärvi: 2 pöntössä ruokittiin poikasia. SCHULMANIN mukaan oli kottarainen v. 1880 näytettyynyt vain satunnaisesti. — Lunkulansaari: 9. VI eräässä pöntössä vielä 5 pienepuoleista poikasta; samana päivänä n. 20 yks. parvena. V. 1881 ei vielä tavattu kottaraista ja vielä R. PALMGREN (1902) mainitsee sen harvinaisena pesijänä.

Carduelis c. carduelis (L). Salmi, Mantsinsaari: 2 kertaa 1 pari. Ei mainita ennestään (v. BONSDORFF 1889, R. PALMGREN 1902).

Carduelis l. linaria (L). Suojärvi, Kaitajärvi: 2 paikassa 2—3 yks., oleskelivat enimmäkseen männyissä. Ainoa pohjoinen laji, jonka tapasin.

Carpodacus e. erythrinus (Pall.). Suojärvi, Kaitajärvi: Laulava ♂. Suistamo 5 VI: laulava ♂ puutarhassa aukeassa kirkonkylässä, Suo-