pencil marking was the source of the contaminant and fine debris was occasionally observed to sift from the mark. Grossly this chemograph is indistinguishable from an autoradiograph and, under magnification, resembles autoradiographs made by fine radioactive particulate material except for a characteristic nonreduced center area.

P. J. Fitzgerald has observed similar reduced areas apparently made by debris produced by the cutting of MLS plates (*4*). The pencil was of about 5B hardness

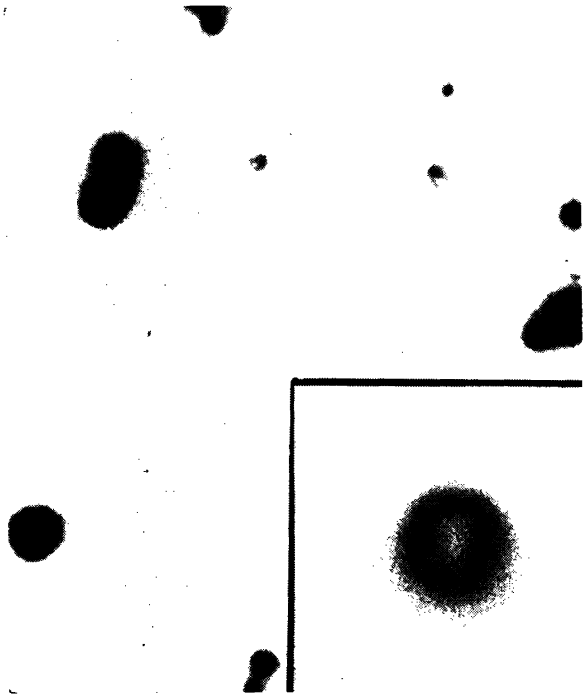

Fig. 2. A small group of chemographs at × 29 demonstrates the size distribution. The insert at × 50 shows the halo effect evident in one of the smaller grain groups. Both are in bright field.

and was of the type custom produced in quantity. However, the artifact was found with only one pencil type. Several pencil brands of different degrees of hardness were tested by varying exposure, development, and marking technique.

Figure 1*a* at × 2.7 in dark field presents the gross appearance of several areas rendered developable by debris from the pencil mark that is shown in part on the left. Figure 1*b* in bright field at × 30 shows striking examples of the clear central area. Figure 2 at × 29 gives the morphology and dispersion of grain groups with the desensitized central area less apparent; the insert, however, at × 50 shows that the "donut" configuration does exist in these chemographs. This structure correlates with the histochemographs of Boyd and Board from rat bone-marrow smears.

The artifacts described here are atypical of the usual pseudophotographic effects found by Fitzgerald. They are not superficial but extend through the emulsion and do not exactly circumscribe the source, but rather the grain concentration decreases with distance from the center. The clearness of the central area varies but suggests desensitization particularly in the larger chemographs where the effect is easily observed. The grain-grouping diameter ranged up to 1 mm, and the size of the artifact presumably was roughly related to the particle size of the reducing agent. The central desensitized area diameter was usually proportional to the total size of the "donut-like" artifact. Occasionally a "smear" of grains point back to the original mark showing the track of the reducing agent across the emulsion. These artifacts have been found up to 20 cm away from the pencil mark. The very fine particulate nature of the reducing agent allows for easy transport. Fitzgerald has also observed the rarer cell chemographs indistinguishable from the autoradiographs in which the grain concentration decreases with distance from the center (*4*).

In view of these findings, markings of autoradiographs with pencil should be discouraged, particularly where the gross apposition technique is employed and especially where the specimen is likely to incorporate fine particulate radioactive material, autographs of which may be confused with the pencil chemograph.

References

1. G. A. Boyd and F. A. Board, *Science* **110**, 586 (1949).
2. F. A. Board, *J. Cellular Comp. Physiol.* **38**, 377 (1951).
3. P. J. Fitzgerald *et al.*, *Laboratory Investigation* **2**, No. 3 (May–June, 1953).
4. P. J. Fitzgerald, private communication.

January 26, 1954.

Sperm Storage at Lower-than-Body Temperature Outside the Body Cavity in Some Passerine Birds

Albert Wolfson

Department of Biological Sciences, Northwestern University, Evanston, Illinois

In most mammals the testes are located in the scrotum outside the body cavity. Moore has demonstrated conclusively the thermoregulatory function of the scrotum and its necessity for the production of mature germ cells (*1*). The temperature of the scrotum in common laboratory animals and in man is approximately 5° to 9° (F) lower than body temperature. In birds the testes are abdominal and the body temperatures are, in general, much higher than in mammals. In view of the need for a lower temperature for normal spermatogenesis in mammals, the condition in birds is of great interest.

During the course of our studies on the relation of photoperiod to the reproductive cycle, we noted an extensive development of the cloacal region at a specific time in the cycle. Further study of this cloacal protuberance showed that it was produced largely by the growth and coiling of the lower ends of the male ducts (*vasa deferentia*). Each enlargement was nodular in form. When fully developed the appearance of the two "nodules" on the posterior wall of the cloaca

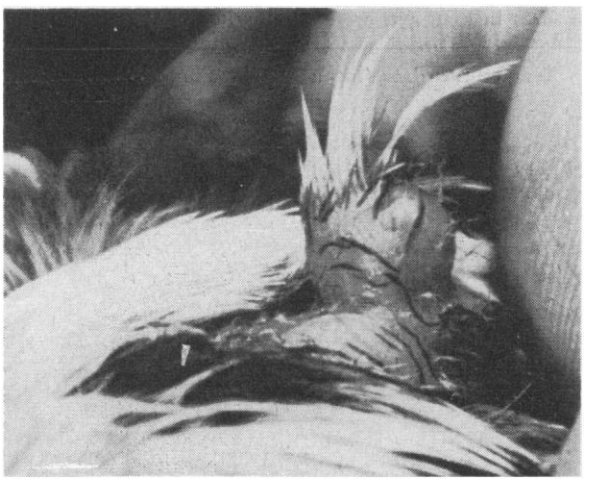

Fig. 1. Cloacal protuberance in an adult male swamp sparrow (*Melospiza georgiana*). Anterior is toward the left and the bird is lying on its back. Note the outline of the "nodules" on the posterior wall and the relative displacement of the cloacal opening. The opening is not visible, but it is surrounded by the anal tuft of feathers; normally it is centrally located. Measurements of the protuberance were anterior wall, 6.2 mm; posterior wall, 6.7 mm; largest diameter, 7.0 mm. (Photographed June 23, 1952.)

was not unlike the testes in the scrotum of a mammal.

In Fig. 1, the distention of the posterior cloacal wall produced by the "nodules" is clearly illustrated. The "nodules" have been called seminal vesicles by most authors, but the term *glomera* (*glomus,* sing.) has also been used. In Fig. 2, the parts of the fully developed reproductive tract are shown. In the inactive state, the seminal vesicles are represented by a slightly coiled region of the *vas deferens* within the body cavity. Its width is slightly greater than that of the adjacent parts of the duct. Detailed observations of the protuberance and the seminal vesicles and their relation to the cycle of testis growth and to copulation have been presented (*2, 3*). These papers also contain a review of the literature and describe a method for obtaining sperm in the live bird. The purpose of this paper is to report on the temperature of the protuberance in relation to body temperature.

Measurements were made with a Leeds and Northrup single-range potentiometer calibrated to half-degrees Fahrenheit and employing an iron-constantan thermocouple. To measure the temperature of the protuberance, the bird was held on its back in the observer's hand; the thermocouple was inserted to below the middle of the protuberance (about ⅛ to ¼ in.) and held there. When the galvanometer needle stopped moving, which usually occurred in less than a minute, a reading was taken. The thermocouple was then inserted into the large intestine (about ½ in.) and another reading was taken. This temperature is referred to as the body temperature in Table 1.

In the absence of a protuberance, as in the inactive state or in the females, the thermocouple was inserted about ¼ in. In the females, the cloacal area is enlarged and swollen at the peak of the reproductive cycle, but it does not form a bulbous protuberance. In the laboratory, maximal development is reached only rarely. In the females in which there was some obvious enlargement of the cloaca, a second reading was taken with the thermacouple inserted into the large intestine.

The measurements on all birds were taken during the midday period, from approximately 11 A.M. to 5 P.M., under ordinary laboratory temperatures (70° to 80°F). In view of this, the handling of the birds, and the short time that elapsed before the initial reading was taken, the body temperatures are undoubtedly maximal temperatures (*4*).

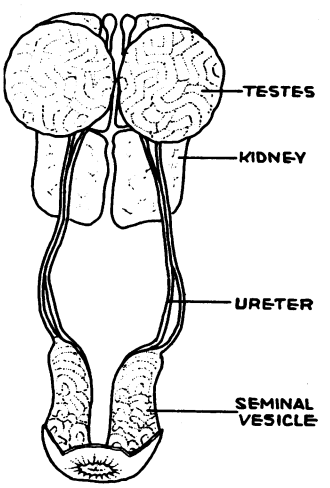

Fig. 2. Reproductive organs of a male slate-colored junco in breeding condition. Ventral view, diagrammatic, with protuberance pulled posteriorly. Weight of right seminal vesicle, 43.2 mg; left seminal vesicle, 40.4; both were 8 mm long, 3.5 mm wide, and 5.5 mm deep.

The birds in this study comprised four species that were being used in experiments on the effect of photoperiod on the reproductive cycle (see Table 1). The birds were captured during spring migration and subjected to highly stimulating photoperiods (20 hr/day), moderately stimulating periods (12 hr/day), and inhibitory periods (9 hr/day). Measurements were also made on birds retained under natural conditions of day length, which are highly stimulating.

The data are presented in Table 1. In each species, the birds are grouped first according to experimental treatment. This has been done to show the difference in the response of the accessory reproductive organs to the various photoperiod schedules. These responses are correlated with the response of the gonads. In each group, the birds are classified according to cloacal condition. The maximum condition is illustrated in Fig. 1. In the minimal state, there is hardly any elevation of the cloacal lips above the body wall. The term *moderate* indicates an intermediate state. No female reached the maximal state in these experiments. In some birds, regression of the reproductive

Table 1. Body and cloacal temperatures in some passerine birds.

No. of birds and sex	Date	Condition of cloaca	Temperature data (mean and range in °F)		
			Body	Cloaca	Difference
		Slate-colored junco (*Junco hyemalis*)			
		Group 1—Natural day length			
5 ♂ ♂	June 20	Maximum	109.4 (109.0–110.0)	101.6 (101.0–102.0)	7.8 (7.0–8.5)
4 ♀ ♀	June 20	Moderate	110.5 (110.0–111.0)	108.1 (107.0–109.0)	2.4 (1.5–3.0)
3 ♀ ♀	June 20	Minimum	110.1 (110.0–110.5)		
		Group 2—20-hr photoperiods per day beginning Apr. 17			
3 ♂ ♂	June 18	Maximum	109.3 (109.0–110.0)	102.8 (102.5–103.0)	6.5 (6.0–7.0)
2 ♀ ♀	June 18	Moderate	109.0 (108.0–110.0)	106.0 (105.0–107.0)	3.0
		Group 3—12-hr photoperiods per day beginning Apr. 16 and 17			
1 ♂	June 18	Submaxium	109.0	106.0	3.0
2 ♂ ♂	June 18	Moderate	110.7 (110.5–111.0)	107.7 (107.5–108.0)	3.0 (2.5–3.5)
2 ♂ ♂	June 18	Minimum	109.7 (109.5–110.0)		
2 ♀ ♀	June 18	Minimum	110.5 (110.0–111.0)		
		Group 4—20-hr photoperiods per day beginning Apr. 6			
2 ♂ ♂	June 22	Maximum	108.5 (108.0–109.0)	102.5 (101.5–103.5)	6.0 (5.5–6.5)
2 ♂ ♂	June 22	Regression (Mod.)	108.8 (108.0–109.5)	105.5	3.3 (2.5–4.0)
1 ♂	June 22	Regression (Min.)	109.0		
1 ♀	June 22	Minimum	111.0		
		Group 5—9-hr photoperiods per day beginning Apr. 25			
7 ♂ ♂	June 15	Minimum	108.0 (107.0–109.5)		
6 ♀ ♀	June 15	Minimum	109.1 (108.5–110.0)		
		White-throated sparrow (*Zonotrichia albicollis*)			
		Group 1—Natural day length			
3 ♂ ♂	June 20	Maximum	110.5 (109.0–112.0)	102.5 (101.5–104.0)	8.0 (7.0–9.0)
1 ♂	June 20	Regression (Submax.)	110.0	106.0	4.0
1 ♂	June 20	Regression (Mod.)	109.0		
		Group 2—20-hr photoperiods per day beginning May 15			
4 ♂ ♂	June 20	Maximum	110.9 (110.0–111.5)	104.1 (103.5–105.0)	6.8 (6.0–8.0)
		Group 3—12-hr photoperiods per day beginning May 15			
4 ♂ ♂	June 20	Maximum	111.9 (111.5–112.0)	104.3 (104.0–104.5)	7.6 (7.0–8.0)
2 ♂ ♂	June 20	Submaximum	110.5 (110.0–111.0)	105.0 (104.0–106.0)	5.5 (5.0–6.0)
2 ♀ ♀	June 20	Moderate	111.0	105.5 (105.0–106.0)	5.5 (5.0–6.0)
		Group 4—9-hr photoperiods per day beginning May 15			
4 ♂ ♂	June 20	Minimum	112.0 (111.5–112.5)		
		White-crowned sparrow (*Zonotrichia leucophrys*)			
		Group 1—20-hr photoperiods from May 31 to June 14; 12 hr, beginning June 14			
2 ♂ ♂	June 14	Maximum	107.0 (106.0–108.0)	99.5 (99.0–100.0)	7.5 (7.0–8.0)
2 ♂ ♂	June 18	Maximum	111.0	102.7 (102.5–103.0)	8.3 (8.0–8.5)
		Song sparrow (*Melospiza melodia*)			
		Group 1—Natural day length			
3 ♂ ♂	June 20	Maximum	110.5 (110.0–111.5)	103.3 (102.0–105.0)	7.2 (5.0–8.5)
1 ♂	June 20	Minimum	111.0		
1 ♀	June 20	Minimum	111.0		

organs had begun. This is indicated in the table along with the amount of regression that had occurred.

The mean body and cloacal temperatures and the range are given for each group. The results show clearly a marked difference in the temperatures of the protuberance and the body. The mean temperatures (°F) for the 10 juncos that had maximal cloacas were 109.2 (body temp.) and 102.1 (cloacal temp.); the mean difference was 7.05 with a range of 5.5 to 8.5. The mean temperatures (°F) for white-throated sparrows in similar conditions were 111.1 (body temp.) and 103.7 (cloacal temp.); the mean difference was 7.4 with a range of 6.0 to 9.0. In the white-crowned sparrows and song sparrows, the mean dif-

ferences were 7.5 and 7.2, respectively. Among the females and males with moderately developed cloacas, the temperature is lower than that of the body. The lack of development of the cloaca in the birds subjected to 9-hr photoperiods is readily observed, but it is interesting to have the added observation of essentially no change in the temperature of this region. The data on body temperature in each species agree closely with those of other authors (*5, 6*).

The function of the seminal vesicles has not been clearly worked out. It is obvious that they store sperm, but it is likely that they have other functions. The epithelium is glandular (apocrine ?) and probably contributes to the somewhat viscous semen. The ejaculate appears to be a "pinpoint" of semen which is presumed to be placed directly in or near the opening of the oviduct (*7*). It seems possible that the sperm mature here in the seminal vesicles. Sperm obtained from the testes are not motile, while those obtained from the vesicles are. In the fowl, functional changes occur in the sperm as they pass through the male ducts, and functional maturity rarely occurs in the testis or epididymis (*8*).

If the main function of the seminal vesicles in these passerine birds proves to be maturation and maintenance of sperm, then it may be that these are temperature-sensitive functions. One of the functions of the protuberance, therefore, could be thermoregulation; another may be to facilitate intromission during copulation.

References

1. C. R. Moore, *Quart. Rev. Biol.* **1**, 4 (1926).
2. A. Wolfson, *Bull. Chicago Acad. Sci.* **10**, 1 (1954).
3. A. Wolfson, *Bird-Banding*, **23**, 159 (1952).
4. S. P. Baldwin and S. C. Kendeigh, *Sci. Publ. Cleveland Museum Natural Hist.* **3**, 1 (1932).
5. A. Wetmore, *Smithsonian Misc. Collections* **72**, 1 (1921).
6. G. B. Becker and J. W. Stack, *Bird-Banding* **15**, 45 (1944).
7. A. Wolfson, *Auk*, in press.
8. S. S. Munro, *J. Exptl. Zool.* **79**, 71 (1938).

February 2, 1954.

A Note on the Flagellation of *Phytophthora infestans* (Mont.) deBary

Virginia Rogers Ferris*

Department of Plant Pathology, Cornell University, Ithaca, New York

Examinations of swarmspores of *Phytophthora infestans* (Mont.) deBary with the phase-contrast microscope reveal paddle-like structures on the flagella. It was thought that further information concerning the structure of the flagella might be obtained from an examination of the swarmspores with the electron microscope. This paper is a preliminary report on the observations made with the electron microscope and an interpretation of the findings.

* National Science Foundation fellow. The author expresses her gratitude to Benjamin M. Siegel, Department of Engineering Physics, Cornell University, in whose laboratory the electron microscopy was carried out; and to Keith Williamson and Ramona Colwell for their help in preparing the electron micrographs.

Swarmspores were prepared for examination by a method similar to that used by Manton and her colleagues in their studies of the flagella of various organisms (*1*). A suspension of swarmspores in distilled water was prepared by incubation at 12°C of sporangia from a 10-day-old culture of the fungus. Droplets of the swarmspore suspension were placed on collodion-coated grids, and the grids were placed in contact with vapor from a 2-percent solution of osmic acid. After killing and fixation had occurred, the droplets were allowed to dry. Some of the preparations were shadowed with uranium before examination, and others were left unshadowed.

The electron micrographs show that one flagellum is ciliated and one is not (Fig. 1*b*). In pictures of shadowed preparations, it can be seen that the cilia of the ciliated flagellum are themselves terminated by still smaller projections (Fig. 1*a*). These findings are

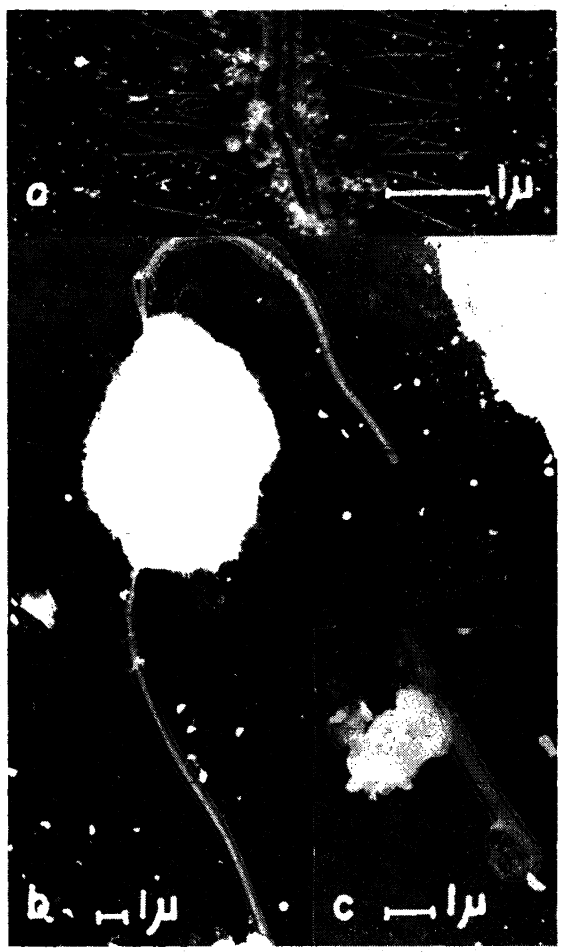

Fig. 1. (*a*) Part of a ciliated flagellum (not that of *b*) showing cilia terminated by smaller projections. Electron micrograph, shadowed, ×14,000. (*b*) Swarmspore, showing part of each flagellum. Electron micrograph, shadowed, ×3500. (*c*) Enlargement showing tip of the nonciliated flagellum of (*b*) at the initial stage of rolling. Electron micrograph, shadowed. ×7000.