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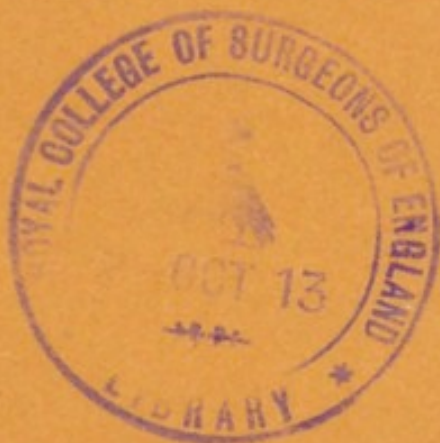


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ON THE BURSA FABRICII.

By JOHN DAVY, M.D., F.R.S., &c.

In this paper I have the honour to submit to the Society some observations which I have made on the Bursa Fabricii—an organ respecting the function of which so little has yet been determined with any certainty, some physiologists considering it, after the manner of the author who first described it, a receptaculum seminis, others the analogue of Cowper's glands, others as that of the prostate; and one as that of the urinary bladder of fishes.

For the sake of order and to save some repetition, before entering into particulars it may not be amiss to state briefly that this peculiar organ, in every instance it is met with, is found to lie low in the cavity of the pelvis, behind the intestine, either directly in the median line, or a little on one side of it; that it is covered anteriorly by the reflected peritoneum; is composed mainly of two coats, one an outer muscular, the other an inner mucous, the latter in the instances of most development abounding in follicles; that it communicates with the cloaca by an opening, in the female, close to the entrance of the oviduct, in the male between and a little inferior to that of each vas deferens, in both inferior to the termination of the ureters*; and that it has over its orifice, when most perfect, a slight valvular fold, affording some, but not perfect, security against the entrance into its cavity of fæcal matter whilst passing in the act of expulsion.

What is remarkable in this organ, giving rise to much of the obscurity adverted to, is the different aspects which it exhibits in the same animal according to age, and the differences as to form and proportional size and degree of persistence which it presents in different species.

The number of birds in which I have sought for the organ, and have examined it when found, has been considerable, at least thirty different species, all of them, with the exception of the skylark, belonging to or frequenters of the Lake district.

I may further briefly premise that, when the microscope has been used, the power employed has been that of $\frac{1}{8}$ th inch focal distance, and that, when spermatozoa have been sought for, a drop of a solution of common salt of the sp. gr. 1038, has been added to the fluid to be examined.

In the descriptive part which follows, I propose to confine myself to the more striking examples illustrative of the peculiarities adverted to and likely

* The ureters in those birds in which they are most easily traced, such as the common fowl, turkey, goose, I have found not to terminate in the cloaca, but just above it, near, or in the margin of the inner anal aperture (anus interne of M. Milne-Edwards), *i. e.* the orifice of the rectum into the cloaca; and, in consequence, the urinary excretion is voided adhering to the inferior portion of the fæcal mass which accumulates in the lower rectum—which is unusually capacious and glandular; accordingly, from such observations as I have made, I cannot but entertain great doubt of the cloaca being the proper place for the reception of the urine before its expulsion.

to aid in accounting for them, passing over the several species, or very briefly noticing them, when displaying no marked difference.

1. *Common Fowl* (*Gallus domesticus*).—I begin with this bird, as I have had the best opportunity of examining it at different ages.

1. Of a chicken four days old, the bursa was about the size of a small pea; it communicated with the cloaca, and was empty.

2. Of another chicken, seventeen days old, found dead on the 10th of March from cold, the bursa measured $\cdot 3$ by $\cdot 2$ inch; it was distinctly plicated internally; it was empty.

3. Of a young cock, eleven weeks old, examined on the 16th of June, the bursa, of a globular form, was $1\cdot 1$ inch in diameter; it communicated with the cloaca by a narrow neck about $\cdot 15$ inch in width; internally it was strongly plicated; the projecting laminae were of a crescentic form, about twenty in number, and their width, where widest, was about $\cdot 4$ inch. It contained some turbid fluid, in which were numerous mucus-like corpuscles and a few well-defined spermatozoa. The testes were large; besides sperm-cells, they contained some spermatozoa.

4. Of another cock, hatched in July, examined when nineteen weeks and six days old, the bursa, $1\cdot 2$ inch in diameter, weighed 74 grs.; it was similar to the preceding in structure, and was empty.

5. Of a third male, hatched on the 19th of September, examined when twenty-one weeks and one day old, weighing six pounds, the bursa was $1\cdot 5$ inch in diameter; its plicae like the preceding, its opening into the cloaca large; many spermatozoa were found in the little turbid fluid with which they were moistened. The testes were large; the left weighed 144 grs., the right 130 grs.; the vasa deferentia were small.

6. Of a fourth, hatched on the 18th of October, examined on the 20th of March, when seventeen weeks and seven days old, weight five pounds, the bursa, compared with the preceding, was of diminished size; its diameter only $\cdot 6$ inch, its plicae few, short and thick, and bloodshot; its opening into the cloaca large and exposed, without any valvular protection. It contained a little thick mucus, in which there was commingled an appearance of spermatozoa. The testes were large, and abounded in sperm-cells and spermatozoa; and the vasa deferentia were well developed, and contained a cream-like fluid rich in delicate spermatozoa*.

7. In a fifth, a cock of about six years old, weighing four pounds and a half, no traces of a bursa could be found. The vasa deferentia were large, and were distended with a cream-like fluid abounding in spermatozoa. They terminated well apart in the cloaca, and had neither of them a visible papilla†. The right testis weighed $93\cdot 7$ grs., the left $119\cdot 7$ grs.

* The examination was made whilst the fowl was still warm. The fluid of the testes had a distinct alkaline reaction. In other instances I have obtained the same result, showing thus a marked difference when compared with the ovum, the yolk of which, when fresh, I have always found to exhibit an acid reaction, proper precautions being taken to avoid contact with the alkaline white. See the author's 'Physiological Researches' (1863), p. 426.

† After immersion in water for forty-eight hours, then from distention the papillae appeared, each about $\cdot 24$ inch in length.

8. Of a young hen, hatched on the 17th of May, examined when eleven weeks old, the bursa was more flask-like than globular; it measured 1·7 by 1·5 inch. Its plicæ were large, and their glandular structure so well developed that the orifices of the follicles, as puncta, were seen with the naked eye. The bursa was empty, merely moistened with mucous fluid.

9. Of a hen hatched on the 17th of March, examined when seventeen weeks and five days old, the bursa was about the same size and form as that of the preceding; it contained a small quantity of turbid mucous fluid, in which were seen delicate filaments bearing a resemblance to spermatozoa.

10. Of another, hatched in May, and which, like the preceding, had never laid, examined when nineteen weeks old, the bursa, which was empty, measured 1·7 by 1·5 inch.

11. Of a fourth, hatched on the 19th of September, said to have laid and known to have been trod, examined when twenty-four weeks old, the bursa was of shrunken appearance; it was ·5 inch in diameter; its parietes thick (·2 inch thick); there were no plicæ; it communicated freely with the cloaca, and contained a little mucous fluid in which were seen filaments like spermatozoa, but not unmistakeably such. There was a large ovum nearly ready to be detached from the ovary. A very few tolerably distinct spermatozoa were found in the oviduct, which was well developed.

12. In a fifth, hatched on the 19th of July, examined when twenty weeks and five days old, after having laid about twenty-five eggs, no vestige of a bursa could be detected*.

13. Of another, about eight months old, examined on the 17th of March, after having laid three or four eggs, the bursa was of a tubular form, ·9 inch long by ·1 wide; its walls were exceedingly thin, and it did not communicate with the cloaca. In the little turbid mucous fluid it contained, a single spermatozoon was detected. There was a fully formed egg in the oviduct, the incrustation of which had begun. Nearest the infundibulum many spermatozoa were found.

14. In a laying hen about three years old the bursa was reduced to a small hard mass, hardly equal to a pea in size. It contained a minute cavity without an opening into the cloaca.

15. In another, about three years and a half old, no traces of a bursa could be detected. Its cloaca and oviduct were very large, as were also those of the preceding.

II. *Pheasant* (*Phasianus colchicus*).—In ten examined (seven males, three females), with the exception of three (inferred to be old birds), the organ in question was found. It resembled in structure that of the common fowl of from four to eight months old. In each instance it was empty, merely wet with mucous fluid. These birds were shot in November, December, January, and February. Not knowing their precise age, but supposing them to have been hatched in the spring, their bursa as to size was some-

* This was a clucking hen, and the day before had been trod. The ova in the ovary were small, the largest ·2 inch in diameter. There was no egg in the oviduct; spermatozoa were found in different parts of it.

what less than that of the common fowl. The smallest, that of a hen shot in February, measured .3 inch by .2; it retained its plicated structure, and freely communicated with the cloaca.

III. *Partridge* (*Perdix cinerea*).—Of this bird three specimens have been examined. In one, apparently old, no trace could be found of a bursa. In the other two, in which it occurred, it resembled in form and structure that of the common fowl; it measured .4 inch by .3. These were young birds which had taken wing.

IV. *Turkey* (*Meleagris gallopavo*).—In three instances of this bird, all hatched in spring, one examined in October, one in December, one in January, the bursa was found similar to that of the common fowl, and in each nearly of the same size, about 1.5 inch by .7.

V. *Grouse* (*Tetrao scoticus*).—In a young bird, not fully fledged, just capable of a short flight, shot in the island of Lewis on the 12th of August, expressly for the purpose of examination, the bursa was found small, about the size of a pea. Air was found in its humeri, but only partially in its femora. In two, both from Scotland, later in the season, no bursa could be detected. Their femora contained air as well as their humeri.

VI. *Pigeon* (*Columba domestica*).—In two full-grown males examined in September, no trace was found of a bursa; in other two (these younger birds) the bursa was pretty large.

VII. *Buzzard* (*Falco buteo*).—Of a young one taken from its nest on the 9th of June, when about a fortnight old, the bursa was globular and comparatively large, about .8 inch in diameter, non-plicated, and empty. This nestling weighed 5193 grs.; it was covered, except at the umbilicus, where bare, with plush-like yellow feathers, thick, very closely set, equal in weight to 647 grs.

VIII. *Sparrow-hawk* (*Falco nisus*).—Of a young bird, examined on the 31st of July, just capable of flight, weighing 3686 grs., its sternum still cartilaginous, its humeri only partially filled with air, the bursa was small. In another, a male, apparently an old bird, shot on the 8th of March, no traces of bursa were found. It weighed 2836 grs.

IX. *Tawny Owl* (*Strix stridula*).—Of a young one taken from its nest on the 21st of June, when well fledged, but its quill-feathers not fully formed, weight 4496 grs., the bursa was globular and comparatively large, .7 inch in diameter. It contained a good deal of turbid urinary fluid abounding in lithate of ammonia. It had no air in any of its bones.

In an old bird, the parent of the preceding, no bursa was found.

X. *Cuckoo* (*Cuculus canorus*).—Of a young one shot on the 25th of August, weight 1310 grs. (judging from its plumage, a bird of this season), the bursa was very small. In another, a male*, an older bird, shot on the 6th of June, weight 1768 grs., no traces could be found of a bursa.

XI. *Common Goose*.—Of one hatched in the spring, examined when

* One testis weighed .7 gr., and measured .24 inch by .26; the other 1 gr., and measured .28 by .20 inch; they were of a rich yellow colour, and contained sperm-cells and spermatozoa, the latter of uniform thickness, about .002 inch in length, nowise spiral.

about six months old, the bursa, of an ovoid form, measured 1·2 by ·7 inch. It was plicated, like that of the common fowl. Of two others, one four months old, one of about eight months, the bursa was about the same size as the preceding.

XII. *Common Duck*.—Of one, a male hatched in March, the bursa was of a cylindrical form, 1·6 inch long by ·4 inch wide. Its lining membrane was without plicæ; the apertures of the mucous follicles were conspicuous, and arranged in parallel lines. It contained some dark fæcal matter similar to that in the intestine.

Of another male, about three months old, the bursa was of a flask-like form, 2·6 inches in length, ·6 inch in width where widest; in structure like the preceding. It contained a turbid greyish fluid, in which were suspended granules and small globules. It was coagulated by nitric acid.

Of a female, about a month older, of the same brood, the bursa resembled the last.

Of another female, a little more than a year old, the bursa was very small; its cavity was not quite obliterated, nor was its opening into the cloaca closed.

Of a male about two years old, no traces remained of a bursa.

XIII. *Water-hen* (*Gallinula chloropus*).—Of a male shot in November, the bursa, of a flask-like form, was ·6 inch by ·4; its cavity was small and without plicæ.

XIV. *Common Coot* (*Fulica atra*).—In a male shot on the 8th of March no bursa was found.

XV. *Common Gull* (*Larus canus*).—The same remark applies to one examined in January.

XVI. *Woodcock* (*Scolopax rusticola*).—In two examined, one in December, the other in February, no traces of a bursa were found.

XVII. *Rook* (*Corvus frugilegus*).—Of this bird thirteen specimens have been examined. In eight no traces of a bursa were detected; from their appearance and the quality of their bones, it was inferred that they were a year or more old. In the remaining five a bursa was met with; three were examined in May, two in August; all had the marks of young birds. Of one, which weighed 6132 grs., caught when not quite capable of flight, the bursa was nearly globular and about ·7 by ·6 inch; it was distended, as was also the cloaca, with a turbid fluid abounding in lithate of ammonia. Its inner surface was not plicated, but slightly pitted. Of the others, the bursa differed little from the last; it was somewhat smaller. In the bursa of one of these some flakes were found, consisting chiefly of lithate of ammonia.

XVIII. *Carrion-crow* (*C. corone*).—Of a young male shot on the 21st of June the bursa was globular, very like that of the rook, about ·7 inch in diameter; it contained some flakes of lithate of ammonia.

Of another, shot on the 30th of June, weight 6163 grs., the bursa was somewhat different in form; it was broadest at its base; it measured ·9 by ·8 inch.

Of one killed on the 16th of July, weight 5653 grs., the bursa was smaller; it contained some flakes of lithate of ammonia.

Of a fourth, killed in February, which, judging from the smallness of the oviduct, was not an old bird, the bursa, had it not been for its opening into the cloaca, might have escaped observation, not on account of its smallness, for it was little less than that of the preceding, but from the extreme thinness of its coats and adherence to the adjoining tissues.

XIX. *Jackdaw* (*C. monedula*).—Three specimens have been examined. Two of these were old; in neither of them was there a bursa: one was young; it was shot on the 11th of July, and was fully fledged; its bursa was pretty large, similar to that of the rook, and empty.

XX. *Jay* (*C. glandarius*).—Of one, judging from the state of its bones, hatched in spring, the bursa was comparatively large, heart-shaped, measuring .6 by .4 inch. Its cavity was small; its inner surface smooth, without plicæ.

XXI. *Blackbird* (*Turdus merula*).—Six different specimens have been examined. In an old bird shot in March, a male, no trace of a bursa was found.

In an unfledged nestling, weighing 112 grs., found dead, the bursa was so thin as to be translucent; it was proportionally large, and contained some flakes of lithate of ammonia.

In the others, which were examined between the middle of June and the beginning of October, none of them, it was inferred, more than five months old, the bursa, nearly globular, was from about .4 to .5 inch in diameter; its lining membrane was smooth; its parietes proportionally thick. In each instance it was empty.

XXII. *Song-thrush* (*T. musicus*).—In an old male examined on the 28th of June no bursa was found.

Of two young ones obtained on the 15th of the same month, the bursa was about the size of a large pea; one was empty, the other contained some lithate of ammonia.

XXIII. *Water-ousel* (*T. cinclus*).—In one, a male, probably a young one, a small bursa was found. It was shot on the 11th of November. In another, an older bird (judging from its appearance), shot at the same time, there was no trace of a bursa*; and the same remark applies to a third examined in January.

XXIV. *Common Starling* (*Sturnus vulgaris*).—Of a young one shot on the 29th of June, the bursa was about the size of that of the young thrush. In two old birds shot on the 7th of March, not a trace of the organ was found.

XXV. *Skylark* (*Alauda arvensis*).—In two examined in January there was the like deficiency.

XXVI. *Chiffchaff* (*Trochilus minor*).—Of one, a young bird, ex-

* It was shot near the river Brathy, in which charr were then spawning. In its gizzard and œsophagus nine ova of this fish were found; they were transparent when extracted, but immersed in water they soon became opaque.

mined on the 14th of July, the bursa, of moderate size, contained a little faecal matter. In another, an older bird, shot in March no bursa could be found.

XXVII. *Robin* (*Sylvia rubecula*).—Of a young one found dead on the 16th of June, still warm, weight 255 grs., the bursa was of moderate size.

Of another, nearly fully fledged, found dead on the 25th of June, weight 285 grs., the bursa was comparatively large, exceeding a little in size that of the preceding.

XXVIII. *Yellow Ammer* (*Emberiza citrinella*).—In one, a male, its testes abounding in spermatozoa, examined on the 16th of June, there was no trace of a bursa.

XXIX. *Blue Tit* (*Parus cæruleus*).—Of two young ones examined on the 8th of June, when just able to fly, one weighing 177·5 grs., the other 162 grs., the bursa was comparatively large; in each it was empty.

XXX. *Cole Tit* (*P. ater*).—In one examined in February no trace of the organ could be found.

XXXI. *Martin* (*Hirundo urbica*).—Of three young ones taken from the nest on the 10th of July, the bursa was comparatively large; in each it was empty. One nestling weighed 414 grs., another 398 grs., the third 423·5 grs. The parent birds were both found of less weight; that of the male was 263 grs., of the female 287·4 grs. In the latter a distinct bursa was found, little less than that of the young birds. Search was made for spermatozoa, but none were found in it. Of the male, the pelvis was so injured by shot that it was useless for examination. In a male shot on the 1st of August, the testes of which contained spermatozoa, no trace of a bursa was found.

From the preceding results may not the following conclusions be drawn?—

1st. That in some birds, as in the common fowl, and probably in all the gallinaceous family, and that of the Anatidæ, the bursa increases in size and in completeness of organization up to a certain age, beyond which it gradually diminishes equally in both sexes, and eventually disappears.

2nd. That in other birds, those of rapid growth, which take wing as soon as they are capable of flight, the bursa is comparatively large whilst they are nestlings, does not increase conspicuously, if at all, with their growth, but rather diminishes, and after a certain age disappears, and probably sooner than in the first mentioned. The buzzard and owl are examples, and probably all birds of the same family, all of the Corvinæ, all of the thrush kind, and all the smaller birds, with the exception perhaps of the female martin.

Of the uses of the organ, I venture to conjecture, founding my conjectures on what I have observed, that they may be provisional and various; that in some birds, whilst nestlings, it may act the part of a urinary bladder, as witnessed in the instance of the young owl, and in some of the young rooks, crows, and thrushes, thereby tending to prevent the fouling of the

nects; that in others it may serve as a seminal reservoir at an early period, and in both male and female in the instances mentioned, in which it has been found most completely formed before the attainment of full size—in the male before the vasa deferentia are fully developed, in the female so long as the oviduct is still small and unexpanded; and that generally, as the organ is more or less amply supplied with mucous follicles, it may serve, by the secretion it yields, to lubricate the cloaca with which it is connected, and to aid in its functions.

These conjectures, or inferences, if deserving of being so considered, might be supported by what we know of the structure of the part and its position in relation to the termination of the ureters, of the spermatic vessels, and of the oviduct; but I think it better to rest them on the facts observed—the urinary matter detected in the organ in some instances, the spermatozoa in others*, and the mucous fluid generally.

But granting even that the bursa may be useful, and in the female as well as in the male, in aid of fecundation, as Fabricius supposed, yet his extreme view that that aid, in the stored-up spermatic fluid in the bursa of the hen bird, might suffice for a year, as stated in the subjoined passage†, for which and for other extracts I am indebted to the kindness of Professor Sharpey, is both highly improbable, and is opposed by the fact of the decrease of the bursa with the advancing age of the fowl, and the enlargement of the oviduct and of the vasa deferentia. Harvey, who was opposed to the notion of Fabricius, expresses the opinion that an intercourse once or twice repeated might suffice to impregnate a whole bunch of yelks, he having found that an egg laid on the 20th day of seclusion of a hen produced a chick‡. This fact is an interesting one, however explained. It might be adduced in favour of the opinion of Fabricius; but inasmuch as the passage of the fully-formed egg in the act of expulsion does not necessarily secure the expulsion of any spermatozoa previously received into the oviduct, it is of little value in the argument: and here I may mention that I have detected spermatozoa in the oviduct, even in that portion in which the egg was receiving its calcareous incrustation.

* As in no instance I have yet found unquestionable spermatozoa in the bursa of the young hen, I cannot fairly infer that the bursa in the female is a receptaculum seminis; but as in two instances there were detected in it filaments which were very like these bodies, and in one a single pretty distinct spermatozoon, and further, as the bursa seems to diminish rapidly as the oviduct becomes developed and not till then, is it not probable that for a short time it may perform the part assigned, as conjectured above? It need hardly be remarked that the mucous secretion of the bursa adds to the difficulty of demonstrating the presence of spermatozoa.

† “Semen autem Galli ad podicem immittitur, et in vesica reponitur et conservatur, quousque pullus conformetur; immo vero per totum integrum anni tempus inibi servatur, postea quam semel admisso Gallo, ova omnia per totum illud anni tempus fecunda red-duntur, tanquam vesica unicum ob id foramen habente, ut in concluso loco semen Galli diutius ut in proprio et congruo loco servetur.”—*Opp. Omnia*, Lugd. Bat. 1738, p. 21.

‡ *Opera Omnia*, a Col. Med. Lond. ed. 1766, p. 206.