

Histological observations on some coccidial lesions, in natural infestations, of goats in India

(Observations histologiques sur des lésions coccidiennes dans des infestations naturelles des chèvres aux Indes)

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Introduction

Seven species of *Eimeria* Schneider, 1875, are known to occur in the goat (Levine, 1961; Levine et al., 1962). But for the work of Balozet (1932) on the life cycle of *E. ninakohlyakimovae* (Yakimoff and Rastegaieff, 1930) Levine, 1961, systematic studies on the different caprine species do not seem to have been undertaken and information on some of the other species is derived from work on sheep. It is generally assumed that the species of coccidia parasitic in sheep also occur in goat, although Lotze et al., 1961, were unable to produce cross infections which resulted in oocyst production. Recently, Levine et al. (1962) have given an account of some of the endogenous stages believed to be of *E. arloingi*, and also described the schizonts of an unknown species in the epithelial cells of some glands of Lieberkühn in the jejunum. The present paper reports on some of the endogenous stages encountered in a histological study of eimerian lesions in 67 goat intestines. These have been determined to be associated with two distinct species, *E. arloingi* and *E. faurei*.

Material and Methods

During a survey, conducted by one of us (P.P.S.) in the academic session of 1961-62, on the incidence of the eimerian species parasitic in 214 local goats — which also includes slaughter house material — oocysts, mostly from the rectal contents, were sporulated. From their characteristics of shape, size, colour and time of sporulation the species of coccidia in goats were found to be: *E. arloingi*. (Marotel, 1905) Martin, 1909; *E. crandallis* Honess, 1942; *E. ninakohlyakimovae*; *E. parva*, Kotlán, Mócsy and Vajda, 1929; *E. faurei* (Moussu and Marotel, 1902) Martin, 1909; and *E. intricata*, Spiegl, 1925 [*E. intricata* was reported by Levine from sheep only (Singh, 1962)]. Sixty seven goat intestines, from the local slaughter house or from post-mortem examinations, were examined for gross coccidian lesions by scrapings. The lesioned tissue was fixed, serially cut and stained (H. and E.) for histological study.

Observations

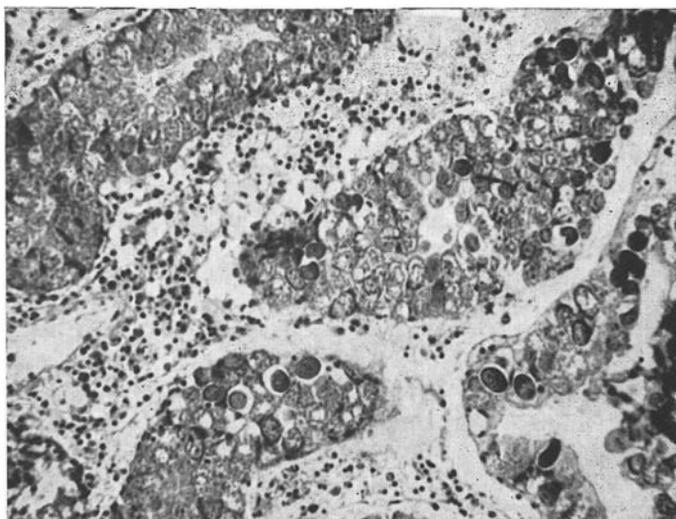
SMALL INTESTINE: Five types of the macroscopic lesions were observed in the duodenum, jejunum and ileum.

1. When held up to the light, distinct white patches in the form of small sessile polyps with rounded or pyramidal shape were seen on the mucous lining of the small intestine, even from the serosal side. These were observed to be concentrated mostly in the ileum. Sometimes they were of reddish (erythromatous) colour. These lesions which were of a softer consistency easily became detached on scraping and, when they were examined under the microscope, revealed numerous gametocytic stages inside the parasitised cells. On a number of occasions, the characteristic capped oocysts of *E. arloingi* were found. Macrogametocytes, microgametocytes and the oocysts, in various degrees of development (Fig. 1, 2, 3 and 4), were found in the epithelial cells in the series of sections. These gametogonic stages, which sometimes occurred in aggregations, practically affected all the epithelial cells of one or more villi, causing them to be enlarged (Fig. 5). Sometimes these stages were present in small numbers and occurred either at the base of the crypts of Lieberkühn or in a few of the surface epithelial cells. These lesions containing the harboured stages were determined to be of *E. arloingi* by comparing their parasites with those described for *E. arloingi* in sheep by Lotze (1953). Measurements of oocysts inside the tissue sections were similar to those of the oocysts recovered from the faecal samples.

2. Whitish patches with no outgrowths, but in general level with the intestinal mucous membrane, and of a size varying from a few microns to 0.5 cm., were observed. Gametocytic stages belonging to *E. arloingi* were found in the scrapings of these. In serial sections of these lesions, gametogonic stages of this species were seen.

On one occasion, in a stained series of sections of the duodenum which was positive for all the sexual stages of *E. arloingi*, there was a rather large schizont in the interglandular area but lying more towards the lumen of the intestine. It was rounded to ovoidal in shape and $238 \times 190 \mu$ in size. Its numerous nuclei were arranged peripherally in the form of many spheres which were interconnected. There was a thick outer wall or capsule (Fig. 6) composed of concentrically laminated fibres derived from tissue reaction and stained with eosin. This structure showed essentially the details given for the developing schizonts of *E. bovis* in cattle as described by Hammond et al. (1946); but evidently it was not fully mature, because under the oil immersion lens, it did not exhibit merozoites inside. As this case was apparently of a pure infection with *E. arloingi*, as ascertained from prior faecal examination, and had also revealed the gametocytic stages belonging to this species, it was indicated that this schizont belonged to *E. arloingi* although its size appeared somewhat greater than that indicated by Lotze for the schizont of this species in sheep.

3. Prominently large and whitish-yellow coloured thickened patches of a spreading type and measuring up to 2.5 cm. in size were observed in the ileum on one



FIGURES 1 to 14: Photomicrographs of sections of alimentary canal of goats.

FIG. 1. — Section of a small intestine showing hypertrophy of the glandular lining harbouring various gametogonic stages of *E. arloingi*.
150 X.

FIG. 1. — Coupe d'intestin grêle chez la chèvre montrant une hypertrophie des villosités avec divers stades gamétogoniques d'*E. arloingi*.
150 X.

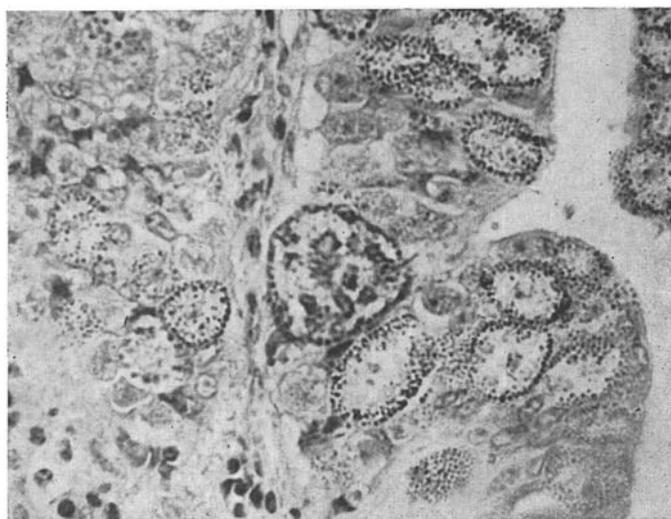


FIG. 2. — Section of an ileum showing, in the centre, an advanced stage in the development of a male gametocyte of *E. arloingi*.
400 X.

FIG. 2. — Coupe au niveau de l'iléum montrant au centre un stade avancé dans le développement d'un gamétocyte mâle d'*E. arloingi*.
400 X.

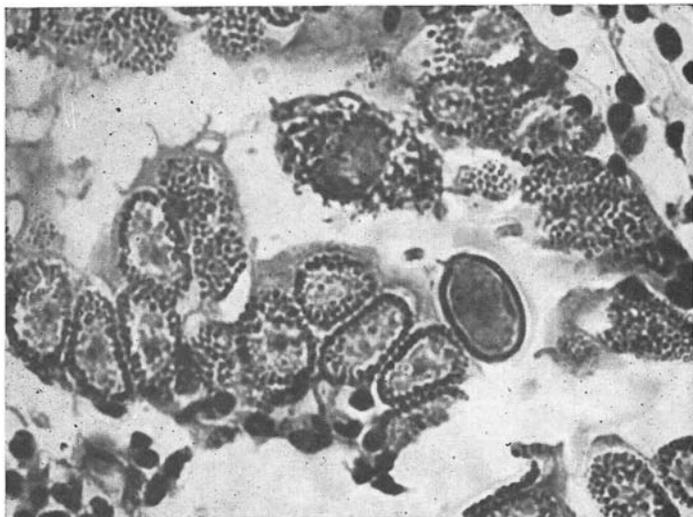


FIG. 3. — Cross section of an ileum showing fully matured characteristically capped oocysts of *E. arloingi* and the male gametocyte with fully formed gametes and residual body. 600 \times .

FIG. 3. — Coupe transversale dans l'iléum montrant un oocyste mûr avec sa coque caractéristique d'*E. arloingi*, ainsi qu'un gamétocyte mâle rempli de gamètes entièrement constitués avec le corps résiduel. 600 \times .

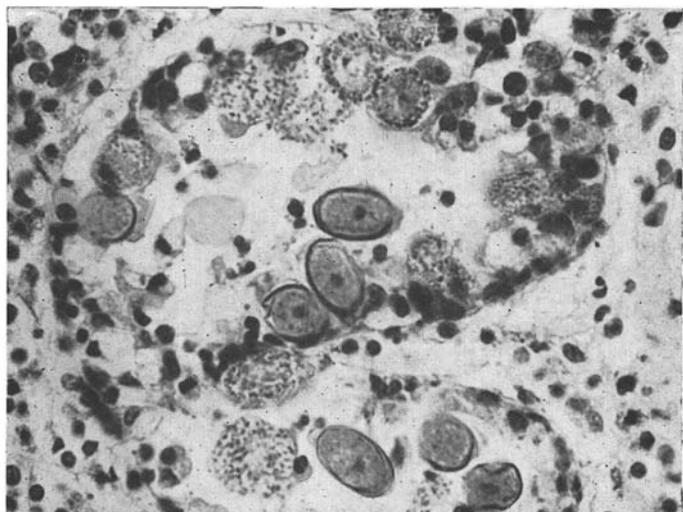


FIG. 4. — Section of a small intestine showing, in the deeper glandular cells, the fully mature characteristically capped oocysts of *E. arloingi* and the male and female gametocytes. 400 \times .

FIG. 4. — Coupe d'intestin grêle montrant, dans la profondeur des cellules glandulaires, les oocystes mûrs d'*E. arloingi* avec leur coque caractéristique, ainsi que des gamétocytes mâles et femelles. 400 \times .

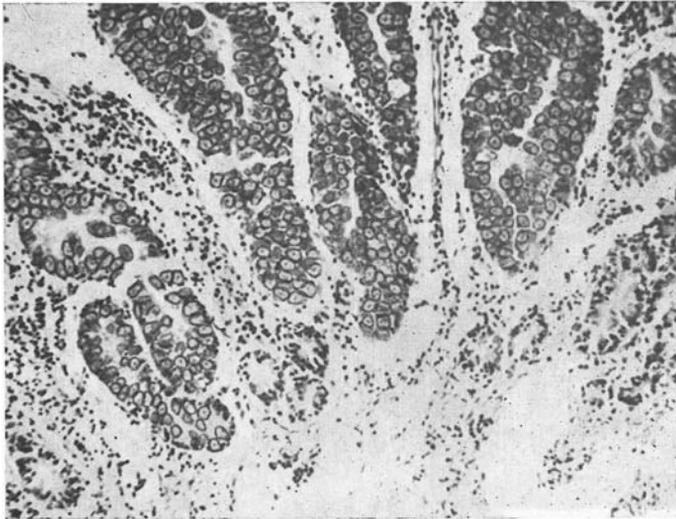


FIG. 5. — Section of an ileum showing heavy parasitization of the cells in the glandular crypts with the gametogonic stages of *E. arloingi*. 100 \times .

FIG. 5. — Section montrant un parasitisme intense des cellules, au niveau des cryptes glandulaires, avec des gamétocytes d'*E. arloingi*.

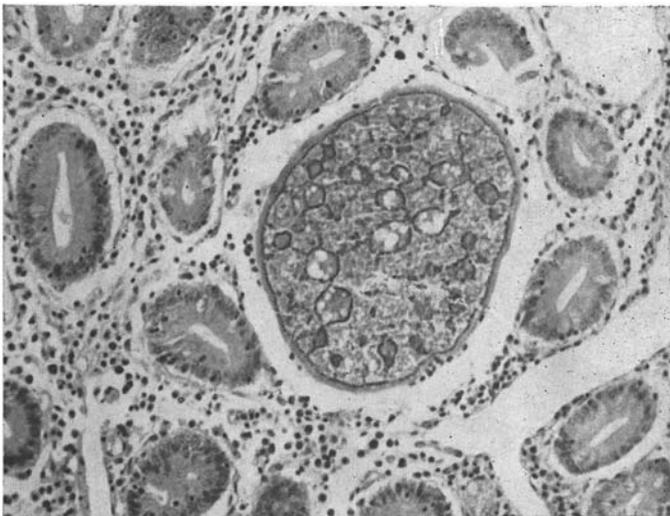


FIG. 6. — Cross section of duodenum showing a thick-walled schizont of *E. arloingi* in the inter-glandular area. 150 \times .

FIG. 6. — Coupe transversale du duodénum montrant un schizonte d'*E. arloingi* à paroi épaisse dans un espace interglandulaire. 100 \times .

occasion. These were hard to the touch as compared with the lesions described above, and scrapings of them revealed sexual stages but no oocysts. In heavy infestations, the histological examination showed there were developing forms in the surface epithelium as well as in the epithelium of villi which were hyperplastic (Fig. 7); some of the gametocytes were in their early developmental stages.

In another series of sections of an ileum, another schizont of particular interest was found. This schizont, ovoidal in shape and situated in the interglandular area near the surface, measured $214 \times 167.2 \mu$ in size and although crescent-shaped merozoites were seen under the oil immersion lens (Fig. 8, 8a), the schizont did not seem to be fully matured. It belonged to either *E. arloingi* or *E. crandallis*, for in *E. nina-kohlyakimovae* the schizont is stated to be of a smaller size which, according to Lotze (1954), is about 300μ in diameter in sheep. The infection, as determined from faecal examination, was of three species: *E. arloingi*, *E. crandallis*, and *E. nina-kohlyakimovae*. In addition to the schizont, early gametocytic stages were also present.

4. Punctiform haemorrhagic areas over thickened oedematous patches were found. Serial sections of such patches revealed macrogametocytes measuring $23.8-30.6 \mu$ in length and $17-20.4 \mu$ in breadth; the microgametocytes measured $34.0-47.6 \mu$ in length and $20.4-30.6 \mu$ in breadth. The male gametocytes were in much greater numbers than the female gametocytes. They occurred singly in the lumen of the intestinal glands and occupied nearly all of the available space in the host cells (Fig. 9). The host-cell nucleus was pushed to one side. On the basis of the size of the sexual stages in the lesions, the infection was considered to be due to *E. arloingi*.

5. After careful examination on many occasions, some minute pinhead-sized spherical bodies were found on the mucosa of the small intestine, particularly in its distal half. When these were removed with the help of pointed forceps, they appeared to be cysts with a definite wall and an inner structure which was clear under the microscope. Stained serial sections of such lesions showed that these bodies were giant schizonts which were situated at the tip of the lacteal or deep towards the base of the mucosa. They measured $210-380 \mu \times 129.2-304 \mu$ in size and contained numerous nucleated bodies which, under oil immersion, were rounded or crescentic in shape and had a central nucleus surrounded by a bit of cytoplasm (Fig. 10 and 11). On account of their large size, the neighbouring areas of tissue appeared to have undergone pressure atrophy. The nuclei in this surrounding tissue were arranged towards the periphery of these bodies. The intestinal tissue harbouring such structures exhibited degenerative changes. The cellular lining of the crypts and the glands was also destroyed.

These bodies appear to be schizonts of *Eimeria*. Since the faecal examination of this goat had revealed oocysts of *E. arloingi*, *E. faurei*, *E. crandallis*, and *E. parva*, it was not possible to determine the species to which these schizontic bodies belong.

LARGE INTESTINE: Sometimes the gross lesions were a thickening and oedematous condition of the large intestine; in some cases there was congestion in the colon with a denudation of the surface epithelium. A histological study of such areas showed,

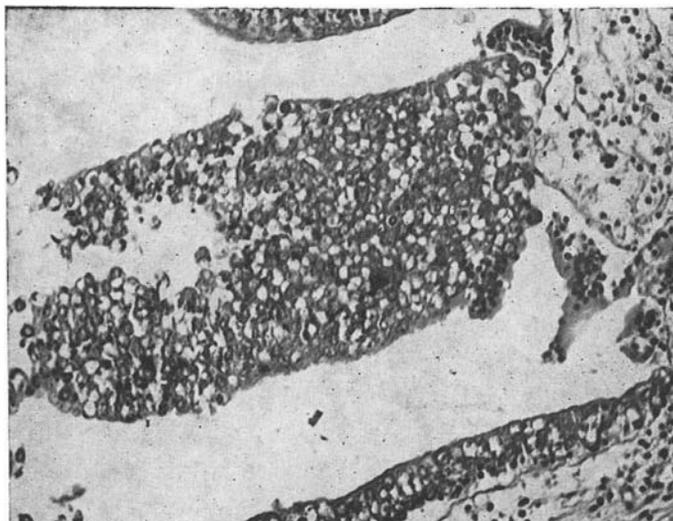


FIG. 7. — Section of the spreading type of lesion in the small intestine showing a very heavy parasitization of the surface epithelium with the sexual stages of eimerian species. 60 X.

FIG. 7. — Section d'une lésion de type extensif au niveau de l'intestin grêle montrant une infestation intense de l'épithélium par des stades sexués d'*Eimeria* sp.

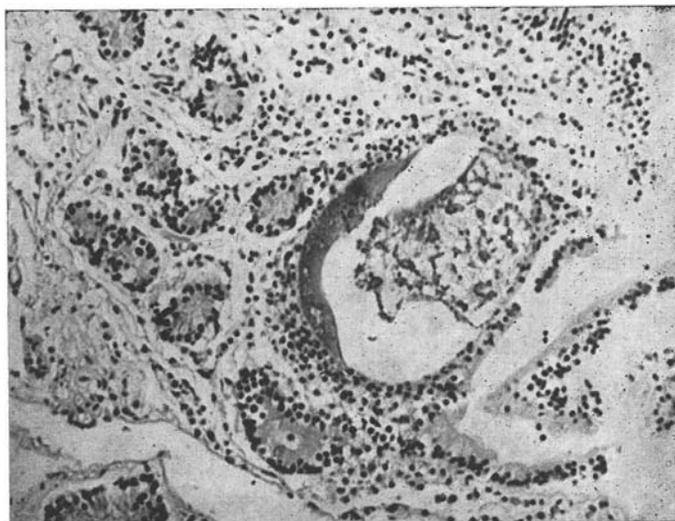


FIG. 8. — Section of lesion in the small intestine showing a schizont in a more advanced stage of development but situated more superficially. 150 X.

FIG. 8. — Section d'intestin grêle montrant un schizonte à un stade plus avancé de développement mais situé plus superficiellement. 150 X.

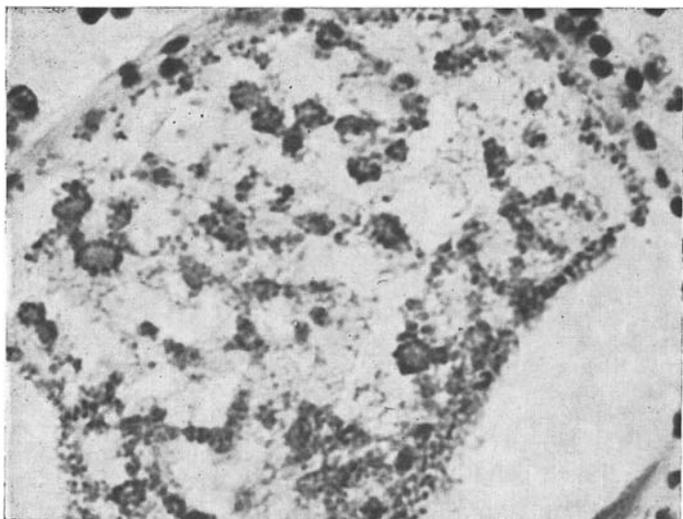


FIG. 8a. — Schizont of figure 8, under high power, showing fully formed merozoites. 600 \times .

FIG. 8a. — Schizonte de la figure 8, à un plus fort grossissement, portant des mérozoïtes tout formés.

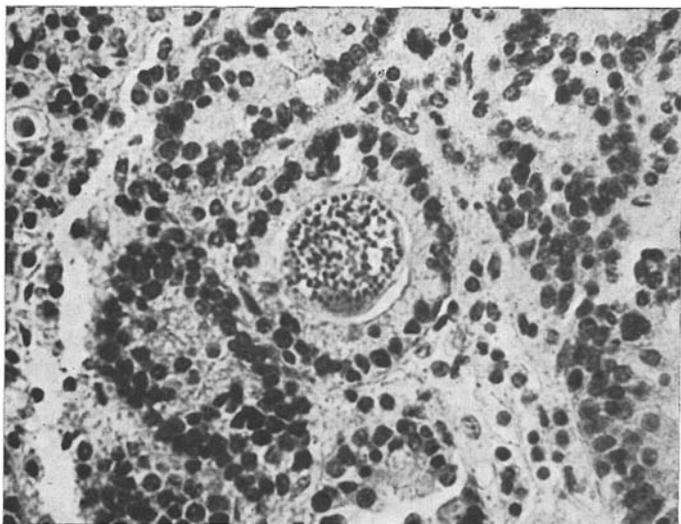


FIG. 9. — Section of a haemorrhagic lesion in the gland lumen of the ileum showing a male gametocyte with the host-cell nucleus pushed outward. 400 \times .

FIG. 9. — Coupe d'une lésion hémorragique dans la lumière d'une glande de l'ileum montrant un gamétoyte mâle et le noyau de la cellule hôte rejeté vers l'extérieur.

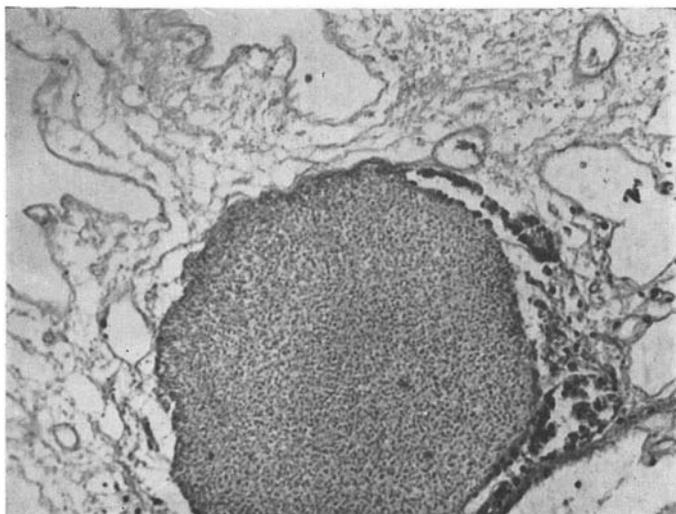


FIG. 10. — Section of a small intestine showing a giant schizont of the mucosa and exhibiting crescent-round merozoites. 150 X.

FIG. 10. — Coupe d'intestin grêle montrant un schizonte géant à la base de la muqueuse, avec de nombreux mérozoïtes.

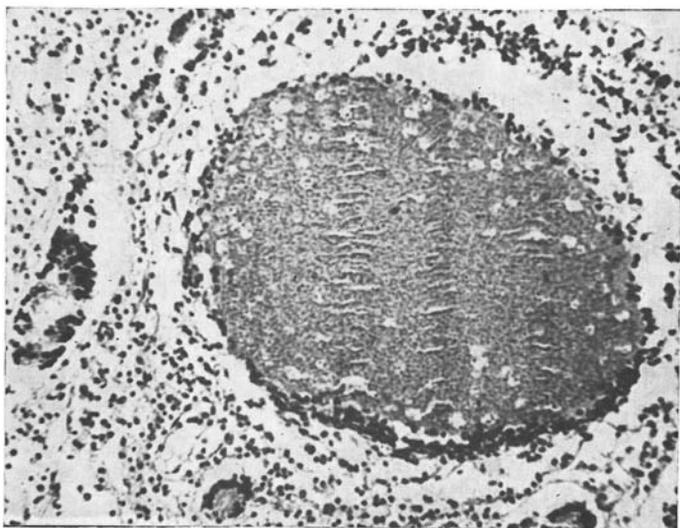


FIG. 11. — Section of small intestine showing the same type of body, as in fig. 10, but with a different nuclear pattern and the presence of vacuoles. 150 X.

FIG. 11. — Même type d'organisme que précédemment, mais avec des caractéristiques nucléaires différentes et la présence de vacuoles. 150 X.

in the lining of the gland, both gametocytic and oocystic stages (Fig. 12 and 13). Male and female gametocytes in various stages of development and characteristic oocysts were found in these serial sections. The shape and size of the fully formed oocysts presented no difficulty in identifying the infection as due to *E. faurei*.

The macrogametocytes, usually lying at deeper sites in the glandular epithelium, showed the nuclei of the hypertrophied host-cells pushed towards the cavity of the gland or in the opposite direction. The nearly mature macrogametocytes were ovoidal in shape and had a dot-like haematoxylin — stained karyosome with a vesicular nucleus and a homogenous basophilic nucleoplasm and an ill-defined nuclear wall. They measured $23.8 - 27.2 \mu \times 17.00 - 20.4 \mu$ in size. The mature microgametocytes occurred mixed with immature forms and macrogametocytes. They were spherical to elongate in shape. Those that had burst showed a clear residual body lying towards their centre and comma — shaped gametes with one end slightly thicker than the other. At times, the egg-shaped and capless oocysts completely filled the lumen of the gland and, in sections, were cut in various planes (Fig. 14). Those that had been cut perfectly longitudinally measured $23.8 - 30.6 \mu$ in length and $17.0 - 22.1 \mu$ in breadth and appeared slightly smaller than those which were recovered from the faeces. The nucleus of these revealed the same characters as seen in the macrogametocytes and the sporont had a clear space around it.

These endogenous stages, occurring inside the glandular lining, had completely destroyed the attacked cells. The fully formed oocysts, lying packed in the lumen of the gland, had caused complete loss of the glands. These were now simple cavities with the oocysts lying inter-mixed in a mass of degenerated cellular material and a copious mass of eosinophils and macrophages. At places, the surface epithelium was denuded and the interglandular areas were infiltrated with a large number of eosinophils, lymphocytes, and macrophages. In some of the glands, the reparative changes included an increase in the interglandular spaces from oedematous changes.

As far as could be ascertained from available literature, there is no information on the histopathology of *E. faurei* infections nor details about the location of its gametocytes in the large intestine of goats. Thus, the present finding seems to be the first description of the gametogonic stages of *E. faurei* in goats.

ACKNOWLEDGEMENT

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Summary

A survey conducted on 214 goats revealed the presence of eimerian infection with *E. arloingi*, *E. crandallis*, *E. faurei*, and *E. intricata* in goats in India. The intestine of 67 goats procured at a local slaughterhouse or at postmortem examinations were used in a histological study of coccidial lesions. The lesions have been identified as being

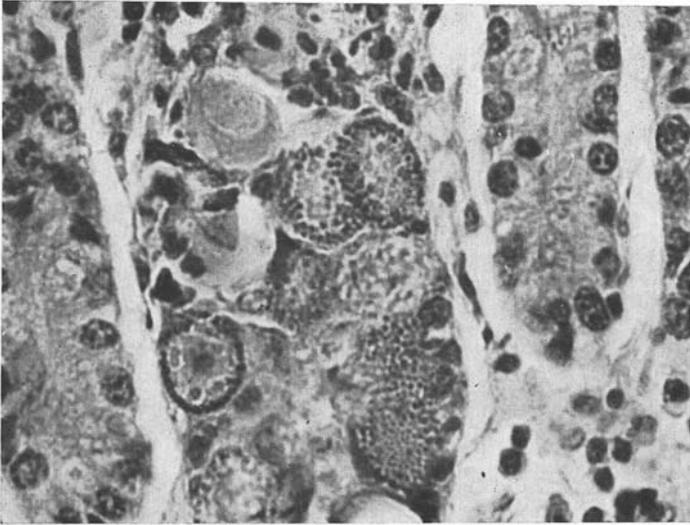


FIG. 12. — Section of caecum showing the male and the female gametocytes of *E. faurei* in the glandular epithelium. 600 \times .

FIG. 12. — Coupe du caecum montrant des gamétocytes mâles et femelles d'*E. faurei* dans l'épithélium glandulaire. 600 \times .

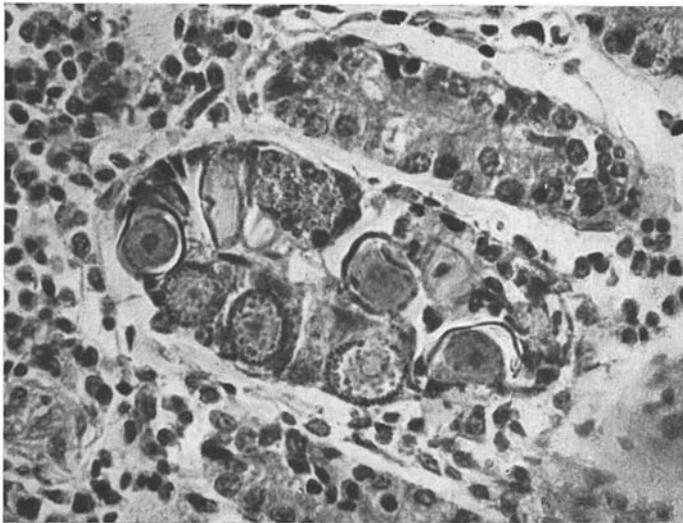


FIG. 13. — Section of the deeper glands of the caecum showing the gametocytes and the oocysts of *E. faurei*, cut in different planes. 400 \times

FIG. 13. — Section des glandes profondes du caecum montrant des gamétocytes et des oocystes d'*E. faurei* coupés dans des plans différents. 400 \times .

due to *E. arloingi* and *E. faurei*. Besides, certain observations on the histopathological changes and endogenous stages of the parasites found in the study, this paper records the finding of eimerian schizonts of giant size and which were not identified as to species. Also, this paper records for the first time the sexual stages of *E. faurei* in the goat.

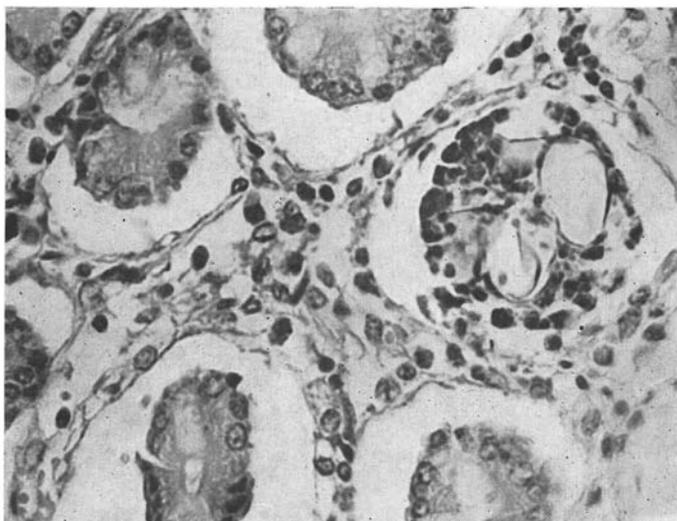


FIG. 14. — Section of caecum showing typical egg-shaped oocysts of *E. faurei* in the glands. 600 \times .

FIG. 14. — Coupe du caecum montrant, dans les glandes, l'aspect typique en forme d'œufs des oocystes d'*E. faurei*. 600 \times .

Résumé

Une enquête effectuée aux Indes sur 214 chèvres a révélé chez ces animaux la présence d'infections eimériennes dues à *E. arloingi*, *E. crandallis*, *E. faurei* et *E. intricata*.

Les intestins de 67 chèvres provenant des abattoirs, ou prélevés après autopsie, ont été utilisés pour une étude histologique des lésions coccidiennes.

Ces lésions ont été reconnues imputables à *E. arloingi* et *E. faurei*.

À côté de certaines observations sur les modifications histopathologiques consécutives à ces infestations, et sur les stades endogènes des parasites observés au cours de cette étude, ce travail fait état de la découverte de schizontes d'*Eimeria* de taille géante, non identifiables à une espèce connue.

Enfin, cet article signale pour la première fois les stades sexuels d'*E. faurei* chez la chèvre.

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