STUDIES ON THE BACTERIOLOGY AND PATHOLOGY OF BOVINE ENDOMETRITIS

by

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INTRODUCTION.

It is generally agreed that the greatest economic loss suffered by the dairy industry is that due to sterility either temporary or permanent. Efficient dairying and breeding demands that a cow shall give birth to a healthy calf every twelve months and be in milk for at least 300 days in the year. If on the other hand the dairyman is obliged to keep a dry cow or one in low lactation he suffers an economic loss in direct proportion to the cost of maintenance for any time beyond three months before she again becomes pregnant. In addition he loses the potential profits of dairying over the same period of time. An account concerning the incidence of infertility in Great Britain contained in the report of the Economic Advisory Council's Committee on cattle diseases (1934) states that of the annual 58.2 per cent wastage in dairy cows due to diseases, 26.8 per cent resulted from diseases of the reproductive system. The Survey Committee on the National Veterinary Medical Association of Great Britain and Ireland (1941) considered that the chief cause of infertility was endometritis of various types, usually secondary to Brucella abortus infection. It also stated that not more than 10 per cent of all causes of sterility in average herds was due to "physiological derangement" and that 80 per cent of the loss from infertility was preventable. The same report estimated the monetary loss from milk and calves due to the presence of sterility, to the tune of £7,600,000 annually.

Albrechtsen (1920) was the first to emphasise the fact that the chief cause of infertility in cows was endometritis which was the result of bacterial infect-:ion. His belief has since been supported by well known obstetricians including Williams (1921), Oppermann (1924), Richter (1926), Nielsen (1926) and others. Nielsen further stated that in herds infected with Brucella abortus the incidence of infertility was much higher than in uninfected herds due to greater facility in such cases for bacterial infection of the genital tract to occur following abortion and retention of placenta. In Brucella free herds such infections are said to be less common. Nielsen, however, gave no figures to support this view. Quinlan (1929), who made an extensive study of sterility in cattle, came to the conclusion that chronic endometritis was responsible for 70 to 80 per cent of sterility in cows in South Africa.

Though it is thus generally recognised that endometritis caused by bacteria is the most important cause of sterility, very little information is available on the bacteria responsible for such a condition. Contributions to the literature in this field have been largely clinical, although some notable work has been done in bacteriology and pathology. Much of the work that has been done seems to have been directed mainly towards the study of the pathogenicity of Brucella abortus and Trichomonas foetus for the reproductive system. Very few workers have taken the trouble to ascertain/

ascertain the nature of other bacteria which might be present in the genital tract either alone or in association with the Brucella group of organisms. It is frequently recorded that cultures of Brucella abortus were obtained but generally no mention is made of the presence or absence of other organisms. Whenever organisms other than Brucella have been encountered the prevailing view has been that they were contaminants. It is apparent that this view is rather a broad assumption unsupported by any scientific evidence. Contagious abortion, trichomoniasis and tuberculosis no doubt play a great role in the production of pathological conditions resulting in sterility or impaired fertility, but it is not unlikely that the so-called contaminants or saprophytes may be responsible for the inflammatory condition either primarily or secondarily. It is but rational to expect that any organism given the right conditions can invade the uterus.

Unfortunately most of the workers in this field have occupied themselves with a study of the pathological conditions of the genital tract without any previous knowledge of the bacteria in normal as compared with abnormal genital tracts. The question which naturally arises at this stage is - what is the bacterial flora of the normal genital tract of the cow. It is obvious that an answer to this question will help a great deal in the proper understanding of the bacterial aspect of endometritis. Though a fair amount of work has been done recently on the bacterial flora of the vagina/

vagina of cows, the questions of the bacterial content of the normal uteri of the large domestic animals is still open to doubt. There are two schools of thought: some research workers (Lutje, 1924; Klimmer and Haupt, 1929) hold that the uteri of healthy animals are normally sterile; a conclusion supported by similar views in human medicine, where in healthy women the Fallopiom tubes, the uterine cavity and the upper third of the cervical canal are free of microorganisms (Shaw, 1945). The other group of authors (Sohnle, 1901; Day, 1917; Beller, 1925, and others) have almost without exception been able to demonstrate bacteria in non-pregnant as well as pregnant uteri of cows.

In the light of these observations it seemed to the author a contribution to the problem of sterility in cattle could be made by a study of the bacteriology and pathology of endometritis. The investigation recorded herein was therefore pursued in an endeavour to obtain accurate information along the following lines, viz. to determine the bacterial flora in a series of normal pregnant and non-pregnant uteri and their associated Fallopian tubes and cervices of cows; to determine the bacterial flora in a series of abnormal uteri, their Fallopian tubes and cervices, and to correlate them with the pathological features of these structures; and to test the influence of some of the predominant organisms isolated upon the genital tract of experimental animals.

HISTORICAL SURVEY.

It is generally credited that Sohnle (1901) was the first/

first veterinary research worker to investigate the bacterial flora of the genital tract of animals. After a prolonged study he published a number of interesting papers in which he stated that he found the same bacteria in the uterine cavity of mares as well as in the organs of the foals. However, he did not examine healthy mares. Day (1917) working in America secured bacterial growths in 56 per cent (out of 18) of non-pregnant and 32 per cent (out of 25) of pregnant uteri of cows. Hagan (1917) examined 10 non-pregnant and 16 pregnant uteri and his findings were 80 per cent positive in the non-pregnant and 87.5 per cent positive in the pregnant uteri. Hagan's material consisted of both normal and grossly pathological genital tracts. Both Day and Hagan conducted bacteriological work in the abattoir soon after slaughter of the cows, but Day's cultures were made in Chicago where cows of beef breed were slaughtered, while those of Hagan were made in Buffalo where the cows and heifers slaughtered were virtually all dairy animals.

Of the eleven genital tracts of pregnant cows examined by Carpenter (1920) five were uniformly negative for bacteria. "Bacterium abortum" was isolated from the foetal fluids of one uterus. A streptococcus mixed with "Pseudomonas pyocyaneus" was found in the uterus of one tract. He also examined 18 genital tracts from non-pregnant cows considered to be normal. Five of these yielded no growths while six gave cultures from the uterus only. Streptococci were recovered from four uteri and one of the oviducts. In others

streptococci/

streptococci, staphylococci and "Pseudomonas pyocyaneus" were isolated either in pure or mixed cultures. Staphylococcus aureus was isolated once from the cervix uteri of one tract.

Beller (1925) investigated the bacterial flora of the uterus, navel cord and placenta of cows and ewes soon after parturition. In the ewe he cultured the amniotic and allantoic fluids as well; portions of the amniotic and allantoic "water bags" were ligated in an aseptic manner and the contents inoculated into bouillon. He obtained uterine material from living non-pregnant cows by infusing into the uterine cavity a 0.85% salt solution by means of a glass funnel and rubber tube which had just been taken out of a 3% creolin solution. He recovered from these inocula "cocci and rods". As a result of his researches, he came to the conclusion that, "The uterus of domestic animals under wholly physiological conditions tolerates a latent bacterial growth without necessarily causing injury to either mother or foetus." The difference between the physiological and pathological state of the uterus according to Beller is the higher resistence of the endometrium or weak virulence of the organisms.

Klimmer and Haupt (1929) examined uteri of mares, cows, sheep, pigs and dogs after slaughter. These authors arrived at the conclusion that the normal non-pregnant uterus of domestic animals was sterile. Hofstadt (1912) made cultural examination of 12 gravid bovine uteri (3 to 5 weeks pregnant) in which he found bacteria in ten (83 per cent).

Conklin/

Conklin, McCarthy, Thompson and Pugsley (1931) examined 80 pregnant uteri, of which 9 were sterile and 71 (88.7%) yielded bacteria. From these the authors isolated an imposing flora belonging to seventeen genera. Nineteen of these uteri exhibited gross pathological lesions of either the uterus or the placenta. Infection was sometimes found in the utero-chorionic space and sometimes in the amniotic fluid and in most cases in both situations simultaneously.

Pellizzari (1933) examined the genital organs of 50 female calves. The majority of the uteri appeared normal; in a few cases the uterine body and horns contained much mucus, in others cases haemorrhages on the uterine mucosa were seen and in one case pus was present. On bacteriological examination, bacteria of various types were recovered not only from those organs which appeared abnormal but also from some which appeared normal. The organisms were mainly "Bact. coli", staphylococci and diplococci.

Quinlan (1929) studied the problem of sterility in cows and concluded that chronic endometritis was responsible for 70 to 80 per cent of sterility in cows in South Africa. He also reported tuberculosis of the uterus in 18 per cent of tubercular cows destroyed during investigations on sterility. But he did not investigate the bacterial aspect of endometritis. Laszlo (1935) on a histopathological study of 300 uteri found that 5% were affected with chronic suppurative endometritis; 3% with chronic non-suppurative endometritis/

endometritis; 3.6% with tuberculous endometritis, and 1.6% showed pigmentation.

The foetal fluid and foetuses (18th to 47th week old) of healthy horses and cattle were found to be sterile by Dubovsky (1932). Buhlmann (1933) isolated Corynebacterium pyogenes from the vaginal discharges of three cows suffering from metritis and vaginitis. Erismann and Saxer (1933) examined 202 uteri on post-mortem and found that 68 were affected with endometritis. Pop and Ogneru (1937) on an examination of 15 cases of pyometra, isolated Trichomonas genitalis in nine of them. In five cases it was found in association with "B. coli", staphylococci and streptococci. It was found in pure culture in four cases.

Wacherbarth (1937) examined 22 uteri from non-pregnant cows (positive for Brucella infection: titre 500). No macroscopic evidence of infection was found in 17 cases; pyometra was found in two and glandular enlargement in three. In nine cases histological findings were abnormal. Neither culturally nor by animal inoculation could Brucella abortus be demonstrated in any uterus.

Fitch, Delez and Boyd (1930) examined the uterine exudate of naturally affected cows with the object of making an accurate determination of the interval during which Brucella abortus is excreted from the uterus. Twelve days were found to be the average period during which the organisms were excreted in the uterine discharges. Subsequently Fitch, Boyd, Bishop and Kelly (1939) studied the problem of localisation of Brucella/

Brucella abortus in the bovine uterus and came to the conclusion that Brucella abortus may be found in the non-gravid uterus. Uteri of cows condemned for slaughter because of Brucella infection were examined as follows:- pieces of uterine mucosa were ground up with sterile sand and injected intraperitoneally into guinea-pigs. Of the 93 non-gravid uteri examined, Brucella abortus was isolated from 51%. 27 of the 93 showed evidence of recent parturition, and Brucella abortus was found in 23 or 85%. 63 uteri showed no evidence of recent parturition and Brucella abortus was isolated from 24 (36%) of these. Of the 41 gravid uteri examined Brucella abortus was found in 13 (45%) of pregnancies of four and a half months or over.

Sykora (1932) made a bacteriological survey of the vagina of normal and sterile cows and concluded that most of the organisms isolated were saprophytes or secondary invaders. He also reported that from the cervix of normal cows he isolated staphylococci in 75 per cent of cases examined, the remaining 25 per cent being sterile. He was of the opinion that there was no difference in the type of flora of healthy and diseased cows (although Corynebacterium pyogenes was isolated from diseased animals only.) Pascu (1939) examined the vaginal swabs of normal cows and came to the conclusion that an increased number of coliforms was present around the urinary meatus and a higher degree of infection in the vestibule.

Smith and Sherman (1939) in a study of streptococci found/

found in the vagina of normal cows recovered 27 strains of Streptococcus acidominimus but none of Group B. streptococci. Francis (1941) examined the vaginal swabs of 40 dairy cows and isolated Corynebacterium pyogenes, Streptococcus dysgalactiae and Streptococcus uberis each once, and Streptococcus acidominimus 15 times. On a special investigation designed for the detection of Streptococcus agalactiae, from the vaginal swabs of 20 heifers and 56 cows, Harrison (1942) reported negative findings.

Weitz (1947) made a cultural survey of vaginal swabs from 100 normal cows and 186 cows with abnormal discharge. He isolated streptococci, staphylococci, Bacillus coli, Corynebacterium renale, Corynebacterium pyogenes and certain unidentified diphtheroids. Though there was similarity in the bacterial flora of normal and abnormal vaginae, the most striking difference was the isolation of Corynebacterium pyogenes in 27.6 per cent of the purulent discharges in contrast to its rare occurrence in normal cows or in sterile cows without abnormal discharge.

There is very little information available in literature with reference to the incidence of tubercle bacilli in the vaginal and uterine discharges of cows. Steward (1941) examined microscopically samples of uterine discharge from a series of 78 cows. 24 of these were found to be positive for tubercle bacilli and in 19 of the positive cases there was during life no other definite evidence of tuberculosis. Later, Berger/

Berger (1944) reported the finding of tubercle bacilli in smears from vaginal discharges in 12 out of 128 cases. He further stated that this proportion of 9 per cent might well have been increased if more careful or repeated examinations had been carried out. However, both the above examinations were carried out in an area (Cheshire) where tuberculosis among cattle is said to be common.

Eggink (1914) in an analysis of 20 cases of acute and chronic endometritis isolated Bacillus tuberculosis 12 times; "B. pyogenes bovis" 14 times; streptococci 12 times; B. coli 6 times; staphylococci 5 times; B. proteus 3 times; and B. subtilis once; while Wall (1914) reported the isolation of "Bacillus pyogenes" 6 times; streptococci 4 times; streptococci and Bacillus pyogenes 5 times; streptococci and B. coli once; streptococci, Bacillus pyogenes and Bacillus coli once; streptococci and a bacillus once from an examination of 18 cases of metritis in cows. Beaver (1922) investigated the bacterial flora of the genital tracts of 19 sterile cows after slaughter. He inoculated the material on serum-agar and horse blood agar plates. Five of the tracts were sterile bacteriologically. From the rest he isolated staphylococci, B. subtilis, non-haemolytic streptococci, Corynebacterium pyogenes and viridans streptococci. He regarded the last two only as pathogenic. Attempts to inject two heifers with a culture of Corynebacterium pyogenes failed.

Reports of the isolation of pleuropneumonia-like organisms/

organisms in the human genital tracts, both normal and abnormal (Dienes and Smith, 1942; Beveridge, 1943; Salaman et al., 1946; and others) have aroused interest among veterinary research workers. In this connection Edward, Hancock and Hignett (1947) examined vaginal discharges from 64 cows and heifers and material from seven bulls; and isolated pleuropneumonia-like organisms from 18 cows and six bulls. It is said that infected cows came from herds with an irregular breeding history.

MATERIALS.

The observations herein reported are based on a study of 231 genital tracts of cows of which 131 were apparently normal and 100 abnormal. All these genital tracts were obtained from cows slaughtered in the abattoirs of Ayr and Edinburgh. They were all from the Ayrshire breed of cows. Following the collection of the genital tracts at slaughter, an effort was made to obtain the breeding history of each animal by forwarding a questionnaire to the original owner of the animal, in which the following information was requested.

Identification Number.

1. Age?
2. Date of last calving?
3. Number of calvings?
4. Whether the calving had been normal?
5. Whether the placenta had been retained?
6. Whether the animal had shown "whites" after calving?
7. Had the cow ever aborted?
8. Had the cow been blood tested and if so, with what result?
9. Had the cow been vaccinated against Brucella abortus infection ? If so, when and with what vaccine?
10. Had the cow been served since last calving? If so, how often, and on what date was she last put to the bull?
11. Had there been any evidence of discharge during heat or after service? If so, what was the character of the discharge?

In most cases it was possible to ascertain the age of the cow and the number of calves it had had with details of all its previous calvings, i.e. whether normal or abnormal and whether the placenta had been retained/

retained or any discharge had occurred.

Procedure and Technique.

When collecting the specimens for examination the genital tract was taken immediately after the slaughter of the cow and tied with a sterile ligature, a handsbreadth from the external genital orifice, wrapped in a sterile towel and transported to the laboratory in a clean container. At the time of slaughter of the cow a sample of blood was obtained for carrying out agglutination test against Brucella abortus antigen. Whenever there was evidence of acute or suppurative mastitis the udder was also collected for bacteriological examination.

The bacteriological examination of the genital tracts so obtained was made within one to three hours of slaughter of the cow. In a small number of cases where it was not possible to do the cultural examination immediately, the uteri were kept in the refrigerator overnight.

Material for cultural examination was taken from each of the following sites - cervical canal, corpus uteri, right and left uterine horns and right and left uterine tubes. When periuterine abscesses, cystic ovaries and other abnormal structures were present, material from these was also obtained.

The following technique was observed in obtaining inocula from the various sites.

Cervical canal: The genital tract was spread dorso-ventrally on a clean enamel tray. An area on the dorsum of the cervix midway between the external and internal/

internal os uteri was sterilised by searing with a heated spatula. Then an incision was made with a sterile scalpal into the canal, a sterile platinum loop introduced into the canal and rubbed against the mucosa. In this manner it was generally possible to obtain sufficient material on the loop for purposes of inoculation.

Body, Horns and Tubes: The corpus uteri was seared just below the bifurcation of the horns, the horns and the Fallopian tubes midway along their lengths. These sterilised sites were opened with sterile precautions and a long platinum (4 inches) loop introduced into the respective cavities and rubbed against the mucosa, taking care not to touch the edges of the incision. In some cases, especially the normal ones where sufficient material could not be obtained on the loop, about 5 cc's of warm glucose broth was introduced into the lumen of the uterus and pipetted in and out several times by means of a Pasteur pipette, or a piece of mucosa was removed with sterile forceps and rubbed directly on the surface of media. If there was fluid or discharge in the uterus it was withdrawn into sterile pipettes. When pregnant uteri were cultured the same procedure was followed.

In addition a piece of the cervical seal of mucus was removed and cultured. The amniotic fluid was withdrawn into sterile pipettes and spread profusely on the surface of solid media and about five c.c's were inoculated into serum-glucose-broth. Material from the utero-chorionic space and the foetal and maternal cotyledons/

cotyledons, if they were large enough to yield pieces of tissue, was also obtained.

Media.

Material thus obtained from each of the sites was seeded directly on to the following media, with a view to satisfying the optimum growth requirements of different types of bacteria.

1. Three blood agar plates (containing 5-10 per cent normal horse blood); one each for aerobic, anaerobic and microaerophilic incubation.

2. Three glucose-serum-broth tubes (bouillon containing one per cent glucose and ten per cent normal horse serum.)

3. One crystal-violet-liver-agar plate for micro-aerophilic incubation.

4. One bacto-tryptose-agar plate containing 2.5 per cent horse blood for micro-aerophilic incubation.

For anaerobic incubation McIntosh and Fildes' anaerobic jar was used while for micro-aerophilic incubation, 5-10 per cent Co2 was introduced into the jar containing the cultures.

All cultures were incubated at 37°C. The aerobic cultures were examined after twenty-four and forty-eight hours' incubation, while the anaerobic and micro-aerophilic cultures after three days, five days and seven days. The various colonies were picked and subcultured into serum broth, and after testing for purity, the strains were stored in cooked meat medium, at room temperature for further study.

5. During the later part of this work uterine material was also inoculated on to the special media recommended by Edwards/

Edward (1947) for the isolation of pleuropneumonia-like organisms from human vagina. The medium consisted of ox-heart infusion broth containing one per cent peptone and two per cent agar; plates were poured after adding 20 per cent horse serum, 10 per cent fresh yeast extract and 1 in 8,000 thallium acetate. The final pH of the medium was 8.0. Just before use two drops of a solution of penicillin containing 1,000 units per c.c. were spread over half the plate and allowed to dry. A semi-solid medium was also used. This contained only 0.3 per cent agar and a 1 in 2,000 concentration of thallium acetate. Immediately before use about 100 units of penicillin per c.c. of the medium were added. The cervical and the uterine mucus was inoculated heavily both on plate and into soft agar.

The plates were incubated in a closed jar at 37°C. After 3-4 days' incubation they were examined for the characteristic colonies of pleuropneumonia group. Semi-solid agar tubes were incubated for a week before discarding them as negative.

6. With a view to check up cultures in case of dead bacteria or living organisms which failed to grow in media smears were made from cervical and uterine mucus or exudates and stained by Gram's method, Giemsa's stain and methylene blue; in suspicious cases Ziehl-Neelsen's stain was also employed.

7. Cervical and uterine discharges from all cases were examined for the presence of trichomonads. Fresh moist smears in warm saline were examined microscopically

for/

for the characteristic motility. If the flagellates were not observed, the discharges were inoculated into a special medium which was examined for trichomonads after 24, 48 and 72 hours' incubation at 37°C.

The medium used was that recommended by Kerr (1947) and was prepared as follows:-

Into sterile test tubes about 5 c.c's of sterile bovine serum were run. The tubes were then placed in an inspissator and heated to 75°C. for one hour to coagulate the serum into slopes. Trypsin broth of a pH of 8.0 containing 2 per cent glucose was then run in and this was covered by a thin layer of sterile liquid paraffin. The medium was sterilised by steaming for one hour on each of three successive days, then incubated to test for sterility. The final pH was 7.4 to 7.6.

Before discarding these tubes as negative after examination for trichomonads, sub-cultures were made on blood agar plates for any bacterial growth. It is of interest to note here that Corynebacterium pyogenes grew well in this medium. In a number of cases where no primary growth of Corynebacterium pyogenes was obtained on blood agar plates, it was possible to isolate Corynebacterium pyogenes from this medium. Moreover its presence was easily indicated by the liquefaction of the serum of this medium. This medium seems therefore to have a special use for the isolation of Corynebacterium pyogenes when it occurs in small numbers mixed with other bacteria.

Crystal/

Crystal violet-liver-agar (Huddleson, 1939) was prepared as follows:-

500 c.c's of distilled water was added to one pound of fresh minced liver, mixed well and placed in cold-store for 24 hours. The container was then covered and placed in a steam steriliser for two hours. From time to time the contents were vigorously stirred. The infusion was removed and strained through muslin cloth. The following ingredients were then measured out: Agar 20 grams; distilled water 500 c.c.; liver infusion 500 c.c.; peptone 5 grams and Sodium chloride 5 grams. These were mixed and steamed for one hour stirring to dissolve the agar. Then the pH was adjusted to 7.2 and 1.4 c.c. of a hot 1/10 per cent aqueous solution of Crystal-violet was added. Now the medium was steamed for a further half an hour. Finally the medium was distributed in pour tubes and sterilised at 15 lbs. pressure for 30 minutes. Plates were poured just before use in the usual manner.

Bacto-tryptose-agar was prepared as follows:-

To one litre of bouillon (pH 7.2) 20 grams of Bactotryptose, one gram of dextrose, 5 grams of Sodium chloride and 20 grams of Bacto-agar were added. These ingredients were mixed and steamed for one hour stirring to dissolve the agar. The medium was then distributed in pour tubes and autoclaved. The final pH of the medium was 7.0. Plates were poured after adding horse blood to a concentration of 2.5 per cent.

Carbohydrate Media were prepared as follows:-

Peptone (Evans) 10 grams.

Sodium chloride. 5 grams.

Distilled water. 1,000 c.c.

These were mixed and steamed for 15 minutes to dissolve the ingredients, and then filtered through chardin paper. The pH was adjusted to 7.6 with N/1 NaoH and sufficient Andrade's indicator (one per cent) was added, then autoclaved at 15 lbs. for 15 minutes. When cool the following sterile solution was added aseptically.

Carbohydrate 5 grams.

Water 10 c.c.

Finally distributed into tubes in a sterile manner.

In the study of corynebacteria the carbohydrate media were made up in Hiss's serum water.

Fermentation reactions were read daily up to seven days' incubation at 37°C. except in the case of corynebacteria where the readings were taken at 2 day intervals up to 10-15 days.

Test for the liquefaction of gelatin was made by incubating the test tubes at 37°C. for four to seven days and examining the tubes after cooling.

All organisms isolated were fully examined for their morphological and biochemical characteristics and in the attempt to identify them the author has closely followed the classification drawn up in the fifth edition of the "Manual of Determinative Bacteriology" by Bergey et al., (1939). Standard methods and techniques were used throughout except where stated.

The agglutination test for Brucellosis was performed against/

against Brucella abortus antigen, kindly supplied by Dr. A. W. Stableforth, of the Veterinary Laboratory, Weybridge. A titre of 1 in 20 with crystal clear supernatant was taken as a positive test.

The pathogenicity of staphylococci was judged by their ability to form coagulase. Citrated human plasma was diluted 1 in 5 with normal saline solution and 0.5 c.c. of the dilution was pipetted into each of two test-tubes (7.5 cms. x 8 m.m.). One tube was inoculated with five drops of an overnight broth culture of the organism under test. The other tube was used as a control. Both the tubes were incubated at 37°C. for 3 to 6 hours and examined every hour. If no clot had appeared by this time, the tubes were left overnight at room temperature and again examined. The test was recorded as positive if, at either of the readings the inoculated tube could be inverted without loss of fluid.

In grouping the streptococci Lancefield's acid extraction method was used. The strain under test was inoculated in 15 c.c. of 1 per cent glucose broth in test tube and incubated overnight, the rest of the procedure was exactly the same as described by Mackie and McCartney (1948).

In the case of Corynebacterium pyogenes, filtrates of culture grown in litmus milk for 72 to 76 hours at 37°C. were tested for their haemolytic activity in the presence of specific anti-toxin (Lovell, 1939).

Pathological examination.

After/

After obtaining material for cultural examination, the genital tract was examined macroscopically and the lesions, if any, described. Measurements of the various parts were taken as follows:-

(a) The cross-measurement of the cervix was taken at about the junction of its middle and caudal third. The length of the canal and thickness of the wall were also noted.

(b) The body of the uterus was measured from the cranial extremity of the cervix to the point of bifurcation of the horns of the uterus.

(c) The uterine horns were measured from the bifurcation to their apices. The thickness of the wall was taken about the junction of the middle and the lower thirds.

(d) The state of the ovaries with regard to the Graafian follicles and corpus-luteum was noted.

(e) Immediately after the macroscopic examination of the genital tract representative slices of tissue were cut from cervix, uterine horns and tubes and preserved in 10 per cent formal saline.

After fixation, the blocks were put through dehydrating and clearing reagents in the following manner:-

Methylated spirit (containing 5% phenol) 2 changes, 12 hours each.

Absolute alcohol - 2 changes, 3 hours each.

Absolute alcohol and benzol (equal parts) - 12 hours.

Benzol - 2 changes, 6 hours each.

Benzol/

Benzol paraffin (equal parts) 12 hours.

Paraffin wax - 2 changes, 12 hours each.

Paraffin - for embedding.

The sections were stained by Haematoxylin - Eosin; Eosin-methylene blue and van Gieson's stain. Whenever necessary they were also stained by Gram's and Ziehl-Neelsen's methods and other differential stains.

Hydrogen-ion Concentration of Uterine Fluids.

In a series of normal and abnormal cases the pH of the uterine discharges and amniotic fluid was determined with a Cambridge potentiometer, using the quinhydrone half-cell and saturated calomel half-cell. About two cubic centimeters of discharge was collected in a glass tube measuring 4" x 1.5". To the discharge was added an equal quantity of glass distilled water and a pinch of quinhydrone and the whole mixed with a glass rod. Immediately on solution the electrodes were immersed in the fluid and the potentiometer readings taken. The pH was read from the table in the Handbook of Chemistry and Physics (Hodgman, 1939). It was often not possible to collect sufficient fluid from normal uteri. In such cases 4 c.c. of glass distilled water was washed through the uterus and collected. The electrodes and the potentiometer were standardised against standard buffer solutions each day before use.

Part I.

Bacteriological Examination of Normal Genital Tracts of Cows*.

A. Examination of normal non-pregnant genital tracts.

For the purpose of this investigation great care was taken to include in this group only genital tracts (including the ovaries) which were perfectly normal in appearance, varying only within the physiological limits (Hammond 1927). As a further check 25 of these uteri picked up at random were also examined histologically and were found to be normal. Besides, in considering a genital tract as normal for bacteriological examination, the history of the cow was very important, in order to correlate the anatomical appearance with the actual breeding history of the animal. Such a history was available in 75 cases out of the 100 examined. The data showing the age, number of calvings and other details are tabulated in Table 1. The age of the cows varied from 2 to 15 years and the number of calvings 1 - 12; 25 of these were heifers that were either not put to bull or just "ran with the bull". Eight cows had difficulty in settling down after their last calving, even though there/

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*The term "genital tract" as used in this text includes cervix uteri, corpus uteri, uterine cornua, and Fallopian tubes.

there was nothing apparently abnormal with their genital tract on post-mortem examination. In these cases, it is possible that other factors such as hormonal disturbance, nutrition or the infertile bull might have caused failure to breed.

Results:-

One hundred normal genital tracts were examined for their bacterial flora. The results of bacteriological examination showing the nature and location of bacteria are set forth in Table 11.

51 genital tracts were sterile bacteriologically and 49 yielded bacteria belonging to the following genera in one or more sites - Micrococcus, Corynebacterium, Staphylococcus, Escherichia, Streptococcus, Bacillus, Alcaligenes and Sarcina. An analysis of the results shows that of the 49 tracts which yielded bacteria, 15 had bacteria in the cervix and uterus, 23 only in the cervix, 7 only in the uterus, 2 in the cervix, uterus and Fallopian tubes, one in the cervix and Fallopian tube only and one in the uterus and Fallopian tube only. It will thus be seen that when the incidence of bacteria in the cervix is ignored, only 26 (26%) of the uteri (including Fallopian tubes) contained bacteria, as compared with 49 (49%) when the cervix is included.

Bacteria were isolated 41, 9, 20, 9, 2 and 2 times from the cervix uteri, corpus uteri, right uterine cornu, left uterine cornu, left and right Fallopian tubes/

tubes respectively. These results are tabulated in Table 111 and represented graphically in Graph 1.

TABLE 111.

Showing the number of times bacteria isolated from the various sites.

	Cervix uteri	Corpus uteri	R. uterine cornu	L. uterine cornu	R. uterine tube	L. uterine tube
Number of times bacteria isolated	41	9	20	9	2	2
Percentage *	88.6	18.3	40.8	18.3	4.0	4.0

* Based on 49 genital tracts which yielded bacteria.

The nature of the curve shows that the incidence of bacteria in the genital tract is highest in the cervix uteri and falls abruptly in the corpus uteri reaching a minimum in the Fallopian tubes. It is further seen that the right uterine horn is the more frequent seat of bacteria than the corpus uteri and left uterine horn. This is probably due to the fact that the potential area in the uterine body is small when compared to that of the horns and the right horn is larger and more frequently the gravid one than the left (Sommer, 1912). This latter observation is supported by the results of this investigation of 31 pregnant uteri where the right horn was gravid in 21 cows (67.7%). It is a matter of surmise that as a result of frequent pregnancy and parturition there may



GRAPH 1. Showing distribution of bacteria in the genital tract of cows. (31 normal pregnant, 100 normal non-pregnant, and 100 abnormal genital tracts.). Figures represent the number of times bacteria were isolated from an organ.

be more chances of bacteria reaching and surviving in the right horn.

Micrococci were the most frequent and they were isolated 31 times - 15, 5, 6, 4 and 1 times from the cervix uteri, corpus uteri, right and left uterine cornu and left Fallopian tube respectively.

Corynebacteria were isolated on 24 occasions - 12, 1, 7, 3 and 1 from the cervix uteri, corpus uteri, right and left uterine cornu and right Fallopian tube respectively.

Staphylococci were isolated 22 times - 16, 1, 3, 1 and 1 times from the cervix uteri, corpus uteri, right and left uterine cornu, and left Fallopian tube respectively.

Coliform bacilli were isolated 13 times - 9, 2, 1 and 1 from the cervix uteri, corpus uteri, right and left uterine cornu respectively.

Streptococci were recovered 12 times - 8, 1, 1, 1 and 1 from the cervix uteri, corpus uteri, right and left uterine cornu and right Fallopian tube respectively.

Bacilli (Gram positive sporulating rods) were recovered four times - 1, 2 and 1 from the cervix uteri, right and left uterine cornu respectively.

Sarcinae were isolated three times - once each from the cervix uteri, right and left uterine cornu respectively.

Alcaligenes faecalis was isolated from the right uterine cornu and right uterine tube of one uterus.

Table/

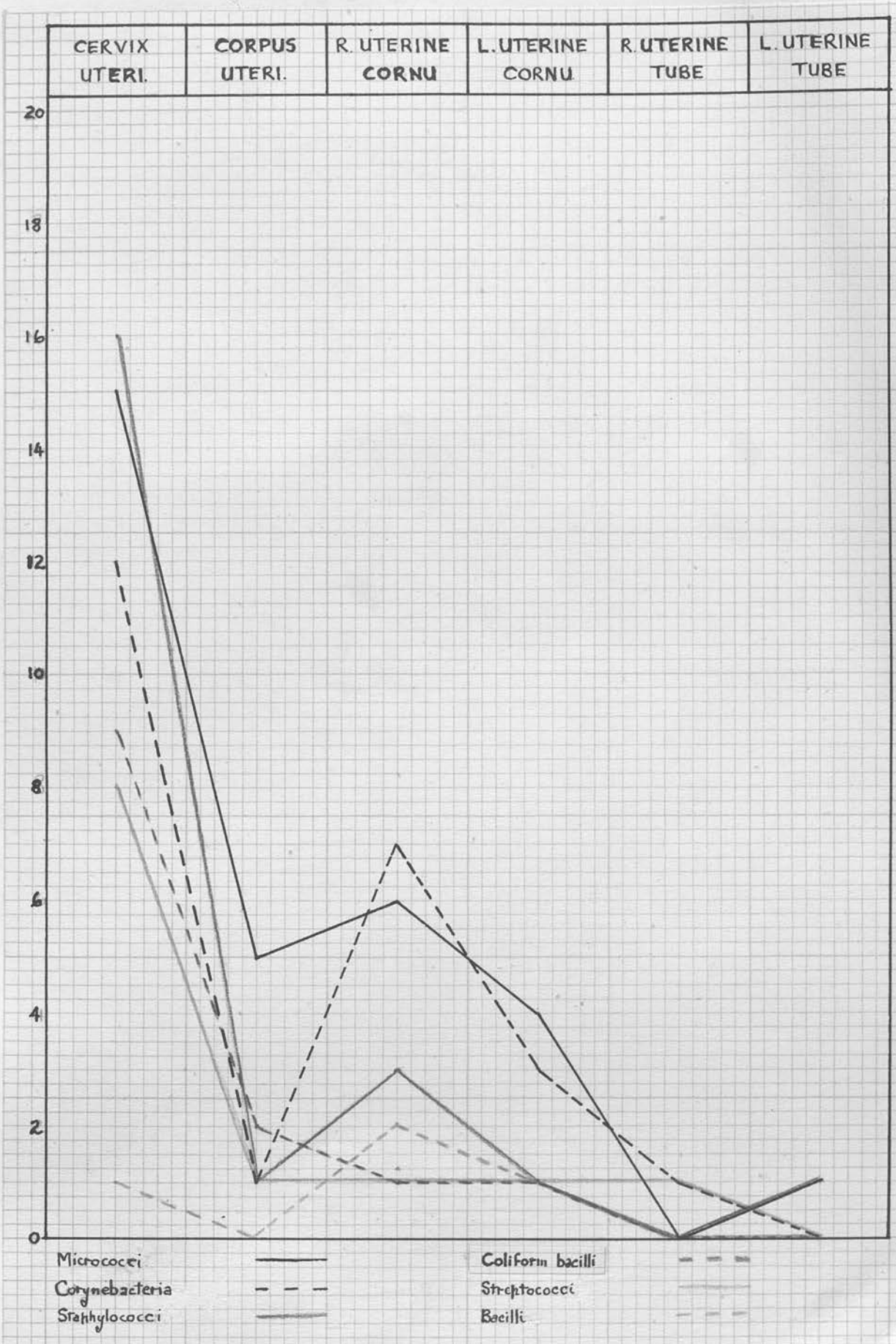
Table 1V shows the frequency and distribution of bacterial genera in the genital tract and these are represented graphically in Graph 11.

TABLE 1V.

GENERA	No. of times bacteria isolated.						
	Cervix uteri	Corpus uteri	R. uterine cornu.	L. uterine cornu.	R. uterine tube.	L. uterine tube.	Total.
Micrococcus	15	5	6	4	0	1	31
Corynebacterium	12	1	7	3	1	0	24
Staphylococcus	16	1	3	1	0	1	22
Escherichia	9	2	1	1	0	0	13
Streptococcus	8	1	1	1	1	0	12
Bacillus	1	0	2	1	0	0	4
Sarcina	1	0	1	1	0	0	3
Alcaligenes	0	0	1	0	1	0	2

The graph shows that the incidence of micrococci, corynebacteria and staphylococci is highest in the cervix, medium in the uterus and lowest in the uterine tubes, whereas in the case of coliform bacilli and streptococci, it falls abruptly in the body and de-:creases gradually; but the bacilli are more in the uterus than the cervix or uterine tubes.

Micrococci were present in 18 genital tracts, corynebacteria in 16, staphylococci in 15, coliform bacilli in 9, streptococci in 9, Gram positive aerobic spore-bearing rods in 3, sarcinae in one and alcaligenes in one. These results are tabulated in Table V.



GRAPH 2. Showing the distribution and frequency of bacteria in normal non-pregnant genital tracts. Figures represent the number of times bacteria were isolated from an organ.

TABLE V.

Bacterial genera found in pregnant and non-pregnant genital tracts of cows listed in order of frequency.

GENUS	Non-pregnant.		Pregnant.	
	Number of Tracts	Percentage *	Number of Tracts	Percentage +
Micrococcus	18	36.73	4	40.0
Corynebacterium	16	32.65	3	30.0
Staphylococcus	15	30.61	2	20.0
Escherichia	9	18.36	1	10.0
Streptococcus	9	18.36	2	20.0
Bacillus	3	6.12	2	20.0
Sarcina	1	2.04	0	0
Alcaligenes	1	2.04	0	0

* Based on 49 genital tracts containing bacteria.
+ Based on 10 genital tracts containing bacteria.

An analysis of the 49 non-pregnant tracts which yielded bacteria shows that 28 tracts had bacteria belonging to one genus, 18 two genera and 3 three genera (Table V1).

TABLE V1.

Number of genera present.	Number of genital tracts.
0	51
1	28
2	18
3	3

B. Bacteriological examination of normal pregnant genital tracts.

A series of 31 normal pregnant uteri were examined for their bacterial content. The breeding histories of the cows were available in 19 cases. The ages of

the/

the cows varied from 3 - 10 years and the number of calves 1 - 8. The age of foetuses as judged by their lengths (measured from forehead to base of tail) varied from about two months to eight months.

Results:-

21 genital tracts did not yield bacteria from any of the sites examined. 10 genital tracts (32.2%) yielded bacteria in one or more sites. The bacteriological findings and the location of the bacteria are given in Table V11.

Of the 10 genital tracts from which bacteria were recovered, 4 (40%) had bacteria in cervix only, 4 (40%) in cervix and uterus and 2 (20%) in uterus only. The Fallopian tubes were sterile in all these cases. If the incidence of bacteria in the cervix were excluded from calculation, then only 6 (19.3%) of the total number of uteri examined contained bacteria. As in the case of non-pregnant uteri it is evident in this instance also that the incidence of bacteria in the uterus is less than that in the cervix.

Identical bacteria were isolated from the utero-chorionic space and amniotic fluid simultaneously in 5 out of 10 uteri, while the amniotic fluid alone contained bacteria in one case (see Table V111).

TABLE VIII.

Bacteria isolated from the utero-chorionic space and the amniotic fluid.

BACTERIA	Utero-chorionic space.		Amniotic Fluid.	
	Times isolated	Per-centage*	Times isolated	Per-centage*
Micrococcus luteus	3	30	3	30
Diphtheroids (unclassified)	1	10	1	10
Streptococcus evolutus	1	10	1	10
Micrococcus candidus	1	10	1	10
Bacillus mesentericus	0	0	1	10

* Based on 10 genital tracts containing bacteria.

Bacteria were isolated 8, 2, 5, 3 and 6 times from the cervix uteri, corpus uteri, right and left uterine cornu and amniotic fluid respectively. The Fallopian tubes were sterile in all cases examined (see graph 1).

As in the case of non-pregnant uteri the incidence of bacteria in the uterus is lower than in the cervix, while it is greater in the right cornu than the left. These facts lend scientific support to the view that a healthy cervix acts as a bacterial filter or at any rate an efficient barrier against bacterial invasion of the uterus.

Micrococci were the commonest and they were isolated 13 times in all - 2, 1, 4, 2 and 4 from the cervix uteri, corpus uteri, right and left horn and the amniotic fluid respectively.

Corynebacteria/

Corynebacteria were recovered 7 times - 3, 1, 1, 1 and 1 from the cervix uteri, corpus uteri, right and left uterine horn and the amniotic fluid respectively.

Streptococci were isolated four times - once each from the cervix uteri, right and left uterine horns and the amniotic fluid respectively.

Staphylococci were isolated twice from the cervix uteri.

Bacillus mesentericus was recovered once from the cervix uteri and once from the amniotic fluid.

Escherichia coli was isolated once from the cervix uteri only. The absence of staphylococci and coliform bacilli from the gravid uterus and amniotic fluid is noteworthy. These results are summarised in Table 1X.

TABLE 1X.

GENUS	Cervix uteri	Corpus uteri	R. uterine cornu	L. uterine cornu	Amniotic fluid	R. uterine tube	L. uterine tube	Total
Micrococcus	2	1	4	2	4	0	0	13
Corynebacterium	3	1	1	1	1	0	0	7
Streptococcus	1	0	1	1	1	0	0	4
Bacillus	1	0	0	0	1	0	0	2
Staphylococcus	2	0	0	0	0	0	0	2
Escherichia	1	0	0	0	0	0	0	1

TABLE 1.

Case Number	Age in Years	Number of Calves	Result of agglutination test for Br. aborus infection	Remarks
11	7	4	-	Normal
16	6¼	4	-	Normal
21	3	0	+	Heifer
22	2	0	-	Heifer
23	2½	0	+	Heifer
25	2¾	0	+	Heifer
28	5	2	+	Aborted last calving, served 5 times
29	2½	0	-	Heifer
30	2	0	-	Heifer
33	6¼	4	+	Served 4 times
35	7	4	-	Normal
37	4	2	-	Vaccinated Strain 19.
38	9	6	-	Normal
40	2	0	+	Heifer
44	2	0	+	Heifer, vaccinated.
48	10	6	+	Normal
51	3	0	-	Heifer
54	9	5	-	Served 4 times.
55	6	3	-	Vaccinated.
60	?	?	-	Normal.

TABLE 1 (continued)

Case Number	Age in Years	Number of Calves	Result of agglutination test for Br. abortus infection	Remarks
62	5	1	+	Served 7 times. Vetted as normal.
65	6	3	-	Normal.
66	6	3	+	Served 4 times.
67	4¾	2	-	Served 6 times.
72	10	7	+	Normal.
74	4½	2	+	Normal.
76	4	2	+	Normal.
84	8	4	-	Normal.
89	7	4	-	Served 5 times.
95	2	0	-	Heifer.
96	10	7	-	Normal.
98	7	4	+	Vaccinated
100	8	5	-	Aborted second calf. Vaccinated. Served 4 times.
101	12	9	+	Normal.
104	2½	0	-	Heifer.
105	15	12	-	Normal.
106	3	0	-	Heifer.
110	3	0	+	Heifer.
112	7	4	-	Normal.

TABLE 1 (continued)

Case Number	Age in Years	Number of Calves	Result of agglutination test for Br. abortus infection	Remarks
113	9	6	+	Normal
116	2	0	-	Heifer
118	$6\frac{1}{2}$	4	-	Normal
129	4	2	+	Normal
130	11	8	-	Normal
132	3	0	-	Heifer
139	$5\frac{1}{2}$	2	-	Served 3-4 times. Vetted as normal.
142	2	0	+	Heifer
146	$3\frac{1}{2}$	0	-	Heifer not put to bull owing to deformity.
156	11	9	-	Served 7 times.
157	3	0	-	Heifer
163	8	5	-	Normal
164	7	3	-	Normal
165	8	5	-	Normal
169	2	0	-	Heifer
173	9	5	+	Normal
175	9	7	-	Normal
176	6	3	-	Normal. Vaccinated Strain 19.
180	10	6	-	Normal

TABLE 1 (continued)

Case Number	Age in Years	Number of Calves	Result of agglutination test for Br. abortus infection	Remarks
181	5	3	-	Normal
182	9	5	-	Normal
187	2	0	-	Heifer vaccinated
189	$2\frac{3}{4}$	0	-	Heifer
191	7	3	-	Normal
193	3	0	+	Heifer
194	3	0	-	Heifer
196	3	0	+	Heifer
198	3	0	+	Heifer
201	14	11	+	Normal
208	9	7	-	Normal
209	5	2	-	Normal
215	$7\frac{1}{2}$	4	+	Normal
220	8	4	-	Normal
221	2	0	-	Heifer
225	2	0	-	Heifer
226	8	5	-	Normal

Bacteriology of normal genital tracts.

Results of the bacteriological examination of one hundred normal non-pregnant and thirty one normal pregnant genital tracts are summarised in table XIII. These bacteriological findings may be looked upon as representing the bacterial flora of the normal genital tracts of adult dairy cattle because the genital tracts from which these bacteria were recovered were all normal morphologically and 92% of them had a normal breeding history as well.

Though the material was mainly derived from the Ayrshire breed of cows, the results give some indication of the bacterial types which may be present in the normal genital tract of cows.

Micrococci were the commonest and were isolated from 18 per cent of cases (12.9%)*; the next in order being corynebacteria in 16 per cent (9.6%); staphylococci 15 per cent (6.4%); coliform bacilli in 9 per cent (3.2%); streptococci 9 per cent (6.4%); Gram positive spore bearing rods 3 per cent (6.4%); sarcinae in 1 per cent (nil) and alcaligenes 1 per cent (nil).

*Figures in brackets represent the corresponding percentage for pregnant genital tracts.

Micrococci.

A total of 44 strains of micrococci were isolated. On basis of their morphology and biochemical reactions they were classified as follows:- Micrococcus luteus 27; Micrococcus candidus 13; Micrococcus luteolus 1; Micrococcus conglomeratus 1; Micrococcus flavus 1; and Micrococcus varians 1.

Corynebacteria.

The next in order of frequency were corynebacteria of which 31 strains were isolated and classified as follows:-

Corynebacterium xerosis. All the seven strains were alike in their cultural and biochemical characters. They fermented glucose, sucrose, and maltose with the formation of acid; acidified litmus milk. They did not reduce nitrates and did not produce Indole.

Though Corynebacterium xerosis has been isolated from normal as well as diseased conjunctiva of man and animals this is probably the first record of its isolation from the genital tracts of bovines.

Corynebacterium renale was isolated twice from the cervix uteri of non-pregnant cows. The morphological and biochemical characters of the two strains are as follows:-

Morphology:- Gram positive rods with round to blunt pointed ends, non-motile, non-sporing, non-capsulated. Barred staining by Methylene blue was prominent. When stained by Neisser's stain the bacteria showed up metachromatic granules.

Horse-blood-agar plate:- The colonies were discrete, circular, 0.3 - 0.5mm. in diameter, raised, dull grewish white in colour. There was no haemolysis.

Serum agar slope:- Discrete, round, pinhead like colonies up to 1 m.m. in diameter with a light cream pigment. When left on bench at room temperature the colonies assumed a dry appearance.

Glucose agar slope:- The colonies were discrete, punctiform, raised.

Glucose broth:- After 24 hours' incubation there was slight cloudiness of the medium. After 3 days' incubation there was granular sediment with clear supernatant broth.

Potato:- Slight greyish white film like growth.

Gelatin:- There was very poor growth, without liquefaction of gelatin even after 15 days at 37°C.

Loeffler's serum:- The colonies were discrete, circular up to 1 m.m. in diameter, raised and smooth. At room temperature the colonies increased in size and coalesced, assuming a light cream pigment. There was no liquefaction of serum.

Litmus milk:- Became alkaline after 5 - 7 days incubation.

Sodium tellurite medium:- The colonies were punctiform and black.

Milk-agar plate:- The medium consisted of plain agar to which was added sterilised milk to a concentrat-
:ion of 10% . After 48 hours incubation the colonies were of a light cream colour and were surrounded by a halo/

halo or zone of clearing. This reaction is in accord with the findings of Lovell (1946) who recommended this medium as of great value in the isolation of Corynebacterium renale.

Carbohydrates:- Dextrose was fermented with the production of acid. Though there was slight acid formation in sucrose and maltose after 24 hours' incubation it was reduced permanently after 3 days' incubation. There was no acid from lactose, xylose, raffinose, Inulin, mannitol, salicin, arabinose and dextrin even after 14 days' incubation. All carbohydrates were done in duplicate.

Jones and Little (1925, 1930); Merchant (1935); Thorp, Langham, Clark and Doll (1943); Feenstra, Thorp and Clark (1945) and others who studied this organism have noted considerable variations in its biochemical reactions. However, all agree with regard to its morphology and typical diphtheroid character, its inability to liquefy gelatin or Loeffler's serum and the fermentation of glucose but not maltose, sucrose or lactose. According to Merchant (1935) l laevulose and mannose may also be fermented. The strains studied herein fermented glucose, sucrose and maltose in 24 hours, but the acidification of sucrose and maltose was transient and was reduced after 3 days' incubation, whereas the acid formation in glucose was permanent and strong even after 14 days' incubation. Weitz (1947) records that two of his strains isolated from urine of cows fermented sucrose and lactose.

Jones and Little (1925, 1930) and others have isolated Corynebacterium renale from cattle suffering from pyelitis. Weitz (1947) recovered it from the posterior urinary tract in about 40 per cent of normal cows and stated that this organism was normally present only in the posterior vagina, especially around the external urinary meatus. Since it was isolated only twice from the cervix uteri out of 131 cases in this investigation it appears that it is not a normal inhabitant of the uterus though it is possible in rare cases that it might be found in the cervix uteri as a result of extension from the vagina.

Corynebacterium bovis.

Two strains of corynebacteria which are considered as variants of Corynebacterium bovis were isolated once from the cervix uteri and once from a non-gravid uterus. Both the strains were identical in their cultural and biochemical characters which are as follows:-

Morphology:- Gram positive, highly pleomorphic bacilli, 1 - 4 microns by up to 0.75 micron, coccoid and club form common. Barred staining by Methylene blue was prominent; metachromatic granules were not seen when stained with Neisser's stain. The organisms were non-motile, non-sporing and non-capsulated.

Horse blood agar plate:- After 24 hours at 37°C. the colonies were minute up to 0.1 m.m. in diameter, without any haemolysis. After 48 hours at 37°C. colonies slightly larger and greyish white with haemolysis/

haemolysis of beta type. On further incubation the colonies coalesced and formed a confluent smooth growth with yellowish green pigment.

Serum agar plate:- Discrete, circular colonies up to 1 m.m. in diameter, convex, greyish white.

Serum agar slope:- 24 hours at 37°C. good greyish white confluent growth.

Agar slope:- Smooth confluent abundant growth, whitish yellow in colour.

Potato:- No growth even after 5 days at 37°C.

Gelatin:- Rapidly and completely liquefied in 48 hours at 37°C.

Loeffler's serum:- Marked liquefaction in 24 hours. After 3 days' incubation the medium was completely liquefied.

Litmus milk:- Acid, soft clot reduction from above downward in 7 days at 37°C.

Glucose broth:- Cloudy with slight granular sediment and no pellicle.

Indole:- Not produced.

Nitrates: Not reduced.

Carbohydrates:- Dextrose, saccharose, lactose, xylose, raffinose, Inulin, mannitol, salicin, maltose and dextrin unchanged even after 14 days at 37°C. All carbohydrates were done in duplicate.

Pathogenicity:- 24 hour old broth cultures did not kill guinea pigs and mice at a dose of 1 c.c. and 0.5 c.c. respectively, when inoculated intraperitoneally. Both the guinea pigs survived for more than three weeks.

Thus/

Thus it will be seen that these two strains agree to a large extent in their morphological and biochemical characters with those of Corynebacterium bovis given by Bergey (1939). This author does not, however, mention anything about its action on horse blood plates, gelatin or Loeffler's serum. Evans (1916, 1917, 1918) described some strains isolated from udders and designated them Bacterium lipoliticum.

Bergey considers these strains as identical with Corynebacterium bovis. While Evans' strains failed to grow in gelatin the strains described herein grew well in gelatin liquefying it rapidly. The distinctive character of Evans' strains was their ability to hydrolyse butter fat to fatty acids. This character was not tested in the two strains just described.

Corynebacterium acnes was isolated once from the cervix uteri of one genital tract. It produced acid from glucose, sucrose, maltose, mannitol and salicin. Sudmerson and Thompson (1909-10) examined two strains, of which one actively fermented saccharose, the other gave a late and slight acidity. According to Topley and Wilson (1947) acid is generally formed in glucose, maltose, and sucrose, sometimes in lactose, but not in mannitol. Litmus milk was practically unchanged. In gelatin there was good granular growth at 37°C. without liquefaction. On Loeffler's serum growth was good with discrete yellowish colonies, which became slightly wrinkled with a crenate border. There was no haemolysis on horse blood agar.

Corynebacterium flavidum.

One strain of Corynebacterium flavidum was isolated once from a uterus. On glucose agar the organisms grew as circular colonies 1-1.5 m.m. in diameter with crenate borders, very adherent to the medium. In glucose broth they grew as fine granular sediment with clear supernatant, at a later stage formed a thin pellicle, greyish yellow in colour. Litmus milk was turned slightly acid, followed by reduction in 7 days. On Loeffler's serum the growth was profuse and cream coloured without liquefaction of the serum. Nitrates were reduced to nitrites, acid was produced from dextrose, maltose and dextrin. Similar strains have been isolated from udder of cows with mastitis (Bergey 1939).

Unidentified diphtheroids.

These comprise a total of 18 strains which judging from their biochemical reactions could not be satisfactorily classified as of any recognised species. In the absence of detailed study any attempt to give them specific names would only lead to confusion. Hence it is thought best to give their biochemical reactions and leave their final classification for future study. On the basis of their fermentative reactions they can be divided into six groups as shown in table X.

Staphylococci.

The 24 strains of staphylococci comprised of Staphylococcus epidermidis 3; Staphylococcus citreus 7; and Staphylococcus albus 14. One of the Staphylococcus albus strains (isolated from cervix) produced clear zones of haemolysis on horse blood agar plates, fermented mannitol and was positive for coagulase test. Hence it is considered as albus variant of Staphylococcus aureus. It is of interest to mention here that two albus strains were haemolytic on horse blood agar and mannitol positive but coagulase negative.

Important biochemical reactions of these staphylocci are summarised in table XI.

Streptococci.

One strain of streptococcus similar to the "minute beta haemolytic streptococcus" of Long and Bliss (1934) was isolated once from a Fallopian tube.

The colonies on blood agar were very minute, barely visible to the naked eye at 48 hours incubation. The only evidence of growth at this stage was the presence of wide zones of haemolysis along the streaks to an extent of 1-2 m.m. in width. The colonies when viewed under the low power of the microscope, were seen as finely granular punctiform areas surrounded by clear zones of haemolysis. After 3 days' incubation the colonies were visible as raised punctiform growths.

In/

In smears made from 24 hours glucose broth culture and stained by Gram's method, the organisms were seen as weakly Gram positive cocci, arranged in pairs and short chains. A few scattered clumps were also seen. The size of the coccus appeared smaller than an ordinary haemolytic streptococcus.

Biochemical reactions:- In glucose broth the organism produced a final pH of 5.4. It did not hydrolyse sodium hippurate or starch, but fermented glucose, trehalose, sucrose, salicin and arabinose with the formation of acid. No fermention of lactose, mannitol, sorbitol, Inulin, raffinose and rhamnose occurred. Gelatin was not liquefied and cultures did not survive a temperature of 60°C. for 30 minutes. It gave positive precipitin reaction against Lancefield's group F anti-serum.

Minute haemolytic streptococci were first isolated by Long and Bliss (1934) and Long, Bliss and Walcott (1934) from the throats of normal persons and also from those suffering from a variety of diseases such as glomerular nephritis and rheumatic fever. Sherman (1937) regards these organisms as harmless human parasites. Apart from their occurrence in the throat of normal persons, they have also been recovered from the human vagina (Lancefield and Hare, 1935); skin (Colebrook, Maxted and Johns, 1935); and faeces (Hare and Maxted, 1935). This is probably the first record of the isolation of "minute haemolytic streptococci" from the bovine uterus.

Streptococci of the Viridans Group.

Of the seven strains of viridans streptococci isolated, one was Streptococcus equinus and six Streptococcus bovis.

Streptococcus equinus was isolated once from the cervix uteri. The colonies produced alpha haemolysis on horse blood agar plates. In glucose broth a final pH of 4.4 was produced; slight growth in gelatin without liquefaction; acidified litmus milk; did not hydrolyse sodium hippurate but hydrolysed starch. Did not grow in 0.1 per cent Methylene blue milk and cultures did not survive a temperature of 60°C. for 30 minutes. They fermented glucose, trehalose, sorbite, Inulin, raffinose and arabinose with formation of acid; did not ferment lactose, sucrose, salicin, mannitol and rhamnose.

Six strains of Streptococcus bovis were isolated from the cervix uteri of six cases. Their fermentation reactions though variable are in general agreement with those of the type species.

They all gave alpha haemolysis on horse blood agar plates. In glucose broth they produced a final pH of 4.2 to 4.8; did not hydrolyse sodium hippurate but hydrolysed starch. In litmus milk five strains produced acid and clot while one produced acid only. Cultures did not tolerate 0.1% Methylene blue and did not survive a temperature of 60°C. for 30 minutes; gelatin was not liquefied. They all fermented glucose, lactose/

lactose, sucrose, salicin, Inulin, raffinose, rhamnose and arabinose with production of acid. In addition to the above sugars two strains fermented trehalose and mannitol, while a third fermented trehalose and sorbitol.

Four of the strains gave positive precipitin test against Lancefield's group D. anti-serum.

Streptococci of Enterococcus Group.

Two strains of non-haemolytic enterococci were recovered - one from the corpus uteri and the other from the cervix uteri. Their biochemical reactions conform to those of Streptococcus faecalis. In glucose broth they produced a final pH of 4.6, did not hydrolyse starch but hydrolysed sodium hippurate. Cultures grew in 0.1 per cent Methylene blue milk and survived a temperature of 60°C. for 30 minutes, produced acid and clot in litmus milk; did not liquefy gelatin. Glucose, trehalose, lactose, sucrose, salicin, mannitol, and sorbitol were fermented without gas production by both the strains. In addition one of the strains fermented inulin and raffinose. Both gave positive precipitin reaction against Lancefield's group D. anti-serum.

Streptococcus evolutus.

Microaerophilic Streptococcus evolutus was isolated twice - once from a non-gravid uterus and once from the utero-chorionic space and amniotic fluid of a gravid uterus/

uterus. The primary colonies were isolated from blood agar plates incubated anaerobically while there was no growth on aerobic plates. On horse blood agar plates incubated anaerobically and microaerophilically for 48 hours the colonies were variable in size up to o.5 m.m. in diameter, circular, entire, translucent with alpha haemolysis. Many appeared in small clumps with a granular surface. There was no growth on aerobic plates. After 4 to 5 subcultivations the cultures were able to grow aerobically but died out rapidly.

Morphology:- The organisms were Gram positive, lanceolate to ovoid in shape, occurring in pairs and chains of 10 - 20.

Glucose broth:- There was slight growth at 24 hours at 37°C. rendering the medium cloudy. After two to three days' incubation thick granular growth settled to bottom of the tube in a whitish mass.

Glucose shake agar:- There was growth in indistinct alternate zones.

The cultures produced a final pH of 5.2 in glucose broth and fermented glucose, trehalose, lactose, sucrose, salicin, mannitol, sorbitol, inulin and arabinose with production of acid. In addition to the above sugars, one strain fermented rhamnose. Both produced acid, clot and digestion in litmus milk. Cultures grew well in gelatin with the production of liquefaction of saccate type. When grown anaerobically colonies produced alpha haemolysis on horse blood agar plates.

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Though Streptococcus evolutus has been isolated from respiratory tract, mouth and human vagina, this is probably the first record of its occurrence in normal bovine uterus. Its isolation emphasises the importance of employing anaerobic and microaerophilic techniques in the study of bacterial flora of the genital tract. The biochemical reactions of streptococci studied herein are summarised in table XII.

Coliform bacilli.

A total of thirteen strains of Gram negative, aerobic, motile, non-sporing rods were isolated, which in their morphological, cultural and biochemical char-:acters were similar to Escherichia coli. Two strains were haemolytic on horse blood agar plates.

All the cultures produced acid and clot in litmus milk. Tests for indole and catalase were positive. Methyle red test was positive while the Voges-Proskauer test was negative. Though there was good growth in gelatin, the medium was not liquefied.

Ten strains fermented glucose, maltose, lactose, dulcite, mannitol, xylose, rhamnose and arabinose with the formation of acid and gas; dextrin, inosite and sucrose were not fermented. Three strains differed from the rest in that they fermented glucose, maltose, lactose, sucrose, dulcite, mannitol salicin, xylose and arabinose with the fermation of acid only without gas. Inosite and rhamnose were not fermented.

Bacillus.

Gram positive, aerobic, motile, spore-bearing rods were isolated from five genital tracts - twice from the cervix uteri, twice from the uterus and once from ammiotic fluid. In their cultural, morphological and biochemical characters they were identical with those of Bacillus mesentericus.

Colonies were haemolytic on horse blood agar plates. On agar slant growth was abundant, slightly raised, spreading and adherent with a coarsely wrinkled surface.

All the five strains fermented glucose, sucrose, maltose, mannitol and salicin with the formation of acid: lactose was not fermented. Gelatin was liquefied, the liquefaction being saccate to stratiform in type. Litmus milk was acidified with the formation of soft clot and later reduction of acid from above downwards. Methyl red test was negative for all cultures while one gave a positive Voges-Proskauer reaction. Hydrogen sulphide was not produced; test for ammonia was weakly positive. Two strains reduced nitrates to nitrites. In liquid media all the strains produced greyish white, thick, wrinkled membranous pellicle.

Pathogenicity:- Only one of these cultures was pathogenic to mice on intraperitoneal inoculation of 0.5 c.c. of 24 hour old broth culture.

Sarcina.

Sarcina lutea was isolated twice from the cervix uteri and uterus of one genital tract.

Alcaligenes.

An organism with the following morphological and biochemical characters was isolated from the uterus and Fallopian tube of one genital tract. It was isolated primarily from the growth on crystal violet liver infusion agar in pure culture. The colonies were pinhead sized, effuse, glistening, lightly tinged with violet colour.

Agar plate:- The colonies were discrete, up to a pinhead in size, circular, entire, whitish yellow and translucent. Though the primary growth was under microaerophilic incubation, subsequently the subculture grew well aerobically.

Agar slant:- The growth was scanty with minute colonies at 24 hours; at 48 hours the growth was confluent though scanty with a yellowish brown pigment.

Morphology:- Gram negative, short, slender rods with rounded ends, arranged singly, in pairs and in small groups and an occasional filamentous chain, sluggishly motile and non-capsulated.

Horse blood agar plate:- The colonies were punctiform to pinhead sized with no haemolysis.

Broth:- After 48 hours' incubation became turbid, with a granular sediment, and thick pellicle.

Cultures/

Cultures produced hydrogen sulphide and ammonia and turned litmus milk alkaline. Gelatin was liquefied after 7 days' incubation at 37°C. Methyl red test, Voges-Proskauer reaction and Methylene blue reductase test were all negative. Nitrates were not reduced to nitrites; and catalase test was strongly positive. Indole was not formed.

Potato:- After 4 days incubation light yellow thin film-like growth. After 7 days' incubation the growth was thick, confluent with a chocolate brown colour.

Carbohydrates:- Dextrose, maltose, lactose, sucrose, dulcite, mannitol, inosite, salicin, and dextrin were unchanged even after 15 days' incubation. All carbohydrates were done in duplicate.

The production of chocolate brown pigment on potato like the Brucella group and the lack of fermentative properties lead one to suspect that it might be a Brucella strain of organism. In order to elucidate this point it was put to agglutination test against Brucella abortus anti-serum. The test was negative, though a positive control against a known Brucella abortus antigen gave a strong positive reaction.

Now, these characters agree with those of Alcaligenes faecalis, except for the liquefaction of gelatin. Evans (1931) described a gelatin liquefying strain of the species - Alcaligenes faecalis var. radicans. The one isolated herein is probably identical with/

with the latter.

Though Alcaligenes faecalis has previously been isolated from faeces and abscesses related to intestinal tract, it is believed that this is the first record of its isolation from a normal bovine uterus.

SUMMARY.

1. A survey of the bacterial flora of 100 normal non-pregnant and 31 normal pregnant genital tracts of dairy cows is reported.

2. 49 per cent of normal non-pregnant and 32.2 per cent of pregnant genital tracts contained bacteria. The incidence of bacteria in the cervix uteri was 41%, corpus uteri 9%, right uterine cornu 20%, left uterine cornu 9%, and Fallopian tubes 2%.

3. There was great similarity between the bacterial flora of the non-pregnant and pregnant genital tracts and also between those of the utero-chorionic space and amniotic fluid of gravid uteri.

4. Micrococci (18%) were the commonest bacteria in the genital tracts of non-pregnant cows, the next in order being corynebacteria (16%), staphylococci (15%), streptococci (9%), coliform bacilli (9%), Gram positive sporulating rods (3%), sarcinae (1%) and Alcaligenes (1%).

A summary of bacteriological findings and the incidence of bacterial species in the normal genital tracts are set out in tables II, VII, and XIII.

5./

5. Though Lancefield's groups D and F and viridans streptococci were recovered none of mastitis group (Lancefield's group B, Minett's groups II and III) were isolated.

A microaerophilic streptococcus - Streptococcus evolutus was isolated from one non-gravid uterus and from the utero-chorionic space and amniotic fluid of a gravid uterus.

6. Neither staphylococci, nor coliform bacilli were isolated from gravid uteri.

7. Despite special media and incubation technique, neither Corynebacterium pyogenes, nor Brucella abortus nor pleuropneumonia group of organisms were isolated from any of the genital tracts.

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
3	Staph. aureus Staph. citreus	0	0	0	0	0	-	-	
4	0	0	Alcaligenes faecalis	0	Alcaligenes faecalis	0	+	-	
6	Staph.albus Staph. citreus Diphtheroids	0	Staph. citreus	Staph. epidermidis Diphtheroids. M.candidus	0	0	+	-	
7	0	Staph. epidermidis	0	0	0	0	+	-	
8	0	0	0	0	0	0	-	-	Sterile
9	C. bovis	0	0	0	0	0	-	-	
10	M. luteus	M. luteus	C.xerosis	0	0	0	-	-	
11	0	0	C.bovis	0	0	0	-	-	
12	Staph. citreus	0	Staph. citreus	0	0	Staph. albus	-	-	
16	Staph.albus (Haemolytic)	0	0	0	0	0	-	-	

							for Brucel-losis	monas	
21	M.candidus	0	0	0	0	M.luteolus	+	-	
22	0	0	0	0	0	0	-	-	Sterile
23	0	0	0	0	0	0	+	-	Sterile
25	Diphtheroids	M. conglo meratus Str.faecalis	0	0	Diphtheroids Minute haemolytic Streptococci group F.	0	+	-	
27	0	0	0	0	0	0	+	-	Sterile
28	0	0	M.candidus Diphtheroid	0	0	0	+	-	
29	0	0	0	0	0	0	-	-	Sterile
30	Staph.albus Esch. coli	Esch.coli	0	0	0	0	-	-	
33	0	0	0	0	0	0	+	-	Sterile
35	0	0	0	0	0	0	-	-	Sterile
37	0	0	0	0	0	0	-	-	Sterile
38	0	0	0	0	0	0	-	-	Sterile
40	0	0	0	0	0	0	+	-	Sterile
44	0	0	0	0	0	0	+	-	Sterile
48	0	0	0	0	0	0	+	-	Sterile
51	0	0	0	0	0	0	-	-	Sterile

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
54	0	0	0	0	0	0	-	-	Sterile
55	0	0	0	0	0	0	-	-	Sterile
60	0	0	0	0	0	0	-	-	Sterile
62	M. flavus	0	0	0	0	0	+	-	
63	Staph.albus	0	0	0	0	0	-	-	
65	M. candidus	0	0	0	0	0	-	-	
66	0	0	0	0	0	0	+	-	Sterile
67	0	0	0	0	0	0	-	-	Sterile
72	Staph.albus M. luteus	0	0	0	0	0	+	-	
74	Esch. coli	0	0	0	0	0	+	-	
76	M. candidus Staph.albus	0	0	0	0	0	+	-	
84	0	0	0	0	0	0	-	-	Sterile
89	0	0	0	0	0	0	-	-	Sterile
95	0	0	0	0	0	0	-	-	Sterile
96	0	0	0	0	0	0	-	-	Sterile

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
98	0	0	0	0	0	0	+	-	Sterile
100	0	0	0	0	0	0	-	-	Sterile
101	Staph.albus	0	0	0	0	0	+	-	
104	0	0	0	0	0	0	-	-	Sterile
105	0	0	0	0	0	0	-	-	Sterile
106	0	0	0	0	0	0	-	-	Sterile
107	0	0	0	0	0	0	-	-	Sterile
110	Str.faecalis	0	0	0	0	0	+	-	
111	Esch. coli	0	0	0	0	0	-	-	
112	0	0	0	0	0	0	-	-	Sterile
113	0	0	0	0	0	0	+	-	Sterile
116	Esch. coli M. luteus	M. luteus	M. luteus	0	0	0	-	-	
117	M. luteus	M. luteus	M. luteus	0	0	0	+	-	
118	0	0	0	0	0	0	-	-	Sterile
127	0	0	0	0	0	0	-	-	Sterile
129	M. candidus	0	0	0	0	0	+	-	

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
130	0	0	0	0	0	0	-	-	Sterile
132	Str. equinus	0	0	0	0	0	-	-	
139	0	0	0	0	0	0	-	-	Sterile
142	0	0	0	0	0	0	+	-	Sterile
146	0	0	C. flavidum	C. flavidum	0	0	-	-	
149	Staph.albus Str. bovis	0	0	0	0	0	+	-	
156	C. acnes	0	0	0	0	0	-	-	
157	C. xerosis Staph.albus	0	0	0	0	0	-	-	
158	0	0	0	0	0	0	+	-	Sterile
163	0	0	0	0	0	0	-	-	Sterile
164	Esch. coli M. luteus	M. luteus	0	0	0	0	-	-	
165	Str. bovis	0	0	0	0	0	-	-	
169	0	0	0	0	0	0	-	-	Sterile
173	C. renale Staph. albus Str. bovis	0	0	0	0	0	+	-	

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
175	C. xerosis	0	0	0	0	0	-	-	
176	0	0	0	0	0	0	-	-	Sterile
180	0	0	0	0	0	0	-	-	Sterile
181	0	0	B.mesenteric	B.mesenteric	0	0	-	-	
182	Esch. coli	0	0	0	0	0	-	-	
187	0	0	0	0	0	0	-	-	Sterile
189	0	0	0	0	0	0	-	-	Sterile
191	0	0	0	0	0	0	-	-	Sterile
193	M.varians Diphtheroid	0	Diphtheroid	0	0	0	+	-	
194	0	0	0	0	0	0	-	-	Sterile
196	0	0	0	0	0	0	+	-	Sterile
198	0	0	0	0	0	0	+	-	Sterile
201	Str.bovis Esch. coli	Esch.coli	Esch.coli	Esch. coli	0	0	+	-	
203	0	0	0	0	0	0	-	-	Sterile; involuting uterus

No.	Cervix Uteri	Corpus Uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
208	Staph.citreus	0	Staph. citreus	0	0	0	-	-	
209	0	0	B.mesentericus	0	0	0	-	-	
215	0	0	0	0	0	0	+	-	Sterile
217	C. xerosis	0	C.xerosis	0	0	0	+	-	
218	M.luteus C.renale	0	0	0	0	0	-	-	
219	Staph.citreus Esch. coli	0	0	0	0	0	-	-	
220	0	0	0	0	0	0	-	-	Sterile
221	0	0	0	0	0	0	-	-	Sterile
225	B.mesentericus M. luteus	0	M.luteus	0	0	0	-	-	
226	0	0	0	0	0	0	-	-	Sterile
228	M. luteus Diphtheroid	0	M.luteus	M.luteus	0	0	-	-	
229	Str.evolutus Esch. coli	0	Str. evolutus	Str. evolutus	0	0	+	-	

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Agglutination test for Brucellosis	Trichomonas	Remarks
230	Diphtheroid. Str. bovis	Diphtheroid	Diphtheroid	Diphtheroid	0	0	+	-	
233	0	0	0	M.candidus	0	0	-	-	
237	Sarcina lutea M. candidus	0	Sarcina lutea M.candidus	Sarcina lutea M. candidus	0	0	-	-	

0 = sterile - = negative + = positive

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Amniotic fluid	Agglutination test for Brucellosis	Trichomonas	Remarks
13	B.mesentericus	0	0	0	0	0	0	+	-	
39	0	0	0	0	0	0	0	-	-	Sterile
50	0	0	0	0	0	0	0	-	-	Sterile
52	0	0	0	0	0	0	0	-	-	Sterile
68	0	0	0	0	0	0	0	+	-	Sterile
69	Staph. epidermidis	0	0	0	0	0	0	-	-	
75	0	0	0	0	0	0	0	-	-	Sterile
77	0	0	0	0	0	0	0	-	-	Sterile
78	0	0	0	0	0	0	0	-	-	Sterile
79	0	0	0	0	0	0	0	-	-	Sterile
81	0	0	0	0	0	0	0	-	-	Sterile
85	0	0	0	0	0	0	0	-	-	Sterile
97	0	0	0	0	0	0	0	-	-	Sterile
103	Str. bovis C.xerosis	0	0	0	0	0	0	-	-	

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Amniotic fluid	Agglutination test for Brucellosis	Trichomonas	Remarks
125	0	0	0	0	0	0	0	+	-	Sterile
138	0	0	M.luteus	M.luteus	0	0	M.luteus	-	-	
144	0	0	0	0	0	0	0	-	-	Sterile
147	0	0	0	0	0	0	0	-	-	Sterile
152	Diphtheroid	Diphtheroid	Diphtheroid. Str. evolutus	Diphtheroid. Str. evolutus	0	0	Diphtheroid Str. evolutus	+	-	
170	0	0	0	0	0	0	0	-	-	Sterile
177	0	0	0	0	0	0	0	-	-	Sterile
184	M.candidus	0	M.candidus	0	0	0	M.candidus	-	-	
186	Esch.coli	0	0	0	0	0	0	-	-	
204	C.xerosis M.luteus	M. luteus	M.luteus	0	0	0	M. luteus	+	-	
227	0	0	0	0	0	0	0	-	-	Sterile
238	Staph. albus	0	0	0	0	0	B.mesentericus	-	-	
120	0	0	0	0	0	0	0	-	-	Sterile
121	0	0	M.luteus	M.luteus	0	0	M.luteus	+	-	

No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Amniotic fluid	Agglutination test for Brucellosis	Trichomonas	Remarks
122	0	0	0	0	0	0	0	-	-	Sterile
137	0	0	0	0	0	0	0	+	-	Sterile
80	0	0	0	0	0	0	0	+	-	Sterile

0 = sterile - = negative + = positive

TABLE X.

Biochemical reactions of 18 strains of "unidentified" diphtheroids.

Group	Dextrose	Sucrose	Lactose	Xylose	Raffinose	Inulin	Mannitol	Salicin	Maltose	Dextrin	Liquefaction of Gelatin	Liquefaction of Loeffler's serum	Haemolysis	Litmus Milk	No. of Strains in Group
I	A	A	A	-	-	A	-	A	-	A	+	-	-	No Change	1
II	A	A	-	-	-	-	-	-	A	A	+	-	-	=	2
III	A	A	A	-	-	-	-	-	A	A	-	-	-	=	5
IV	A	A	A	A	-	-	-	-	A	A	-	-	-	=	4
V	A	A	A	-	-	-	-	-	A	-	-	-	-	=	5
VI	A	A	A	A	-	-	-	A	-	A	-	-	-	=	1

A - Acid. - - Negative. + = Positive.

TABLE XI.

Strain Number	Glucose	Maltose	Mannitol	Lactose	Sucrose	Litmus milk	Haemolysis	Coagulase	Pigment
SN 3, C.	A	A	A	A	A	AC	+	+	White
SN 3, C.	A	A	A	A	A	AC	-	-	Orange Yellow
SN 6, C.	A	A	A	A	A	A	-	-	P. White
SN 6, C_2.	A	A	-	-	A	Alk.	-	-	Orange Yellow
SN 7 B.	A	A	-	A	A	A	-	-	Greyish White
6 LH.	A	A	-	A	A	A	-	-	White
12 C.	A	A	-	-	A	Alk.	-	-	Orange Yellow
12 RH.	A	A	-	-	A	Alk.	-	-	Orange Yellow
12 LH.	A	A	-	-	A	A	-	-	P. White
16 C.	A	A	A	-	A	Alk.	+	-	P. White
30 C.	A	A	-	A	A	A	-	-	P. White
63 C.	A	A	A	-	A	A	-	-	P. White
72 C.	A	A	A	A	A	A	-	-	Dull White
76 C.	A	A	A	A	A	No change	+	-	Dull White
101 C.	A	A	-	A	A	A	-	-	P. White
149 C.	A	A	-	A	A	A	-	-	P. White
157 C.	A	A	A	A	A	A	-	-	White
173 C.	A	A	-	A	A	AC	-	-	P. White
208 C.	-	-	-	-	-	-	-	-	Orange Yellow
208 RH.	-	-	-	-	-	-	-	-	Orange Yellow
219 C.	A	A	-	-	A	Alk.	-	-	Lemon Yellow
69 C.	A	A	-	A	A	A	-	-	White
238 C.	A	A	A	A	A	A	-	-	P. White.

A = acid; AC = acid and clot; Alk = alkaline;
+ = positive; - = negative.

TABLE XII.

Biochemical reactions of streptococci isolated from the genital tracts.

Strain Number	Final pH in Glucose broth	Hydrolysis of Sod. hippurate	Hydrolysis of starch	Growth in 0.1% M.B. milk	Glucose	Trehalose	Lactose	Sucrose	Salicin	Mannitol	Sorbite	Inulin	Raffinose	Rhamnose	Arabinose	Litmus Milk	Gelatin	Haemolysis	Heat resistance at 60°C for 30 minutes	Lancefield's Group	Type or variety.
25B	4.6	+	-	+	A	A	A	A	A	-	-	-	-	-	-	AC	-	alpha	+	D	Str. faecalis
110C	4.6	+	-	+	A	A	A	A	A	A	A	A	A	-	A	AC	-	"	+	D	"
132C	4.4	-	+	-	A	A	-	-	-	-	A	A	A	-	A	A	-	"	-		Str. equinus
149C	4.8	-	+	-	A	-	A	A	A	-	-	A	A	A	A	AC	-	"	+	D	Str. bovis
165C	4.8	-	+	-	A	-	A	A	A	-	-	A	A	A	A	AC	-	"	+	D	"
173C	4.2	-	+	-	A	A	A	A	A	A	-	A	A	A	A	AC	-	"	+	D	"
201C	4.4	-	+	-	A	-	A	A	A	-	-	A	A	A	A	AC	-	"	+		"
230C	4.2	-	+	-	A	A	A	A	A	A	-	A	A	A	A	A	-	"	+	D	"
103C	4.2	-	+	-	A	A	A	A	A	-	A	A	A	A	A	AC	-	"	+		"
25 RT	5.4	-	-	-	A	A	-	A	A	-	-	-	-	-	A	A	-	beta	-	F	Minute haemolytic streptococci.
229C	5.4	-	-	-	A	A	A	A	A	A	A	A	-	A	A	ACD		alpha	-		Str. evolutus
152RH	5.2	-	-	-	A	A	A	A	A	A	A	A	-	A	A	ACD		"	-		"

+ = positive; - = negative; A = acid; AC = acid and clot; ACD = acid, clot and digestion.

TABLE XIII.

Summary of bacteriological findings in normal genital tracts (100 non-pregnant and 31 pregnant).

Organism.	Number of tracts positive.	%
Micrococcus luteus	11	8.4
Micrococcus candidus	9	6.8
Micrococcus luteolus	1	0.7
Micrococcus conglomeratus	1	0.7
Micrococcus flavus	1	0.7
Micrococcus varians	1	0.7
Corynebacterium xerosis	6	4.5
Corynebacterium renale	2	1.5
Corynebacterium bovis	2	1.5
Corynebacterium acnes	1	0.7
Corynebacterium flavidum	1	0.7
Diphtheroid (unidentified)	9	6.8
Alcaligenes faecalis	1	0.7
Staph. albus	12	9.1
Staph. citreus	6	4.5
Staph. epidermidis	3	2.2
Staph. aureus	1	0.7
Strep. bovis	6	4.5
Strep. equinus	1	0.7
Strep. faecalis	2	1.5
Strep. evolutus	2	1.5
Strep. group F.	1	0.7
Escherichia coli	10	7.6
Bacillus mesentaricus	5	3.8
Sarcina lutea	1	0.7

PART II.

Anatomical features of the uterus of the cow.

The uterus has been described by Sisson (1911) as a hollow muscular organ. Anteriorly it receives the Fallopian tubes and opens into the vagina posteriorly. It is situated almost entirely within the abdominal cavity in the adult and is attached to the upper part of the flanks, about a handsbreadth below the level of the external angle of the ilium, by two folds of peritoneum termed the broad ligaments. The uterus is differentiated into a neck or cervix, body and two horns or cornua.

The uterine or Fallopian tubes are thin walled and flexuous measuring about 20 - 25 cms. in length. They follow a course over a pouch formed by a folding over of the free edge of the broad ligaments which envelops the ovary. The fimbria is attached to the free margin of this pouch. The uterine extremity of the tube is funnel shaped while the ovarian extremity is fimbriated, though the fimbriae are not so extensive as in the mare.

The cervix is about 8 - 10 cms. long with a dense wall about 2-3 cms. in thickness. The lumen of the cervix i.e. the cervical canal is spiral and is ordinarily firmly closed. It opens posteriorly into the vagina by the os uteri externum and anteriorly into the body by the os uteri internum. The mucous membrane of the cervix is pale and glandless. It forms numerous folds/

folds arranged in several series which obliterate the lumen. At the os uteri externum the folds form rounded prominences arranged circularly, which are seen projecting into the cavity of the vagina.

The body of the uterus is only 3-4 cms. in length, although externally it gives the impression of being much longer, owing to the fact that the posterior parts of the cornua are united by connective and muscular tissue and have a common peritoneal covering.

The cornua are very variable in length (25-40cm.), cylindrical in appearance and taper gradually towards the anterior extremity, so that the junction with the Fallopian tubes is not abrupt, as in the mare. The free portion of the horn takes a spiral course by proceeding downward, forward and outward and then turning upward (Fig. 1.)

The uterine wall consists of three coats, an external serous, a middle muscular and an internal mucous. The serous coat is adherent to the muscular coat and is continuous with the broad ligaments. The muscular coat consists of an external longitudinal layer and an internal circular layer which is in two strata; in between these muscular layers there is a vascular bed in which the blood vessels ramify.

The mucous membrane of the horns and body of the uterus presents a feature characteristic of ruminants but which is unlike that of the majority of other animals. This is the presence of uterine cotyledons, which/

which are round button-like prominences about 80-100 in number, scattered irregularly over the surface or arranged in rows along the longitudinal axis of the uterus; they serve as points of attachment for the foetal membranes. In the non-gravid uterus they are small in size, (15 m.m. x 15 m.m. x 15 m.m.), but during the pregnancy they become greatly enlarged and pedunculated, (10-12 cms. x 3-4 cms. x 2-2.5cms.). Their surface has a spongy appearance, due to numerous crypts which receive the chorionic villi.

The presence of the cotyledons thus differentiates the mucosa into two parts, viz., the cotyledonary and the inter-cotyledonary areas. The mucosa of the inter-cotyledonary area is smooth and the uterine glands open on to its surface. Beneath the epithelial layer there is a layer of connective tissue which can be differentiated into two - a rather dense superficial layer and a deep layer of loose connective tissue in which the uterine glands ramify. The cotyledons are lined by a single layer of columnar epithelium as in other parts of the uterus, but have no glands opening on to their surface. Beneath the epithelium there is a dense layer of connective tissue richly supplied with blood vessels. The loose connective tissue layer beneath the former has glands as in other parts of the uterus. (Figs. 13, 14, 15, 16, 17).

In order to appreciate the histopathological changes, it is considered necessary to review briefly the/

the sequence of changes which occur in the endometrium of the cow during the oestrous cycle (Hammond, 1927).

The cotyledons. The connective tissue stroma of the cotyledons appears to be unusually dense three days to 14 hours before heat. There is slight congestion of sub-epithelial blood vessels during heat and twenty-four hours after the beginning of heat. At 48 to 72 hours after the beginning of heat the connective tissue appears to be oedematous, with great congestion of blood vessels and slight extravasation of blood into the sub-epithelial tissues (Fig. 17). By eight days after the beginning of heat, the congestion and oedema of the tissues have subsided.

The intercotyledonary area. The vascular and connective tissue changes which take place in this area are very similar, but less intense than those which take place in the cotyledons. The capillaries become slightly enlarged during heat, but do not appear to reach their maximum congestion with extravasation of blood until 72 hours after heat. Sub-epithelial extravasation of blood is followed by pigment formation eight days after heat, but not to the same extent as in the cotyledons. About 3 days to 14 hours before heat there appears to be an accumulation of hyaline matter between the strands of loose connective tissue of the uterine mucosa, but it disappears in 48 - 72 hours after the beginning of heat.

No great difference could be observed in the number and distribution of the uterine glands during the oestrous cycle. During the middle of the cycle and then just before the onset of heat the changes appear most marked in the deep glands, with an increase in size which is followed by a rapid diminution to a minimum 24 to 48 hours after heat; thereafter a gradual increase in size again occurs from 3 days after heat until the middle of the next heat period.

Endometritis.

Endometritis can be defined as the inflammation of the mucous membrane lining the cavum uteri, which in the majority of cases is the result of bacterial activity. Actue or chronic inflammation of the endometrium may affect the gravid or the non-gravid uterus.

The normal bovine uterus, though not free from bacteria, is resistant to infection. But an involuting uterus is highly susceptible for the interior of such a uterus presents large areas of raw surface containing remnants of placental tissue undergoing disintegration along with numerous blood clots. Besides, at this stage particularly it is open to infection both from the cervix and the blood stream and thus offers an excellent medium in which pathogenic bacteria may thrive. Bacteria which gain entrance to the uterus are the primary cause of endometritis, whereas secondary factors/

factors, such as inflammation of the cervix, injudicious manipulation leading to trauma and haemorrhage, irritating chemicals and exhaustion pre-:dispose to infection.

There are three main sources of infection of the uterus, viz.

(a) Genital - Bacteria already present in the vagina and the cervix uteri.

(b) Exogenous - In this type of infection bacteria are introduced from without, usually by attendants and dirty surgical instruments. Unhygienic byre conditions enhance the risk of infection from this source. Sometimes a bull with diseased genitalia may be responsible for transmitting the infection during copulation.

(c) Endogenous - In this the infection is from an extra-genital source but within the cow itself.

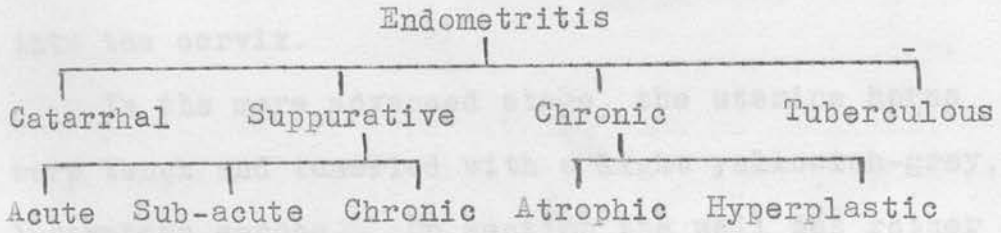
An infection of the uterus from any of the sources mentioned causes a tissue response which varies according to the type of organism and the length of time the uterus has been infected. The pathological picture of endometritis is an interesting one depicting various stages and forms of inflammation.

Pathology.

In this study 100 abnormal genital tracts were examined, 93 of which showed lesions mainly in the endometrium and partly in other associated structures - cervix, Fallopian tubes and ovaries. Five had only primary/

primary cervicitis and two only salpingitis. The gross examination of the ovaries was included in every case, in order to take into consideration the physiological variation in the endometrium due to cyclical changes.

Based on a study of macroscopic and microscopic pathology, it is proposed to classify endometritis into four main groups as shown in the chart below.



Before giving a full account of the pathological changes, the author wishes to emphasise that his classification of endometritis has been made entirely according to the type of lesion predominating in each particular case, as other subsidiary types of lesions might exist in the uterus at the same time.

Catarrhal Endometritis.

Thirty-two cases (34.4 per cent) were classified as belonging to this type, which is characterised by a catarrhal inflammation of the endometrium with a certain amount of non-purulent exudate. In a few cases it followed on an acute attack, whilst in many others it was of a chronic character from the outset.

In the mildest form of this type there was no obvious/

obvious change either in the appearance and size of the uterus or the thickness of its walls. A slight catarrhal exudate covered the mucosa in a thin layer which was often confined to certain parts of the horn, especially around the cotyledons (Fig.2). In some, the mucosa was pale and oedematous and the cotyledons were indistinct, while in others it was rather difficult to appreciate any change macroscopically. The discharge was not sufficient in quantity to flow out into the cervix.

In the more advanced stage, the uterine horns were tough and tumefied with a light yellowish-grey, lustreless serosa. On section the wall was rather thickened with enlargement of one horn (usually that recently gravid), in which the reaction was more advanced. The infection from this horn usually spread to its companion via the body of the uterus. There was a thick greyish-white mucinous exudate resembling "pea soup", with numerous yellowish flocculi, which was often sufficient to flow out freely from the cervix. The volume of the exudate varied from case to case and averaged 100-300 c.c. The endometrium showed yellowish to greyish-brown discolouration distributed in patches about the size of a penny all over the surface. It was thickened and the normal lustre and smoothness were absent. In severe cases, especially those associated with staphylococcal infection, there were minute epithelial erosions/

erosions of the mucosa. The cotyledons either could not be recognised or were reduced to variously sized greyish-yellow elevations with depressed centres. In such cases of advanced endometritis, it was not uncommon to find co-existing lesions in the cervix, Fallopian tubes and ovaries. In this series fifteen had co-existing cervicitis, twelve salpingitis, four cystic ovaries and three persistent corpora lutea.

These two stages of endometritis seem to merge into one another. The earlier cannot be diagnosed clinically, but the more advanced can be diagnosed by the cervical discharge where this occurs.

Results of bacteriological examination (Table XIV) reveal that thirteen were pure staphylococcal infections (6 Staphylococcus aureus, 7 Staphylococcus albus), two streptococcal (one group D and the other group D and F), two Klebsiella pneumoniae, one Escherichia coli, one Proteus vulgaris, one Pseudomonas aeruginosa and eight harboured a mixed flora of staphylococci, streptococci, micrococci and diphtheroids other than Corynebacterium pyogenes, while one was sterile throughout.

The breeding histories of twenty-six cows in this group were available and it was found that twenty-two (84.6%) had difficulty in settling or had proved sterile. Eleven had failed to conceive even after being served three or more times after their last calving, (Case Nos. 20, 36, 47, 57, 61, 126, 131, 151, 200, 211 and 224. Appendix)

Of the seven (Case Nos. 20, 36, 57, 61, 109, 126 and 200) that had retained their placenta only three had a history of abortion. Five were heifers which had never conceived, even though they 'ran with the bull' for varying periods of time.

Trichomonas foetus was found in three uteri with typical catarrhal endometritis. The cows from which these uteri had been obtained had all aborted - two in the third month and one in the sixth month of pregnancy. The herd history of two cows showed no previous history of abortion. In the third herd, however, since this record of trichomoniasis, three other heifers returned to the bull with a history of discharge after apparently 'holding' for three months. After their return they were each served twice without success.

Cervical discharges from these heifers did not show any trichomonads on microscopical and cultural examinations. The samples of cervical discharge and blood sera from these heifers were forwarded to Dr. W. R. Kerr, of the Ministry of Agriculture, Veterinary Laboratory, Belfast, who reported a strongly positive mucin test for one of the samples; the serum agglutination test for trichomonas infection was negative for all

Suppurative Endometritis.

Suppurative endometritis (38.7%) is characterised by the presence of pus in the uterus. According to the severity of the reaction, this has been met with in the acute, subacute and chronic forms.

The acute form is characterised by a severe suppurative inflammation, which is invariably the result of puerperal infection following upon abortion or a full term parturition. In mild cases there was absence of involution of the uterus, which was oedematous with flabby walls. The serosa was sticky and lustreless with dirty brick red inflammatory patches. The endometrium was covered with soft, dirty sloughs and bathed in purulent exudate. The cotyledons were soft, oedematous and covered with sloughs and semi-fluid mash-like exudate which had an offensive odour.

In the more severe form the uterus was completely flaccid with no involution at all. The serosa was highly inflamed with inflammatory patches and petechiae. The cavum uteri was packed with semi-solid bran mash-like material mixed with disintegrating remains of placental tissue. The cotyledons were necrosed and gangrenous, and emitted a putrid smell. The mucosa was blackish-blue and necrosed with extensive erosions and nodular thickenings with suppurating foci (Fig.3).

The cervix in all these cases was flaccid and open, with bluish-black discolouration; some had laceration in addition.

The/

The vagina was apparently normal except for the discolouration due to the putrid discharge. It is of interest to mention here that the appearance of the vagina at a clinical examination may be fairly normal and so is very deceptive with regard to the state of the uterus.

The Fallopian tubes were involved in addition and contained purulent exudate. The regression of the corpus luteum had not progressed to the same extent as in a normal involuting uterus.

In all these cases of puerperal endometritis, Corynebacterium pyogenes was invariably present either in pure or mixed culture. Of six such cases, it was isolated in pure culture from three uteri, in one it was in association with Staphylococcus albus, one with Escherichia coli and one with micrococci (Table XV).

Of the six cases met with in this study (Case Nos. 45, 214, 223, 231, 232, and 239), one resulted from abortion and four had retained their placenta after full term parturition. The interval between parturition and examination of the uteri varied from three days to four weeks.

The sub-acute form of suppurative endometritis really represents an early stage of pyometra or a uterus that is becoming normal after a mild attack of puerperal infection.

In the early stages the lesions were confined more/

more often to one horn (the one recently gravid), though both horns were affected at a later stage. If only one, it was slightly enlarged with dense walls and a more or less normal serosa. The lumen contained a thick, muco-purulent, creamy discharge scattered over the mucosa, occurring especially as small clumps around the cotyledons. In general, the mucosa was oedematous and showed small inflammatory patches, while underneath the pus it was necrotic and eroded. The cotyledons showed numerous necrotic spots. Occasionally there were small pieces of necrotic tissue mixed in with the pus. The discharge was not sufficient to fill the lumen of the horn, though in some cases it was sufficient to flow into the other horn via the body of the uterus. Such a condition seemed to follow relatively rapidly after calving. In one case (Case No. 2) such a condition was found when examined 13 days after calving. The lesions were chiefly confined to the cornua and the cervix in most cases appeared normal. Out of twenty-two cases included in this group, five had co-existing salpingitis. In three cases the ovaries contained persistent corpora lutea.

Bacteriologically the most constant organism isolated was Corynebacterium pyogenes either in pure or mixed culture. It was isolated from eighteen cases (81.8 per cent), being pure in fourteen cases and in four mixed with either Staphylococcus albus, Micrococcus candidus or Escherichia coli. Corynebacterium bovis

bovis was isolated from two cases in pure culture while it was mixed with Staphylococcus citreus and Staphylococcus albus in another. Corynebacterium equi was present in a pure form in one case (Table XV).

From the histories of eighteen cows it is found that six (Case Nos. 41, 87, 102, 150, 159 and 207) had failed to conceive even after being served four to many times, and one after two services. The rest of the animals do not have a history of being served, even though they were slaughtered on an average of 7-8 months after calving. It is not unreasonable to assume that these cows, having been served for a while without success, would have been disposed of for slaughter. The ages of the cows varied from 4 - 13 years and the number of calves 1 - 11.

It is of interest to note here that this form of endometritis cannot ordinarily be appreciated at a clinical examination, since the uterus and cervix appear apparently normal. But a bacteriological examination of uterine swabs will help a great deal in the diagnosis of such cases.

Chronic suppurative endometritis was characterised by a marked pathological change evident on a clinical examination per rectum. In this form there was an accumulation of pus in the uterus (pyometra), either as a result of stenosis or atresia of the cervix or complete lack of tone in the uterine wall.

In the early stage, when the accumulation of pus was not great, the uterine cornua were usually symmetrically/

symmetrically enlarged, but were also found unequal in size, with thick flabby walls. The tubal end of the horn was rounded and pouch-like. The serosa was discoloured, lustreless and thickened, while the endometrium was light brown to dark brown with areas of greyish-black discolouration, with necrotic spots and erosions showing adherent purulent flocculi (Figs. 10 and 12 in actual colour). The cotyledons were small, greyish brown to reddish-brown in colour, with a rough surface showing epithelial defects. The cavum uteri contained creamy pus which often had small blackish flocculi in it. In some cases, where the purulent exudate had not entirely filled the uterus, a marked line of demarcation was evident at the upper limit of the contents, the mucosa towards the cervix being smooth and pink.

In long-standing cases there was an enormous enlargement of one or both horns, depending upon the amount of pus. In these cases the uterine body was also enlarged and distended with pus. The serosa was greyish-black in colour, thick, moist and sticky. When the accumulation of purulent material was great the wall was thin and the anterior extremity of the horn folded upon itself (Figs. 4, 5 and 6). On palpation there was usually fluctuation and the walls were thin and leathery to touch. The pus varied from thick sauce like to semi-solid in consistency and from creamy yellow to dark grey in colour. In quantity it varied from/

varied from one to several litres and often contained parts of the foetus. In one case about twenty litres of pus were recorded mixed with foetal bones in a state of maceration. The pus often had an offensive odour. The greyish-black mucosa showed small and large areas of erosion which were both shallow and deep. The cotyledons were either absent or, if present, were only very small, necrotic and gangrenous. In advanced cases the mucosa was blacker and the erosions more extensive, with a nodular appearance, the nodules being placed close together.

It is of special interest to mention here that in three cases (Case Nos. 32, 88 and 205), there was what might be considered an early infection of the foetal fluid, with the development of pus in the gravid uterus. On post-mortem examination of the unopened uteri they all appeared apparently normal gravid uteri. The cervix in every case was firmly closed with a plug of mucus as in pregnancy; the ovaries contained corpus luteum of pregnancy. The amniotic fluid, when with-:drawn in a Pasteur pipette was greyish-white and sticky in consistency. On opening the uterus, the foetal fluids were abnormal in appearance, being slimy in consistency and yellowish-white in colour, containing numerous yellowish flakes. In some parts it resembled liquid pus. The foetus was soft, friable and sticky, being covered with dirty yellowish material. The foetal membranes were in a state of disintegration. In one/

In one case they were apparently normal. In two cases the cotyledons showed a necrotic surface. Judging from the size of the foetuses they were about four months, two and a half months and two months old.

From two of these uteri Corynebacterium pyogenes was isolated in pure culture and Corynebacterium equi from one also in pure culture. These bacteria were present both in the foetal fluids and utero-chorionic space. Neither Brucella abortus nor Trichomonas foetus were observed on examination of smears and cultures. If the cows from which these uteri were obtained had been allowed to live, they would have either aborted or developed a typical closed pyometra.

This hypothesis is based on a study of the cases and their breeding histories. Though the histories in most cases are given in full in the appendix, it is considered essential to refer briefly to two of them here.

In one of them (Case No. 15) the left uterine cornu was enlarged and doughy to touch. It was impacted with what appeared to be a macerating mass of tissue (size about 5 inches x 2 inches) moulded to the shape of the lumen of the horn. The rest of the horn was partially filled with thick masses of pus from which Corynebacterium pyogenes was isolated in pure culture. The history of the cow showed that she had had two normal calvings. After her last calving on 12.9.46 she had been served five times consecutively on 13.11.46; 5.12.46/

5.12.46; 18.12.46; 7.1.47 and 27.2.47 without apparent success. She was slaughtered on 2.4.47.

It appears that the difficulty in settling the cow was due to the suppurative endometritis. The lump of tissue found in the uterine cornu could have been either the remains of placenta (though the history seems to suggest that the cow cleansed normally) or an embryo which perished (either owing to infection or some other cause) resulting in pyometra.

In the other case (Case No. 43) the uterus was greatly enlarged and simulated pregnancy externally. The cavum uteri contained creamy pus mixed with a well formed foetal skeleton. The soft tissues were in a state of advanced decay and maceration. Neither the cotyledons nor the foetal coverings could be recognised. Corynebacterium pyogenes was recovered in pure culture from the uterine contents.

The subject was a three year old heifer which had been successfully served in January 1946. She showed all the clinical signs of pregnancy and was expected to calve sometime in October 1946. As she had not calved even long after her expected date she was fattened and slaughtered in July 1947. The indications in this case are that the foetus had perished after reaching full development.

Out of eight cases of pyometra, Corynebacterium pyogenes was isolated in pure culture from seven and Corynebacterium equi from one (Table XV). The outstanding/

outstanding features of pyometra are the distension of the uterus with pus, closure of cervix with a false plug of mucus and persistent corpus luteum, which could only be expressed with difficulty, even on directly handling the ovaries post mortem.

Chronic Endometritis.

Two types of chronic endometritis can be distinguished according to the type of changes in the uterus, viz. atrophic and hyperplastic.

Atrophic Endometritis.

In this type the uterus showed reddish-brown discolouration of the serosa. Though there was no marked enlargement on palpation of typical cases, the walls were flabby with a complete lack of tone, the tissues were very soft, friable and were easily crushed and torn when pressed by forceps or fingers. (It is not possible to do so with a normal uterus). When opened, a small quantity of curdy exudate containing flakes of necrotic tissue flowed out. There was marked atrophy of the endometrium, which was brick red, rough and pitted with dark necrotic spots, while the cotyledons were replaced by large shallow depressions. In a few cases the mucosa was studded with small yellowish-grey spots, looking as though bran had been sprinkled over the surface.

In some of the uteri the uterine walls were flabby, but thin and leathery to touch, the whole uterus/

uterus giving the impression of being in a state of collapse, with partial or complete obliteration of the cavum uteri, which was traversed by four to five longitudinal folds, giving the uterus a shrunken and furrowed appearance. The mucosa was atrophic, of a brick-red colour, dry, rough and studded with necrotic spots.

Twelve uteri (12.9%) were classified as belonging to this group. Bacteriologically (Table XVl), six were sterile (50 per cent); two yielded Proteus vulgaris; two Klebsiella pneumoniae; one Staphylococcus albus and one Corynebacterium pyogenes.

Four cases were associated with bilateral salpingitis, of which two contained bacteria - one Proteus vulgaris, which was also isolated from the uterus, and the other Klebsiella pneumoniae, the cervix and uterus being sterile in this case. Four had cystic ovaries, two of which yielded pure cultures of Staphylococcus albus.

An analysis of the breeding history showed that three cows had aborted and one retained her placenta after her last calving. Four cows (33.3%) had been treated for sterility by irrigation of the uterus with Iodine solution and had been served frequently without success (Case Nos. 185, 199, 237, 71). The rest of the cows were not served and were presumably sterile. Only two had been disposed of because of poor milk yield.

Hyperplastic Endometritis.

Nine cases (9.6 per cent) of hyperplastic endometritis were met with. The horns were usually symmetrically enlarged with thick flabby walls. The mucosa was covered by a tough tenacious cloudy mucus spread more or less evenly in a thin layer over the whole surface. A few brownish-yellow flocculent masses were occasionally seen, while in one case the exudate was a chocolate coloured glairy gelatinous mass partially filling up the lumen of both cornua. In two uteri (Case Nos. 73 and 188) the cavum uteri was packed with a glairy tenacious mucus similar to the cervical plug of mucus during pregnancy. The mucus was so compact that it could be rolled out of the horns as a mould.

The endometrium was light brownish to pale pink, smooth, velvet-like and highly thickened (three to four times the normal thickness) with small glistening cysts of a greyish colour varying in size from a pinpoint to a barley grain, protruding slightly above the surface. The cysts were mainly confined to the middle and lower third of the horns, although sometimes they extended right through the cervix to the os uteri. In such cases the cervix was enlarged, rigid and somewhat sclerotic. The larger cysts contained a translucent mucinous substance.

The cavum uteri in seven (78%) of these uteri was sterile bacteriologically, while two yielded Micrococcus/

Micrococcus candidus (Table XVII). The ovaries were pathological in all these cases. In eight they were cystic and one, which was also cystic, was lined by a thin band of luteal cells. The ovarian cysts were large, thick-walled and difficult to rupture. The cystic fluid was clear and colourless or had a yellowish tinge and was sterile bacteriologically in all these cases.

The presence of pathological cysts in the ovaries seems to be a common feature in these cases (Fig. 7). In fact, one cow (Case No. 56) had been disposed of because she had developed symptoms of nymphomania and was a nuisance to the rest of the herd.

Four cows were definitely infertile; one was a heifer that never conceived in spite of several services, thus showing that 55.5% of cows in this group were sterile.

The most striking feature of these cases was the general hyperplasia of the uterine structures, especially the endometrium and the uterine glands. A similar condition has been referred to by previous workers (Beaver, 1922; Quinlan, 1929; and Wright, 1945) as the cause of sterility in cows. Quinlan (1929) described this condition as "endometritis chronica catarrhalis cystica". In view of the pathological changes, which are mainly hyperplastic, the author would prefer to classify it as hyperplastic endometritis, which is also the term used in human medicine/

medicine for such changes in the uterus.

Hydrometra.

Hydrometra is characterised by the presence of fluid in the non-gravid uterus which thus simulates pregnancy. In the two cases examined the following were recorded. In one of them (Case No. 167) the condition was confined to one horn, while in the other (Case No. 235) both horns were enlarged more or less symmetrically. The fluid fluctuated as in a gravid uterus, but the walls were thinner than in pregnancy and were leathery to touch, the serosa being dry, rough and thick. In the bilateral case the serosa was greyish-white; in the other it was bluish and congested (Fig. 11). In each the cervix was stenosed and closed with a false seal of mucus. There was a large persistent corpus luteum in the proximal ovary in each case. The uterine fluid was viscid, slimy and straw-coloured in the bilateral one, while in the other it was coffee-coloured. The endometrium was thickened and oedematous, with pitted yellowish-grey spots about the size of a threepenny piece scattered over the surface. In neither was there any sign of a foetus, foetal membranes or cotyledons; both were sterile bacteriologically (Table XVll).

Hydrometra seems to be a rare condition in bovines, since it was found only in two out of more than 231 uteri examined in this investigation.

Quinlan (1929) in South Africa, recorded one case of hydrometra with cystic degeneration of the mucosa. Williams (1921) also reported a similar case, but in this the cervical canal was open and admitted a uterine catheter.

The breeding history was available in one of the cases referred to here. The cow (Case No. 167) was seven years old, had had seven calves and at the time of slaughter was said to be in calf.

Tuberculous Endometritis (2%)

It is not intended to refer to this condition in great detail since it is an easily recognisable, well established pathological entity. In this investigation only two cases were studied, as the animals came from an almost completely tuberculosis-free area.

One of these cases (No. 160) was a very good specimen of descending infection from the peritoneum, which was grossly infected, showing advanced tuberculous lesions. The infection had involved the broad ligaments, ovaries and their bursae and Fallopian tubes, and then spread internally down the uterine cornua via the Fallopian tubes.

The uterine cornua were slightly enlarged with thick, firm walls whose serosa was pinkish-yellow and had many barley sized glistening tubercles. The endometrium was pinkish, smooth and thickened. The lesion/

lesion was a diffuse inflammation with millet-to-barley sized glistening translucent tubercles protruding from the surface of the endometrium. There was slight yellowish mucoid exudate scattered around the lesions, which were mostly confined to the ovarian extremity of the cornu (Figs. 8 and 9). The older and more pronounced lesions were found at the tubal end, while they became smaller as they extended down the horn until no macroscopic lesion could be detected in the lower third of the cornu, body or the cervix. On section the lesion was opaque and greyish-yellow in colour. The cervix was closed and contained a small amount of mucoid discharge at the external os. The uterine and cervical discharge revealed numerous acid-alcohol fast bacteria morphologically identical with Mycobacterium tuberculosis.

The other (Case No. 134) appeared to be a case of primary uterine infection, since no lesions were observed macroscopically anywhere else in the carcase. The uterine cornua were slightly enlarged with thick tense walls. The cervix was open, with chronic thickening of the walls and yellowish viscid mucus in the canal. The lesions in the uterus consisted of numerous lentil-sized glistening nodules protruding from the endometrium, which was light pink in colour, smooth and thickened. Scattered over the mucosa was a yellowish, slimy mucoid exudate. The tubercles contained a yellowish caseous exudate which was rich in acid-alcohol/

acid-alcohol fast bacteria, morphologically identical with Mycrobacterium tuberculosis. The Fallopian tubes were normal.

The subject was a three years old cow that had retained her placenta after aborting an eight months old bull-dog calf in January 1947. Following abortion her uterus was irrigated several times and she was served. Since she did not conceive, she was slaughtered in November 1947.

The nature of the lesions and the history of the cow strongly suggest that this was an instance of primary uterine tuberculosis, probably due to the irrigation of the uterus or service by a bull with infected genitalia.

HISTOPATHOLOGY.

Catarrhal endometritis.

The microscopic picture in general was indicative of chronic inflammation with proliferation of connective tissue. The mucosa showed thickening and oedema. In about half the number of cases the epithelium was intact. Epithelial desquamation was most frequent in cases associated with staphylococcal infection, especially Staphylococcus aureus. In some there were attempts at regeneration of the simple columnar epithelium, which was replaced by squamous epithelium, often several layers thick amounting to what might be called squamous metaplasia (Figs. 18, 19 and 20). Wall/

Wall (1914) described this process as "ectodermoisering". This condition was most prominent in the case of Trichomonas foetus infection. There was an increase in the connective tissue, which was infiltrated with lymphocytes, plasma cells and occasionally eosinophiles.

Pathological changes were also evident in the uterine glands, which were reduced in size and number and showed periglandular cellular infiltration. The epithelial lining of the glands in some was desquamated, the lumen being filled with cell debris (Figs. 21, 22 and 23). An occasional enlarged gland was also seen. In a few sections the capillaries showed slight thickening of their wall, though arterio-sclerosis, described by Quinlan (1929), Kaltenegger (1915) and Wester (1921), was never found in the cases examined. The muscular layer was normal, though slightly thickened.

Suppurative endometritis.

The histological changes were those of suppuration and necrosis. In the early acute stage the mucosa was swollen and congested, with dilated capillaries and extravasation of blood. There was heavy infiltration of the mucosa with polymorphonuclear leucocytes forming a thick layer beneath the degenerating necrotic epithelial layer (Fig.24). In more advanced cases the epithelium was completely destroyed or just lifted off/

off its attachment. The mucosa as a whole showed degenerative changes. Necrotic areas were infiltrated by a dense zone of leucocytes. The myometrium was also involved showing oedematous and degenerative changes.

In the sub-acute form the structural changes were mostly confined to the cotyledons and their surrounding areas. The epithelium was necrotic and desquamated; necrotic changes in the superficial connective tissue were also present, with an infiltration of leucocytes. In some squamous metaplasia and thickening of the connective tissue was present (Figs. 25 and 26).

In the chronic form, (pyometra), the epithelial as well as the sub-epithelial layers of the mucosa in most areas were completely necrosed. There were, however, local areas of stratification. The mucosa was covered by a purulent layer containing cell debris and neutrophils. Here and there areas of thickening with granulation tissue were evident. The superficial uterine glands were greatly reduced in number or almost completely destroyed; some of them were in a state of disintegration and were surrounded by dense connective tissue infiltrated with neutrophils, lymphocytes and round cells (Fig. 27). In deep glands the glandular epithelium was mostly desquamated, the lumen of the gland being filled with cell debris. The myometrium showed an infiltration with fibroblasts and isolated glands containing neutrophils and cell debris. Purulent tracts penetrating the myometrium were/

were a common feature of Corynebacterium pyogenes infection (Figs. 28 and 29.)

Atrophic endometritis.

The most prominent changes in this type were those of atrophy. The mucosa showed marked degener-:ative changes varying from complete desquamation of the epithelium to necrosis of the cells, being covered by a thick layer of cell debris containing clumps of deeply staining nuclei (Fig. 30). The superficial glands were atrophic with a reduction in their size and number. The glandular epithelium was desquamating, the lumen being filled with cell debris. Some of the deeper glands were dilated and had a flat epithelial lining. In some sections glands were also present in the myometrium, which was atrophic and contracted. Marked thickening of the intima of the blood vessels with narrowing of the lumen (endarteritis obliterans) was a frequent feature observed in almost all these cases. In many the thickening was so great as to obliterate completely the lumen of the vessels (Figs. 31 and 32).

Hyperplastic endometritis.

The histological picture presented in this type was one of general hyperplasia of the uterine structures, especially the mucosa and uterine glands. The superficial areas of the mucosa in some showed patches of degeneration and necrosis with an increase in connective tissue. The superficial glands were dilated with a tendency to cyst formation - cystic dilatation was a prominent feature of the deep glands. The shape and size of the cysts varied greatly, some being round or oval and others irregular. Under a low magnification the presence of these cystic glands gave the endometrium what has been aptly described as "Swiss-cheese appearance" (Boyd 1943). The cysts were lined by a single layer of cuboidal to flattened epithelium; larger cysts showed a markedly flattened epithelium owing to the pressure from the accumulated contents (Figs. 33, 34, 35, and 36). In a few cases small glands were present at the junction of the endometrium and myometrium, some penetrating the latter. The intermingling of glandular and muscular elements probably represents adenomyosis.

Hydrometra.

The uterine wall showed thickening of the mucosa and serosa while the myometrium was greatly reduced in thickness. The mucosa was of variable thickness and showed slight infiltrative changes. The epithelium/

epithelium consisted of high columnar cells whose cytoplasm was swollen. There was a marked increase in the number of the uterine glands - being more than twice the normal number per given area. The superficial glands were numerous, in dense clusters, tortuous in shape with jaw toothed internal surface; they opened freely on the mucous surface (Figs. 37 and 38). The deeper glands were enlarged and cystic, with a low cuboidal epithelium, the lumen being filled with mucus. Isolated mucin glands were also seen in the muscular layer adjoining the endometrium (Fig. 39). The serosa showed marked thickening and infiltration with fibroblasts (Fig. 40).

Tuberculous endometritis.

The epithelium showed areas of desquamation and stratification while the sub-epithelial layers had typical tubercles. In the youngest lesions the overlying epithelium appeared to be intact. The older lesions had damaged the epithelium, leaving an ulcerated surface covered with cell debris and epithelioid cells. Between the superficial ulcers the epithelium showed slight stratification. The uterine glands were much reduced in number. In some of the glands in the neighbourhood of the tubercles the epithelial lining was desquamated, and the lumen was filled with debris. Some of the glands were more or less completely destroyed and could only be recognised by their brokendown outline. In the older tubercles there/

there was caseation surrounded by a zone of round cells and a few giant cells (Fig. 41). The muscular layer appeared normal and showed no tubercles.

In tubercular salpingitis the lumen of the tube was completely occluded with caseating masses containing epitheliod cells. The mucosa showed desquamation and the tubercles contained epitheloid cells, giant cells and acid-fast bacteria. Caseous and calcified foci were also common in the mucous layer. The muscular and serous layers also exhibited typical tubercular foci.

Salpingitis.

The Fallopian tubes, because of their direct continuity with the uterus, naturally become involved in uterine infections, though pathological changes in these are not so common as in the uterus itself. Thus their infection is mostly secondary and rarely primary. In this investigation, 32 of the 93 (29.31 per cent) endometritic uteri showed lesions in their Fallopian tubes also. Only two cases showed what appeared to be a primary infection of the Fallopian tubes.

On post-mortem examination it was found that in some the whole length of the Fallopian tube was affected, while in others the lesions were confined to certain portions of the tube, such as the extremities. Simple bilateral inflammation of the Fallopian tubes without/

without appreciable distension of the duct with lymph or purulent discharge was the commonest type of lesion. The tubes were thin-walled and varied in colour from greyish-white to light yellow. They showed great flexibility and mobility and contained either a clear, straw-coloured or thick, cloudy fluid, in which were suspended small flocculi. The mucosa was apparently normal in most cases, though in some it was oedematous, thickened and thrown into thick folds. This type of lesion was usually associated with catarrhal endometritis and the bacteria present were those also found in the uterus.

In cases associated with virulent uterine infections (e.g. suppurative endometritis) the Fallopian tubes showed either acute or chronic lesions. In the acute type the tubes were greatly convoluted and swollen up to one centimetre in diameter (Fig. 42). The serous covering was tense, glistening and showed petechiae. The mucosa was in thick folds, swollen and showed spots of congestion and petechiae. The swelling was so great that the opposing mucous folds were in contact, thus occluding the lumen of the tubes; occasionally these folds gave the Fallopian tubes the impression of being beaded as a result of fluid accumulating between the folds and distending small segments of the tube.

In chronic cases the walls were much thickened, leading to kinking and deformation of the tubes, and in a few/

few thin fibrous strands passed from the tubes to the mesosalpinx, the bursa and the ovary. When this occurred, the pavilion showed chronic thickening and was partly or completely adherent to the ovary. In some specimens there was free drainage of purulent discharge into the cornu uteri and at the ostium abdominale tubae. This type was usually secondary to pyometra, and the bacteria responsible were those also present in the uterus. But in some cases of salpingitis it was not possible to isolate any organism from the uterus (which looked apparently normal), though various bacteria, e.g. Bacillus mesentericus, Staphlococcus aureus, and Escherichia coli were present in the tubes themselves. It is quite possible that in such cases the uterus had cleared itself of infection, though bacteria still lingered on in the tubes, where the mucous folds afford a favourable abode for bacteria.

In the only case of tuberculous salpingitis, the infection was a direct extension from the peritoneal cavity. Both the Fallopian tubes were affected. The fimbriated extremity of the tube was thickened and adherent to the ovary, which was enlarged, hard and caseous. The whole length of the tube was irregularly enlarged and highly convoluted. On palpation it was firm and nodular. Barley to large pea-sized, glistening, friable lesions were found on the serosa of ovary, Fallopian tubes, uterus and broad ligaments.

On/

On section the lumen of the tube was packed with a yellowish, caseous to brittle material. On removing the contents the mucosa was yellowish-brown and showed greyish ulcerated areas.

Cervicitis.

Inflammatory changes in the cervix may be either primary or secondary to uterine infection. Both acute and chronic forms were encountered, though an intermediate sub-acute form could also be recognised.

In the acute stage the cervix was swollen, with the mucous membrane inflamed and raspberry red. The first cervical fold was tumefied, deep red in colour, with petechiae and protruding into the vagina. The cervix was so tense that the os resembled a ripe tomato with a moist sticky surface. There was no appreciable discharge, though in some cases thick mucus was present in the anterior extremity of the vagina. In the sub-acute cases mucus mixed with yellowish purulent flocculi was often present in the anterior part of the vagina surrounding the os uteri.

In the chronic cases the cervix was very firm (almost hard) and enlarged. The discharge was more mucoid and less purulent. The enlargement was very prominent at the caudal extremity owing to fibrosis of the walls of the cervix and the caudal folds, which were very rugged and deeply furrowed. In such cases the mucosa of the cervix was of a dirty brick red colour, studded with spots of erosions. The os uteri

was covered with a tenacious yellowish-brown discharge. The cervical canal contained a dirty, chocolate-coloured, slimy discharge mixed with purulent yellowish flocculi. If pyometra was present the discharge was purulent, with extensive greyish-black discolouration of the cervical and vaginal mucosa.

In very chronic cases the cervical canal was stenosed and indurated; polipoid cauliflower-like growths protruded into the canal, almost completely occluding the lumen. Such growths were commonly seen in old cows and were presumably due to parturition injuries rather than to infection.

In this study there were thirty-three cases (32%) of cervicitis associated with endometritis. The discharge in these cases mostly yielded the bacteria present in the uterine exudate.

Only five cases of primary cervicitis were met with - three of them were acute and two chronic. Two of the acute cases yielded pure cultures of Corynebacterium pyogenes and one Lancefield's Group G streptococci. Corynebacterium bovis was isolated from both the cases of chronic cervicitis - in one it was recovered in pure culture while in the other it was found mixed with Staphylococcus albus. It appears that organisms isolated from endometritis are also responsible for cervicitis and vice versa. The presence of group G streptococci in one odd case tends to show that in very rare cases they may be responsible for/

for an inflammatory condition in the genital tract. The uteri and Fallopian tubes in all cases of primary cervicitis were sterile (Table XVIII).

Pathological Conditions of the Ovaries.

Various writers in the field of sterility have recorded ovarian abnormalities from time to time. Quinlan (1929), in South Africa, recorded that 66 per cent of cows slaughtered because of incurable sterility had pathological changes in the ovaries.

During this study of endometritis no direct investigation of the ovarian pathology had been made, but incidentally certain abnormalities have been recorded which have an important bearing on the subject. Pathological changes in the ovaries have been observed concurrently with endometritis in 46.5 per cent of abnormal genital tracts. Apart from ovaritis and tuberculosis of the ovaries (seen once), the changes were mainly of two types - cystic ovaries and persist-:ent corpora lutea. These pathological changes and their incidence in various types of endometritis are summarised in Table XIX.

TABLE XIX.

Type	Alone	With ovarian cysts	With persistent corpora lutea	With cysts and persistent corpora lutea	Total
Catarrhal	25	3	3	1	32
Suppurative	15	1	15	-	31
Atrophic	6	4	2	-	12
Hyperplastic	-	9	-	-	9
Hydrometra	-	-	2	-	2

Cystic ovaries.

The ovary is subject to variation in size and shape. Usually the normal ovary is oval, triangular or almond shaped but the presence of cysts and corpora lutea may alter the shape considerably. If one or more large mature follicles are present the ovary appears as an irregular fluctuating mass. At a clinical examination it is not always possible to differentiate between a large follicle and a cyst. However the normal follicle is prominent on the surface and is more easily ruptured, whereas the cyst as a rule is thick walled, not so prominent and is difficult to rupture. An ovarian cyst may be of the same size as a fully developed follicle or much larger measuring 2-5 cms. in diameter. The essential difference between them macroscopically is the dense thick wall of the pathological cyst. A cystic ovary usually had one large cyst, which varied considerably in size about 2-5 cms. in diameter. Occasionally there were two such smaller cysts separated from one another by a complete or incomplete septum. In one case the whole of the ovarian substance was occupied by one large cyst divided into three compartments by thick septa. Sometimes two or more smaller cysts occurred together giving the ovary a lobulated appearance.

The cysts contained a clear transparent colour-:less to slightly yellowish tinged fluid. In three instances/

instances the fluid was turbid and had numerous small flakes. From these cysts the following bacteria were isolated - Pseudomonas aeruginosa was isolated from one, Staphylococcus aureus from another, and Staphylococcus albus from the third, all in pure culture. In these three cases identical bacteria were isolated from the corresponding uteri which had endometritis. These findings would seem to indicate that infection had spread to the ovaries, via the Fallopian tubes, possibly through the ruptured ovisac. It is significant to note that all the ovarian cysts associated with hyperplastic endometritis were sterile bacteriologically.

Persistence of Corpus luteum.

This condition represents the failure of corpus luteum to undergo physiological regression after a normal interovulation period, an abortion or parturition. A persistent corpus luteum is large and firmly imbedded and encapsulated within the ovarian tunic. It could only be expressed with difficulty even on directly handling the ovaries post-mortem. In some cases it was impossible to enucleate it without damaging the ovarian structures. In the majority of cases it occupied almost the whole substance of the ovary and was surrounded by a thick capsule (Figs 43 and 44 K) Neither corpora rubra nor follicles were recognisable macroscopically.

There was great variation in size and colour. The colour varied from light yellow to brownish yellow or intense orange yellow. In size it varied from 2 - 3.7 c.m. in diameter.

The corpus luteum was generally found in the ovary of the affected uterine cornu. The other ovary was small and firm and appeared inactive. In one case there was persistent corpus luteum in one ovary while the other ovary was cystic. In another case there were two large corpora lutea in one ovary; these might be the result of twin ovulation, becoming subsequently persistent (Fig. 44 J.R.). Cystic condition of the persistent corpus luteum was met with in two cases. The ovaries were round to ovoid in shape. In one instance the cystic corpus luteum was larger than a pingpong ball. The wall of the cyst was thick and very resistent so that externally it was not possible to differentiate it from a cystic ovary. But on section the condition became evident; the cyst was lined internally by a band of luteal cells varying in thickness from 0.5 to 1.5 cms. The cysts contained a transparent fluid with a yellowish tinge.

This form of cystic degeneration of the corpus luteum has also been recorded in association with sterility by Williams (1939), Quinlan (1929) and others.

It is seen (Table XIX) that in the infective forms of endometritis the number of ovaries with persistent corpora lutea were more than twice the number of cystic ovaries, whereas in the non-bacterial hyperplastic type all the ovaries were cystic. All the well-established cases of pyometra had persistent corpora/

corpora lutea, whereas in the subacute form (where the lesions were not progressive) only six (27.2%) had persistent corpora lutea and one cystic ovary out of twenty-two cases in this group.

In the puerperal metritis occurring within three to four weeks of parturition, the regression of the corpus luteum was rather slow but it cannot be said whether it was persistent since it takes a variable time for regression to take place. The opinions among workers are varied on this point. Hammond (1927) states that the atrophy of the corpus luteum is delayed until four weeks after parturition, while Williams (1939) is of the opinion that the corpus luteum remains at full size up to and through parturition and does not normally atrophy until about 60 days after the termination of pregnancy when the cow is again on heat.

Bacteriology of abnormal genital tracts.

Results of the bacteriological examination of one hundred pathological genital tracts (endometritis, cervicitis and salpingitis) are summarised in Table XX. These bacteriological findings may be looked upon as giving some general indication of the frequency with which various bacterial species are associated with endometritis, because the material from which they were recovered was unselected and was collected over a period of about 18 months. Though the material was mainly derived from the Ayrshire/

Ayrshire breed of cows, the table gives some indication of the multiplicity of bacterial types which in nature may give rise to endometritis.

Corynebacteria were by far the largest group (51%), the next in order being staphylococci (33%), coliform bacilli (14%), streptococci (12%), micrococci (10%), Klebsiella pneumoniae (4%), Proteus vulgaris (3%), Mycobacterium tuberculosis (2%), Bacillus mesentericus (2%), and Pseudomonas aeruginosa (1%).

A comparison of the above table XX with table XIII giving the normal bacterial flora shows that Corynebacterium pyogenes, Corynebacterium equi, Staphylococcus aureus, (with one exception where it was isolated from a normal cervix), Klebsiella pneumoniae, streptococci of Lancefield's groups C. and G., Proteus vulgaris, Pseudomonas aeruginosa, and Mycobacterium tuberculosis were present only in the pathological genital tracts. Further, the incidence of Staphylococcus albus was increased to 25% in the pathological tracts as compared with 9.1% in the normal, the respective figures for Escherichia coli were 14% and 7.6% and for Corynebacterium bovis 5% and 1.5%

Thus it will be seen that apart from Mycobacterium tuberculosis the most significant bacteria associated with endometritis are Corynebacterium pyogenes, Corynebacterium equi, Corynebacterium bovis, Staphylococcus aureus, Staphylococcus albus, Klebsiella pneumoniae, Proteus vulgaris, and Pseudomonas aeruginosa either because of their great frequency or rare occurrence.

Corynebacteria.

Corynebacterium pyogenes:- Corynebacterium pyogenes was isolated from 31 (89%) out of 36 cases of suppurat-:ive endometritis. In 24 of these cases it was isolated in pure culture and in the rest it was in association with either Staphylococcus albus, Escherichia coli, or micrococci. It was also isolated from periuterine abscesses in pure culture from three cases.

Morphologically the organisms were Gram positive, appeared as short cocco-bacilli arranged in parallel bundles or at acute angles. A frequent feature observed was the narrow petal like shape of the individual cell, with the tip only lightly stained (Lovell 1937); cultures from egg medium and Loeffler's serum showed pleomorphism and irregular staining.

All the 34 strains grew under aerobic, anaerobic and micro-aerophilic conditions. The colonies were punctiform rarely exceeding 1 m.m. in diameter and produced beta haemolysis on horse-blood agar plates after 48 hours incubation at 37°C. Almost all of these strains failed to grow on plain agar and plain broth. Growth was better in serum glucose broth and settled as a granular deposit after 2 to 5 days at 37°C. There was no surface pellicle. Media containing Loeffler's serum and 2% glucose broth with a layer of liquid paraffin on top was found to be very favourable for their growth in primary cultures. In eight/

eight cases of sub-acute suppurative endometritis where there was no primary growth on blood agar plates there was good growth in this medium. If the material had not been inoculated simultaneously on this medium as well as others one would have failed to isolate this organism. This tends to show the value of using enriched media for the isolation of Corynebacterium pyogenes, when it occurs in small numbers or mixed with other bacteria.

All the strains liquefied gelatin, Loeffler's serum and egg medium. Litmus milk was acidified with the formation of clot which was digested in 3 to 5 days at 37°C. leaving a clear pinkish supernatant fluid.

All the strains fermented glucose, maltose, lactose, xylose and sucrose. The production of acid in sucrose was late and transient. In addition 6 strains fermented mannitol. Most workers agree that glucose, lactose and maltose are fermented by Corynebacterium pyogenes though individual strains may vary in their fermentative activity.

All strains produced a filterable haemolysin though in variable quantities which was neutralised by standard Corynebacterium pyogenes antitoxin.

Haemolytic test:- (Lovell, 1939, 1944) Cultures were grown in litmus milk for about 72 hours at 37°C. Then the clear supernatant whey was filtered through a Seitz filter the pad of which had been moistened with broth saline. The culture filtrate was tested for/

for sterility by inoculating on blood agar plates and incubating for 48 hours. The culture filtrate was then titrated in 1 c.c. quantities with 10% broth-saline as a dilutent. To each dilution (1/5, 1/10, 1/100, 1/1000) of the filtrate was added 0.1 c.c. of a 10% suspension of washed sheep red blood corpuscles. The tubes were then incubated in a water bath at 37°C. for one hour, and then examined. The result was taken as positive when there was 50% haemolysis at a dilution of 1 in 5 or more.

Neutralisation test:- Culture filtrates were diluted in the above manner and standard anti-toxin was added in such a manner that each dilution contained 10 "x" units of anti-toxin, The mixtures were left at room temperature for one hour. Then 0.2 c.c of 10% suspension of washed sheep red blood corpuscles were added and kept in a water bath at 37°C. for one hour. A psoitive control containing only toxic filtrate and sheep red blood corpuscles was included in each test. The test was taken as positive when there was haemolysis in the positive control and no haemolysis in the toxin-anti-toxin mixture.

Pathogenicity:- Seven strains were selected at random (culture nos. 15, 120, 43, 45, 70, 88 and D 11) and tested for their pathogenicity as follows. The individual cultures were grown in litmus milk for 72 hours at 37°C. and filtered through Seitz filters as described previously. For each strain of organism two mice were inoculated intravenously with 0.5 c.c. of culture filtrate. All the mice died in 4 to 6.5

minutes with symptoms of respiratory distress and convulsions.

Since its first isolation and description by Lucet (1893) Corynebacterium pyogenes has been isolated from suppurative conditions in animals. Grips (1898) isolated it from suppurations in swine and Kunnemann (1903) from cattle. Under natural conditions it has been reported as the cause of suppurative pneumonia, arthritis, and mastitis, the animals affected being cattle, pigs, sheep and goats. Wall (1914), Beaver (1922) and others have reported its occasional presence in cases of metritis in cattle, while Hignett (1940) isolated it from discharges from the vulva. Recently Weitz (1947) reported the isolation of Corynebacterium pyogenes in 27.6 per cent of the copious purulent vaginal discharges in contrast with its rare occurrence in normal cows or sterile cows without abnormal discharge.

Corynebacterium equi:- Two strains of Corynebacterium equi were isolated in pure culture - one from a non-gravid uterus with purulent endometritis and the other from a gravid uterus with early pyometra. Both the strains were identical in their morphological, cultural and biochemical characters which were as follows.

Morphology:- In smears made from solid medium the organisms appeared as highly pleomorphic rods, straight or slightly curved, with parallel or slightly bulging sides and rounded to clubbed ends. They

were arranged in pairs lying side by side, at angles and in parallel groups. A few coccoid forms were also seen. In broth culture the bacillary form was more pronounced than the coccoid. They were Gram positive, non-motile and non-sporing. When stained by Leishman's stain or Methylene blue they exhibited beaded appearance (Fig. 45). The beads were bipolar in short rods, while in long rods three to four were distributed through the length of the rod.

Cultural characters:- On agar growth appeared in 24 hours at 37°C. The colonies were round, pinhead like about 1 m.m. in diameter, discrete, circular with entire margin and smooth, moist shining surface with a yellowish pigment. On further incubation for 24 hours the colonies increased in size and tended to coalesce. When left at room temperature, the growth increased, fused and flowed down the agar slant accumulating at the bottom (Fig. 46). In about ten days' time the pigment was of a tan yellow colour, which was more intense on glucose agar. The colonies were succulent and easily emulsifiable in water. On horse-blood agar there was good growth which became tan yellow in two to three days' time. There was no haemolysis, though a slight clearing of the plate around the growth was noticeable.

In broth there was slight surface growth at 48 hours with no turbidity of the medium. On further incubation for one or two days a well formed pellicle was present, with granular sediment at the bottom. Even at room temperatures the growth continued with

the pellicle becoming thicker and tan yellow in colour and growth particles settling to the bottom of the tube leaving the supernatent medium clear.

Gelatin stab:- There was slight growth along the tract of the needle and on the surface. No liquefaction of the medium occurred, even after 15 days at 37°C.

Potato:- There was a thick confluent growth in 48 hours at 37°C. When left at room temperature, growth increased and developed a pinkish yellow pigment.

Loeffler's coagulated serum:- There was abundant growth with intense yellow pigment without liquefaction of the serum.

Growth on Sodium tellurite medium was scanty and black in colour.

Biochemical reactions:- No fermentation was observed in glucose, lactose, maltose, xylose, salicin, dulcitol, rhamnose, mannitol, arabinose, inulin, inosite, sucrose, raffinose, dextrin, trehalose and sorbitol. The carbohydrates were done in duplicate and incubated for 15 days. Litmus milk was slightly alkaline in 7 days at 37°C. Tests for indole, ammonia and hydrogen sulphide were negative. Cultures produced catalase and reduced nitrates to nitrites. Methyl red and Voges-Proskauer tests were negative.

Pathogenicity:- The organisms were non-pathogenic to guinea pigs and mice at a dose of 1 c.c. and 0.5 c.c. respectively, of a 48 hour broth culture given intra-peritoneally.

The cultural and biochemical reactions of this

strain were compared with one strain of Corynebacterium equi (presumably of equine origin) kindly forwarded by Dr. R. Lovell. The only obvious difference between these strains was that the equine strain produced slight turbidity in broth in addition to slight pellicle formation, whereas in the bovine strain the broth was clear with a thick pellicle. In this respect the strain under study resembles the bovine strain described by Craig and Davies (1940) which produced no turbidity of the medium.

Though it has been demonstrated by Brunner, Dimock, and Edwards (1939) that Corynebacterium equi possesses both species specific and type specific antigen, no attempt was made in this study to verify the usefulness of these tests in the identification of the organism referred here. On the basis of cultural, morphological, and biochemical characters the difference between the organism reported herein and Corynebacterium equi is so slight that it may be regarded as variant of the type species.

Corynebacterium equi has often been reported as the cause of certain suppurative conditions in equines and swine. Dimock and Edwards (1931), Rajagopalan (1937), Magnusson (1938) and Bull (1924) have reported it as the cause of pulmonary and other pyaemic lesions in foals. Dimock and Edwards (1933) isolated it from the os uteri of barren mares and aborted equine foetuses while Magnusson (1938) and Plum (1940) reported it from the cervical glands of pigs with lesions resembling those of tuberculosis.

The first report of the occurrence of Corynebacterium equi in bovines was that of Rajagopalan and Gopalakrishnan (1938) who isolated it from the vaginal swabs of a she buffalo which had aborted an eight month old foetus. Subsequently Craig and Davies (1940) isolated similar organisms from the uterine discharges of two cows affected with pyometra.

In conclusion it may be stated that the present report is the first instance of Corynebacterium equi isolated directly from a non-gravid as well as gravid (both pathological) uterus of the cow.

Corynebacterium bovis:- Five strains of organisms which are tentatively considered as variants of Corynebacterium bovis were isolated thrice from sub-acute suppurative endometritis and twice from cervicitis. All these strains were identical in their morphological, cultural and biochemical characters with those already described in detail under normal bacterial flora of genital tract.

These strains resembled the type species isolated from fresh milk drawn directly from the cow's udder, (Bergey (1939, 1948) in their morphology, cultural requirements and lack of fermentative abilities, while they differed from it in their ability to produce clear zones of haemolysis on horse blood agar plates and liquefy gelatin and Leoffler's serum incubated for 48 hours at 37°C. Thus it will be seen that in their haemolytic and proteolytic properties they are closely related to Corynebacterium pyogenes, but

differ from it in their inability to ferment carbohydrates and cultural requirements which are simple. These strains grow well on plain agar and broth; on agar the growth is profuse, confluent and shining within 24 hours at 37°C. It must also be noted that these strains liquefy Loeffler's serum markedly within 24 hours, whereas the liquefaction by Corynebacterium pyogenes is not noticeable until after 48 hours incubation.

The most vigorous activity of these cultures is found in their rapid liquefaction of gelatin and Loeffler's serum. The author has not come across any description of this variety in literature. In view of these important differences and its association with metritis, it is considered that it represents either a new species of diphtheroid or a variant of Corynebacterium bovis. Pending further investigation it is proposed to refer to it as Corynebacterium bovis var. metritis, to distinguish it from the type species isolated from udder.

Staphylococci.

Staphylococci were the next largest group of bacteria isolated from the abnormal genital tracts. They were mainly associated with catarrhal endometritis having been isolated from 50% of such cases, in 40% of which they were present in pure culture. Staphylococcus aureus was present in eight cases in seven of which it was isolated in pure culture/

culture. Staphylococcus albus was isolated from 25 uteri, in seven of which it was in pure form.

All the Staphylococcus aureus strains produced clear zones of haemolysis on horse blood agar plates, fermented glucose, maltose, lactose, sucrose and mannitol; produced acid and clot in litmus milk and liquefied gelatin, and were positive for coagulase test.

The Staphylococcus albus strains produced whitish to porcelain white pigment on agar, fermented glucose, maltose, lactose and sucrose. Fermentation of mannitol was variable since only fifteen strains fermented it. Twelve mannitol positive strains also produced clear zones of haemolysis on horse blood agar. All the Staphylococcus albus strains were negative for coagulase test.

Though pathogenic staphylococci are generally associated with bovine mastitis they are not restricted to the udder alone. Little and Plastridge (1946) record the isolation of haemolytic-coagulase-positive staphylococci from one of nine cases of bovine metritis. Recently Pounden, Ferguson, Knoop and Krauss (1947) in America reported the isolation of Staphylococcus albus from four cases of abortion in a herd of 50 cows. The herd bull was incriminated as a possible transmitter of the infection. Organisms of apparently similar characters were recovered from samples of semen obtained from the bull concerned.

Streptococci.

Lancefield's group C streptococci were isolated once in association with Staphylococcus albus from catarrhal endometritis. These colonies were beta haemolytic on horse blood agar. They produced acid in litmus milk and fermented glucose, trehalose, lactose (after 7 days), salicin, mannitol and sorbitol but inulin, raffinose and rhamnose were not fermented. Methylene blue milk was not reduced and Sodium hippurate was not hydrolysed.

Lancefield's group G streptococci were isolated only once in pure culture from an acute primary cervicitis. The colonies produced wide zones of beta haemolysis on horse blood agar; acidified litmus milk. They fermented glucose, trehalose, lactose, sucrose and salicin, but neither mannitol, sorbitol, inulin nor raffinose were fermented. Methylene blue milk was not reduced and Sodium hippurate was not hydrolysed.

Non haemolytic group D streptococci were isolated four times, group F haemolytic streptococci twice, and viridans streptococci four times from genital tracts.

Proteus vulgaris was isolated from three uteri - twice from atrophic endometritis and once from catarrhal endometritis. Cultures were pathogenic to mice on intraperitoneal inoculation of 0.5 c.c. of an overnight broth culture.

Pseudomonas aeruginosa was recovered from the uterus/

uterus and cystic ovary of one genital tract with catarrhal endometritis.

Since this organism was not isolated from any of the normal genital tracts, it would appear to be of pathogenic importance in endometritis. Pseudomonas aeruginosa has been associated with infertility in the male bovine from time to time. Gilman (1922) reported the isolation of this organism in conjunction with a streptococcus from abscesses of the seminal vesicle of a bull, which had suddenly become sterile, while Gunsalus, Salisbury and Willett (1941) isolated it from five out of 19 bulls. Recently Rollinson (1948) isolated it from the semen of 14 bulls (41%) in herds where the fertility rate was unsatisfactory leading to suspicion of the bulls.

Mycobacterium tuberculosis was identified in two uteri by examination of smears made from uterine exudate and histological sections.

Klebsiella pneumoniae.

Bacteria which morphologically, culturally and biochemically resembled Klebsiella pneumoniae were isolated in pure culture from four genital tracts - two of which had lesions of catarrhal endometritis and two atrophic endometritis. All the four strains were identical in their cultural, morphological and biochemical characters which are as follows:-

Morphology:- The organisms appeared as short rods with parallel sides and rounded ends, arranged singly,

in pairs end to end, and in small groups. An occasional filamentous form was also seen. They were Gram negative, non-motile, non-sporing and capsulated.

Cultural characters:- On agar plates at 24 hours at 37°C. the colonies were round, 1 to 1.5 m.m. in diameter, convex with an entire margin and greyish white smooth glistening surface. On further incubation for two days the colonies increased in size up to 3 to 5 m.m. with a wavy or undulate margin. Some of the colonies appeared like a rosette with thick opaque centre and translucent radial sectors. On agar slope at 24 hours the growth was profuse with an uneven surface and wavy borders.

Gelatin stab:- At 22°C after 48 hours there was slight growth along the tract of the needle. After 6 to 8 days the growth was thick, tapering to a point below and spreading on the surface of the medium thus giving a nail headed appearance. There was no liquefaction of the medium even after three weeks at 22°C.

Broth:- After 24 hours at 37°C. the broth became cloudy with numerous fine flocculi suspended in the medium. After three days' incubation the flocculi settled to the bottom in a glutinous mass to a depth of about half a centimeter. The supernatant broth was cloudy and viscous with a ring of surface growth.

Glucose agar shake:- 24 hours at 37°C. Tiny colonies throughout the medium, more numerous near the top/

top with a film of whitish growth on surface. After 48 hours incubation the medium was torn into rifts with gas.

Horse blood agar plate:- The colonies were larger than on agar with a smooth, shining, milky white surface. There was no haemolysis but the plate was browned.

Potato slope:- At 48 hours the growth was thick, confluent and of a light yellow colour. After seven days' incubation the growth was more profuse with a yellowish brown pigment.

Biochemical reactions:- Cultures produced acid and gas in dextrose, maltose, lactose, sucrose, dulcite, mannitol, inosite, salicin, xylose and arabinose. In addition one culture fermented dextrin. Tests for Indole, reduction of nitrates, ammonia and catalase were positive; M.R. positive, V.P. negative; Hydrogen sulphide was not produced. Litmus milk was acidified with the formation of clot and subsequent reduction of the acid. Growth in Koser's citrate medium was positive.

Pathogenicity:- All the four strains were patho-:genic to mice. An 18 hour broth culture at a dose of 0.5 c.c. given intraperitoneally killed mice in about 18 hours. Smears from spleen and liver showed capsulated bacteria and culture was recovered from heart blood.

These foregoing characters place the organisms just described under the genus Klebsiella with the nearest approach to the type species - Klebsiella

pneumoniae. The/

The evidence for differentiating these strains into a distinct species is so meagre, in view of the great differences between the individual strains of the same species in this group, that for the present these may be regarded as a variety of Klebsiella pneumoniae.

Dimock and Edwards (1927) reported the isolation of an organism belonging to encapsulated group from metritis in mares. This organism was apparently indistinguishable from Friedlander's bacillus and others of the encapsulatus group. To this organism they gave the designation Encapsulatus genitalium. On a cultural examination of the cervix and uterus of 1424 mares they isolated this organism from 62 mares (4.4%) all of which showed clinical symptoms of cervicitis and metritis. All the mares except three had been barren for at least one year. They further stated that they were able to reproduce the typical disease regularly in mares after intra-uterine inoculation of saline suspension of the organisms.

The isolation of Klebsiella pneumoniae in this investigation from four cases of endometritis is probably the first instance of their presence in bovine metritis. However, these organisms seem to be very rare in the bovine genital tract since they were isolated only from four uteri (1.73%) out of a total of 231 examined. Since they were not isolated from any of the normal uteri their presence in endometritis seems to be of pathogenic significance.

TABLE XIV.

Results of Bacteriological Examination of 32 cases of Catarrhal Endometritis.

Case No.	Cervix uteri	Corpus Uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic Ovaries	Agglutination test for Brucellosis	Trichomoniasis
1	Micro-luteus Staph-citreus	Staph. albus	Micro-candidus. C.xerosis	Micro-flavus.	0	0	X	-	-
19	Staph. albus C.flavidum	0	0	0	Staph.albus C.flavidum	Staph.albus C.flavidum	X	-	-
20	Strept-ococci (Group D) Diphther-oids	Strept-ococci (Group D)	0	0	Streptococci (Group F)	Streptococci (Group F)	X	+	-
24	0	0	Staph. albus Streptococci (Group F) Diphtheroids	0	0	0	X	+	-
26	0	0	Staph. albus Streptococci (Group C)	0	0	0	X	+	-
31	E. coli	Micro-luteus	0	0	0	0	X	+	-
36	E. coli Staph. aureus	Staph. aureus	Staph. aureus	Staph. aureus	Staph aureus	Staph.aureus	X	-	-

TABLE XIV. (continued)

Case No.	Cervix Uteri	Corpus Uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic ovaries	Agglutination test for Brucellosis	Trichomoniasis
42	0	0	0	0	0	0	X	-	-
46	Staph. albus	Staph. albus	Staph. albus	0	0	0	X	-	-
47	Staph. albus	0	0	0	0	0	X	+	-
49	E.coli	0	0	Staph.albus	0	0	X	-	-
57	Strept-ococci group D	Strept. ococci group D	Strept. ococci group D	Streptococci group D	0	0	X	-	-
61	E.coli	0	E.coli	0	E. coli	E. coli	X	-	-
99	Staph. albus E. coli	Staph. albus Diptheroids	Staph. albus Diphtheroids	Staph.albus Diphtheroids	0	0	X	-	-
109	Str. viridans E.coli C.xerosis Tr.foetus	Tr.foetus	Tr.foetus	Tr.foetus	0	0	X	-	+
119	Staphl albus	Staph. albus	Staph. albus	Staph.albus	Staph.albus	Staph.albus	X	-	-
123	0	0	0	Ps.pyocyanea	0	0	Ps.pyocyanea	-	-
126	Proteus	Proteus	Proteus	Proteus	0	0	0	+	-

TABLE XIV (continued)

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic Ovaries	Agglutination test for Brucellosis	Trichomoniasis
128	0	Tr.foetus	Tr.foetus	Tr.foetus	0	0	X	-	+
131	Streptococci group D Micro. candidus	Streptococci group D Micro. candidus	Streptococci group D Micro. candidus	0	0	0	X	-	-
151	Staph. aureus	Staph. aureus	Staph. aureus	Staph. aureus	0	0	X	-	-
154	Staph. albus Chromobacterium violaceum	0	0	Micro.luteus	0	0	X	+	-
168	B.mesentericus Staph. aureus	Staph. aureus	Staph. aureus	Staph.aureus	0	0	X	+	-
178	0	0	0	0	Staph.albus	Staph.albus	X	+	-
192	Staph. albus Diphtheroids	Staph albus	Staph. albus	Staph albus	Staph.albus	Staph.albus	X	+	-
195	Staph. aureus Diphtheroids	Staph. aureus	Staph. aureus	Staph. aureus	0	0	X	-	-

TABLE XIV (continued)

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic Ovaries	Agglutination test for Brucellosis	Trichomoniasis
197	Str. viridans	0	0	Kleb-pneumoniae	Kleb-pneumoniae	Kleb-pneumoniae	X	-	-
200	Kleb-pneumoniae	Kleb-pneumoniae	Kleb-pneumoniae	Kleb-pneumoniae	0	0	X	+	-
211	Staph. candidus	Trichomonas foetus	Trichomonas foetus	Trichomonas foetus	0	0	0	-	+
216	Staph. albus E. coli	Staph. albus	Staph. albus	Staph. albus	0	0	X	+	-
224	Staph. aureus E.coli	Staph. aureus	Staph. aureus	Staph. aureus	Staph.aureus	Staph.aureus	X	+	-
236	Staph. aureus	Staph. aureus	Staph. aureus	Staph. aureus	Staph.aureus	Staph.aureus	Staph. aureus	+	-

Index:- 0 = Sterile; - = positive; - = negative; X = ovarian cysts not present.

TABLE XV.

Results of Bacteriological Examination of 36 cases of Suppurative Endometritis.

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic ovaries	Agglutination test for Brucellosis.
2	C. pyogenes	C. pyogenes	C. pyogenes	0	0	0	X	-
5	C. bovis Staph.albus	0	C. bovis Staph.citrus	C. bovis	0	0	X	-
15	C. pyogenes Micro.candidus	C. pyogenes	C. pyogenes	C. pyogenes	0	0	0	-
32	C. pyogenes Staph.albus	0	C. pyogenes	C. pyogenes	0	0	X	+
41	Staph.albus	C. pyogenes Micro.candidus	C. pyogenes Micro.candidus	C. pyogenes Micro.candidus	0	0	X	+
43	Staph.citrus	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
45	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	+
58	C. pyogenes E. coli	0	C. pyogenes Staph.albus	C. pyogenes E. coli	0	0	X	-
59	Strep.groupD	0	C. pyogenes	C. pyogenes	0	0	X	+
82	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	X	-
83	C. pyogenes	C. pyogenes	C. pyogenes	0	0	0	0	-
86	E. coli	0	C. pyogenes	C. pyogenes	C. pyogenes	0	X	-

TABLE XV (continued)

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic ovaries	Agglutination test for Brucellosis
87	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	X	-
88	0	0	C. pyogenes	C. pyogenes	0	0	X	-
90	C. pyogenes E. coli	C. pyogenes E. coli	C. pyogenes E. coli	C. pyogenes	C. pyogenes	C. pyogenes	X	+
91	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
92	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	X	-
94	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	X	-
102	C. pyogenes Staph. albus	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	+
133	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	X	-
135	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	0	0	X	-
143	C. pyogenes Staph. albus	C. pyogenes	C. pyogenes	C. pyogenes Staph. albus	0	0	X	-
150	Micro.luteus Staph. albus	C. bovis	C. bovis	C. bovis	0	0	X	+
153	C. pyogenes	0	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
159	0	0	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-

TABLE XV (continued)

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic ovaries	Agglutination test for Brucellosis
166	0	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
172	Str.viridans E. coli	C. bovis	C. bovis	C. bovis	0	0	X	+
174	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
205	0	C. equi	C. equi	C. equi	0	0	X	+
207	C. equi	C. equi	C. equi	C. equi	0	0	X	+
210	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
214	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
223	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	C. pyogenes	X	-
231	C. pyogenes Staph. albus	C. pyogenes Staph. albus	C. pyogenes Staph.albus	C. pyogenes Staph.albus	C. pyogenes	C. pyogenes	X	-
232	C. pyogenes E. coli.	C. pyogenes E. coli	C. pyogenes E. coli	C. pyogenes E. coli	C. pyogenes E. coli	C. pyogenes E. coli	X	+
239	C. pyogenes Micro-candidus	C. pyogenes Micro-candidus	C. pyogenes Micro-candidus	C. pyogenes Micro-candidus	0	0	X	-

Index:- 0 - sterile; + = positive; - = negative; X = cysts not present.

TABLE XVI.

Results of Bacteriological Examination of 12 cases of Atrophic Endometritis.

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube	L. uterine tube	Cystic ovaries	Agglutination test for Brucellosis
71	C. pyogenes	C. pyogenes	C.pyogenes	C.pyogenes	0	0	0	-
93	Staph.albus	Staph.albus	Staph-albus	Staph-albus	0	0	Staph-albus	+
108	Proteus vulgaris	0	0	Proteus-vulgaris	Proteus-vulgaris	Proteus-vulgaris	X	-
124	Proteus vulgaris	Proteus-vulgaris	Proteus vulgaris	Proteus vulgaris	0	0	X	-
140	B.mesentericus	0	0	0	0	0	X	+
145	C. xerosis Staph. albus Str. viridans	0	0	0	0	0	X	-
162	0	0	0	0	0	0	X	+
179	0	0	0	0	Kleb-pneumoniae	Kleb-pneumoniae	X	-
185	Kleb-pneumoniae	Kleb-pneumoniae	0	0	0	0	0	-
199	0	0	0	0	0	0	X	-
202	0	0	0	0	0	0	0	+
237	0	0	0	0	0	0	X	-

Index:-
0 - sterile; + - positive; - - negative X - cystic ovaries not present.

TABLE XVII.

Results of Bacteriological Examination of Hyperplastic Endometritis.

Case No.	Cervix uteri	Corpus uteri	R. cornu uteri	L. cornu uteri	R. uterine tube.	L. uterine tube	Cystic ovaries	Agglutination test for Brucellosis
18	0	0	0	0	0	0	0	-
56	0	0	0	0	0	0	0	+
64	Micro.flavus	0	0	0	0	0	0	+
73	Staph.albus Micro.luteus	0	0	0	0	0	0	+
115	0	0	Micro-candidus	Micro.candidus	0	0	0	-
136	0	0	Micro.candidus	Micro.candidus	0	0	0	+
188	0	0	0	0	0	0	0	+
190	Diphtheroid	0	0	0	0	0	0	-
206	E. coli Staph.citreus	0	0	0	0	0	0	-
167 ✠	0	0	0	0	0	0	X	-
235 ✠	0	0	0	0	0	0	X	-

✠ Hydrometra.

Index:- 0 = sterile; + = positive; - = negative; X = Ovarian cysts not present.

TABLE XVIII.

Results of Bacteriological Examination of Cervicitis and Salpingitis.

Case No.	Cervix uteri	Corpus uteri	R. uterine cornu	L. uterine cornu	R. uterine tube	L. uterine tube	Cystic Ovaries	Agglutination test for Brucellosis
14	0	0	0	0	E. coli	0	X	+
148	0	0	0	0	0	Staph.aureus	Staph.aureus	+
155	Group G streptococci	0	0	0	0	0	X	-
171	C. pyogenes	0	0	0	0	0	0	+
183	C. bovis	0	0	0	0	0	X	+
234	C. pyogenes Staph. albus	0	0	0	0	0	X	-
212	C. bovis Staph. albus	0	0	0	0	0	X	-

Index:- 0 = sterile; - = negative; + = positive; X = Ovarian cysts not present.

TABLE XX.

Summary of bacteriological findings in 100 abnormal genital tracts.

Organism.	Percentage of positive genital tracts.
Corynebacterium pyogenes	34
Corynebacterium bovis	5
Corynebacterium equi	2
Corynebacterium xerosis	3
Corynebacterium flavidum	2
Diphtheroids (unidentified)	6
Staphylococcus albus	25
Staphylococcus aureus	8
Staphylococcus citreus	3
Staphylococcus candidus	1
Streptococcus group D	4
Streptococcus group F	2
Streptococcus group G	1
Streptococcus group C	1
Viridans streptococci	4
Micrococcus candidus	6
Micrococcus luteus	5
Micrococcus flavus	1
Escherichia coli	14
Klebsiella pneumoniae	4
Proteus vulgaris	3
Chromo. violaceum	1
Pseudomonas aeruginosa	1
Bacillus mesentericus	2
Myco. tuberculosis*	2

* By smears only.

Results of agglutination test for Brucella abortus infection.

Among cows with normal genitalia 35% were positive and 65% negative for Brucella infection at the time of slaughter. The corresponding figures for cows with endometritis were 43% and 57%

The results taken as a whole show a higher per-:centage of Brucella infected cows in the "endometritis" group than in the normal group. But when they are considered separately for the different types of endometritis the difference between the number of positive and negative results is not appreciable except for suppurative endometritis where the negative results are more than twice the positive ones (Table XX1).

TABLE XX1

Type of endometritis.	Agglutination test.	
	Positive	Negative.
Catarrhal	17	15
Suppurative	11	25
Atrophic	4	7
Hyperplastic	5	6
Tuberculosis	1	1
Cervicitis and Salpingitis	5	3
Total	43	57

Hydrogen-ion concentration of uterine fluids of the cow.

The results of estimation of the pH of the uterine fluids are set out in Table XXlll. An analysis of these results (Table XXll) shows that the normal uterine fluids have an average pH of 7.08 with a range of 6.86 to 7.28. The amniotic fluid averaged a pH of 7.22 with a range of 7.00 to 7.54. The average pH of the uterine exudate in catarrhal, suppurative, hyperplastic and atrophic endometritis was 7.50, 7.61, 7.01 and 7.48 respectively.

TABLE XXll.

Nature of fluid.	Number of Cases.	pH	
		Range	Average
Normal uterus	28	6.86-7.28	7.08
Amniotic	7	7.00-7.54	7.22
Catarrhal endometritis	10	7.13-8.18	7.50
Suppurative endometritis	13	7.28-7.86	7.61
Hyperplastic endometritis	5	6.89-7.24	7.01
Atrophic endometritis	4	7.34-7.67	7.48

The results further show that 20 out of 28 normal uterine fluids (71.4%) had a slightly alkaline reaction, 4 were slightly acid and 4 neutral while the pathological exudates in endometritis of bacterial origin viz. catarrhal, suppurative and atrophic were all markedly alkaline being near the optimum for bacterial growth. It is noteworthy that though the average pH of the jelly like glairy discharge/

discharge in hyperplastic endometritis was just alkaline or neutral, the individual figures (6.89; 6.98; 6.97; 7.00; 7.24) show that three were slightly acidic, one neutral and one alkaline. The one having an alkaline reaction was a case of hydrometra (Case No. 167) in which the mucus had become liquefied. This relationship between the consistency of the mucus and its pH seems to support Hammond's (1927) observation about cervical mucus that, "mucus in a slightly acid medium becomes tough and stringy while in a slightly alkaline one it becomes fluid."

The results for the normal uterine fluid and normal amniotic fluid are in general agreement with those of Lardy, Pounden and Phillips (1940) who recorded an average pH of 6.8 with a range of 6.6 to 7.15 for the uterine fluids and 7.12 and 7.0 to 7.4 respectively for the amniotic fluid. Conklin, McCarthy, Thompson and Pugsley (1931) examined 70 samples of amniotic fluid and reported an average pH of 6.85 for amniotic fluid from clinically normal cases and 5.46 to 7.20 for fluid from clinically diseased specimens.

TABLE XXIII.

Results of pH of uterine fluids.

NORMAL.						ENDOMETRITIS.							
Uterine fluid.				Amniotic fluid.		Catarrhal.		Suppurative.		Atrophic.		Hyperplastic.	
Case No.	pH.	Case No.	pH.	Case No.	pH.	Case No.	pH.	Case No.	pH.	Case No.	pH.	Case No.	pH.
130	7.09	182	7.00	170	7.35	154	8.18	153	7.65	162	7.34	136	6.98
132	7.11	187	7.14	177	7.27	171	7.13	159	7.76	179	7.67	167	7.24
139	7.09	189	7.00	184	7.09	178	7.78	166	7.84	185	7.56	188	6.97
142	7.00	191	7.25	186	7.54	192	7.47	172	7.65	202	7.38	190	6.89
156	7.18	193	7.12	204	7.00	195	7.49	174	7.65			206	7.00
158	6.86	194	7.28	227	7.20	197	7.56	205	7.56				
163	7.01	196	7.00	238	7.12	200	7.34	207	7.48				
165	6.91	198	6.96			211	7.38	210	7.56				
169	7.08	203	7.17			224	7.18	214	7.86				
175	7.05	208	7.10			236	7.43	223	7.45				
176	6.95	215	7.03					231	7.38				
129	7.17	146	7.08					232	7.86				
180	7.20	157	7.09					239	7.28				
181	7.25	164	7.18										

PART III.

EXPERIMENTAL.

The lesions produced in the uterus of guinea pigs by injections of suspensions of Corynebacterium pyogenes, Corynebacterium equi and Staphylococcus albus.

Introduction:-

The object of this investigation was to test the pathogenicity of certain bacteria isolated from cases of endometritis upon the uterus of animals under experimental conditions. The ideal animal to use for this purpose would have been the cow itself, but economic considerations prevented such a procedure being adopted. Among the laboratory animals the choice fell on the guinea-pig for its uterus resembles that of the cow in its gross anatomy.

As the usual methods of subcutaneous, intra-peritoneal or intravenous inoculation are not suitable for the purpose of this study it was found necessary to adopt a technique by which organisms could be introduced directly into the uterus with certainty. Hence it was decided to inject bacterial suspensions into ligated segments of the uterus of guinea-pigs. By this method one could follow not only the fate of the bacteria but also the reactions of the uterine tissues in a circumscribed area.

Materials:-

Female guinea-pigs weighing between 350 to 400 grams were used in these experiments. Since the changes which take place in the endometrium during different/

different phases of the oestrous cycle might influence the resistence of the tissues towards micro-organisms it was decided to use guinea-pigs at a definite period of the cycle, in order to get comparable results. The period chosen was 5 to 7 days after heat, which was determined by examination of smears prepared from vaginal fluid and stained with haematoxylin and eosin as described by Stockard and Papanicolaou (1917).

The following five strains of bacteria were used in these experiments. Two strains of coagulase negative Staphylococcus albus (Nos. 17/2 and S 251) isolated from catarrhal endometritis, two Corynebacterium pyogenes (Nos. 120 and 15/10) and one Corynebacterium equi (No. 78) isolated from suppurative endometritis.

Methods:-

The bacterial suspensions were prepared in the following manner. In the case of staphylococcus a 24 hour glucose broth culture was used. Coryne-:bacterium pyogenes was grown on Loeffler's serum for 48 hours, then the growth was washed in 5 c.c. of normal saline; for Corynebacterium equi the suspension consisted of a 48 hour glucose broth culture. In each case the culture was tested for purity by examination of smears. The dose was 0.05c.c. of the bacterial suspension.

Operative technique:-

The whole of the abdominal area of the skin was closely clipped and shaved. Under ether anaesthesia the guinea-pig was laid on its back and secured in position. The cutaneous and muscular layers of the abdominal/

abdominal wall were incised along the linea alba and the peritoneal cavity was entered with complete aseptic precautions. The uterus was then exposed and fixed in position with the aid of a glass rod. The tubal end of each uterine horn was ligated by means of a sterile ligature. The lumen of the right horn was entered into by means of a fine needle fitted to a syringe containing the bacterial suspension. A second ligature was inserted at the cervical end a little below the point where the needle entered. Into this tied off segment 0.05 c.c. of the bacterial suspension was injected and the lower ligature tied firmly as the needle was being withdrawn. Extreme care was taken to avoid any undue disturbance of the uterine tissue. The left horn, which was similarly ligated (but without injection of the bacterial suspension), served as a control. The abdominal incision was closed by means of catgut and the animal allowed to recover.

In order to secure uniform conditions of experiment the general plan was to inoculate five guinea-pigs for each culture on the same day. Provided the operation was carried out with proper care the guinea pig had an uneventful recovery.

With a view to follow the progress of reaction the guinea pigs were sacrificed at the rate of one each at the end of 2, 4, 7, 10 and 15 days respectively, following the injection. After macroscopic observat-:ion of the uterus and obtaining material for cultural examination, both the injected and control horns were fixed in formalin for histological examination.

Corynebacterium pyogenes (Strain No. 120.)

2 days:- The injected segment of the uterus was markedly distended, almost double that of the normal control horn in diameter. The uterine wall was tense and inflamed. The lumen was filled with an albuminous cloudy exudate, containing masses of polymorphonuclear leucocytes and a few plasma cells. Histological sections through the injected horn showed an acute inflammation of the mucosa, with infiltration of polymorphonuclear leucocytes.

4 days:- The lesion was a little enlarged and distended. The wall was rather thin and showed fluctuation. The serosa was tense and petechiaeted. The lumen was filled with thin, creamy pus. Histological sections revealed small areas of epithelial desquamation. Just underneath the epithelium there was a dense layer of polymorphonuclear infiltration. The connective tissue was oedematous with haemorrhage and capillary engorgement (Fig. 47.).

7 days:- The enlargement of the inoculated cornual segment was more general, with tense walls whose serosa showed numerous patechiae. The lumen was distended with a sticky, creamy pus, while the mucosa was brick red studded with pin-head like necrotic spots and punctiform erosions. Histological sections revealed extensive necrosis of the superficial layers of endometrium and their replacement with purulent exudate; the underlying connective tissue was oedematous and showed cellular infiltration; the glands were mostly obliterated (Fig. 48).

Results.

Corynebacterium pyogenes (Strain No. 120.)

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10 days:- By this time the lesion was a typical pyometra, with distended walls and appearing like a sausage. The diameter of the injected horn was 13 m.m. as compared to 3 m.m. of the normal control horn. The lumen was packed with thick creamy pus which was adherent to the mucosa in dense granular masses. The mucosa was dark brown and showed extensive areas of erosions. Histological sections showed complete absence of epithelium and in some parts superficial mucosal layers were necrosed. Masses of leucocytes were found to penetrate deeply at various levels of the connective tissue reaching the muscular layer (Fig. 49).

15 days:- The cornual lesion was greatly dis-:tended measuring 18 m.m. in diameter as compared to the normal horn which was 3 m.m. The lesion, which was egg-shaped, had occupied most of the abdominal cavity and was pressing upon the intestines. In some there were local areas of adhesions with the intestinal loops and broad ligaments of the uterus. The wall was stiff and leathery with a sticky discoloured serosa (Fig. 56). On opening the horn the pus which was held in tension came out with force. The pus was thick, creamy yellow and emitted a foul odour. The mucosa was dark, rough and covered with sloughs and erosions. Histological sections showed extensive necrosis of the endometrium which appeared to be breaking away from its attachments. In some the mucosa was completely absent and was replaced by cell debris and leucocytes. The muscular layer was markedly thinned/

thinned and showed purulent tracts and necrotic foci. The uterine glands were completely destroyed and were not recognisable (Fig. 50).

Pure cultures of Corynebacterium pyogenes were recovered from the lesions at every stage of the reaction. The uninoculated control horn was normal in appearance and its structure corresponded to the period at which examination took place.

Corynebacterium pyogenes (Strain No. 15/10):- It gave rise to similar typical lesions as described for Strain No. 120.

Since it was surmised whether strains of Corynebacterium pyogenes isolated from sources other than the uterus would give rise to similar lesions, one strain of Corynebacterium pyogenes isolated from acute suppurative mastitis was inoculated into the uterus of two guinea pigs in the usual manner. One of the guinea pigs was destroyed on the tenth day and the other on the fifteenth day after inoculation. The lesions were similar to the one produced by Corynebacterium pyogenes strain no. 120. The 15 day lesion had formed extensive adhesions with the broad ligaments, intestines and abdominal wall.

Corynebacterium equi.

2 days:- The inoculated horn showed only a slight inflammatory reaction. The lumen of the horn contained a small amount of albuminous fluid and the mucosa appeared normal. The epithelium was intact with a slight leucocytic infiltration in the superficial connective tissue.

4 days:- The serous coat was acutely inflamed. The inoculated segment was distended and measured 5 m.m. in diameter as compared to 3 m.m. of the normal control horn. The lumen was filled with a cloudy albuminous fluid; mucosa was smooth and oedematous and showed petechiae. Histological sections showed the epithelium to be intact, the connective tissue layer was distended with fluid and slight infiltration with leucocytes and plasma cells.

7 days:- The distension of the inoculated horn was very marked being more than thrice the size of normal horn. The epithelial cells were cuboidal or flattened. The mucosa showed numerous leucocytes and plasma cells. The glands were much reduced in size and appeared to be compressed.

10 days:- The lesion was similar to the 4-day reaction with only a slight filling up of the horn with cloudy fluid. The mucosa was oedematous.

15 days:- The inoculated horn was very much distended with fluid. Its diameter was 20.1 m.m. as compared to 3.3m.m. of the control horn. The wall was very thin, tense and parchment like. The exudate was thin, milky in consistency and contained yellowish flakes. The mucosa was smooth, oedematous and showed congested spots and petechiae. Histological sections showed areas of epithelial desquamation and infiltration with leucocytes and lymphocytes. The connective tissue layer was much reduced in thickness and the glands were small and compressed. The muscular layer was also very thin being reduced to a few fibres (Figs. 51 and 52.).

Cultures were recovered at every stage of the reaction. There were no peritoneal adhesions in any stage of these lesions. The control horn was found to be normal and its structure corresponded to the period at which examination took place.

Staphylococcus albus (Strain No. 17/2)

2 days:- The inoculated horn appeared normal except for a very slight congestion of the serosa. The mucosa was slightly oedematous, covered with a thin film of serous fluid. Histological sections showed a slight oedematous condition of the connective tissue being infiltrated with leucocytes and lymphocytes.

4 days:- The inoculated horn was slightly enlarged and congested. The lumen was partially filled with a serous fluid. The connective tissue was oedematous and diffusely infiltrated with leucocytes and lymphocytes. The epithelium was intact mostly, though the individual cells were markedly cuboidal in shape.

7 days:- By this time the reaction was well defined with an enlargement of the segment. The serosa showed congested spots. The lumen was filled with a greyish soupy fluid. The mucosa showed petechiae. Histological sections revealed oedema of the connective tissue and infiltration with lymphocytes, plasma cells and leucocytes. The glands were much compressed and showed desquamation of the epithelium.

The/

The epithelial lining of the mucosa was cuboidal to flat.

10 days:- The inoculated horn was markedly distended to about three times the diameter of the normal horn. The walls were flabby and the lumen contained thick, soup-like exudate. Mucosa was brick-red in colour, and showed punctiform erosions. Histological sections showed degeneration of epithelium with sub-epithelial infiltration of lymphocytes, plasma cells and leucocytes. The mucus layer was much thickened, and showed cloudy changes with congestion of blood vessels (Fig. 53).

15 days:- The horn was greatly distended resembling a sausage, with an ash grey serosa (Fig. 55). The wall was soft and flabby. The lumen was completely filled with a mucinous exudate which resembled pus in some parts. The mucosa was dark brown and showed small erosions. Histological sections showed extensive epithelial necrosis and prominent cellular infiltration of underlying connective tissues; the glandular epithelium was degenerating the lumen of many glands being filled with cell debris (Fig. 54). The myometrium appeared to be distended with fluid.

Pure cultures of Staphylococcus albus were recovered from the lesion at all stages of infection. The control horn was found to be normal and the structures corresponded to the period of cycle at which examination took place.

Staphylococcus albus (Strain No. S.259)

The lesions produced by this strain were similar to those of Strain No. 17/2 except that the 4th day lesion was almost normal and resembled the normal control horn. Cultures were recovered at all stages of the reactions.

The results of these experiments show that the mode of reaction of the uterine tissues of the guinea-pigs injected with suspensions of Corynebacterium pyogenes, Corynebacterium equi and Staphylococcus albus differed in severity and type.

It will be seen that the effect of infection with Corynebacterium pyogenes was very pronounced from the outset and progressed rapidly leading to destruct-:ion of the tissues culminating in typical pyometra in 4 to 7 days after inoculation. In the early stages haemorrhage in to the tissues was a marked feature. The toxic activity of Corynebacterium pyogenes seems to exert a necrotising effect on the endometrium which is more or less completely destroyed, thus enabling the organisms to penetrate deep into the uterine structures. As a result of this the periuterine structures were often involved in the process. These observations simulate closely the structural changes met with in suppurative endometritis due to Corynebacterium pyogenes infection in cows. In short, Corynebacterium pyogenes gave rise regularly to a severe purulent inflammation accompanied by extensive destruction of uterine wall. A comparison of/

of the origin of the strain and the results of the pathogenicity tests failed to reveal any significant difference between strains isolated from endometritis and mastitis.

In contrast, the reaction produced by Corynebacterium equi was rather slow and mild. It was characterised by an outpouring of abundant fluid in the early stages; only at a later stage did the exudate become slightly purulent. The inflamatory changes in the endometrium were not marked except for epithelial degeneration and cellular infiltration. The connective tissue layer was much reduced in thickness and the glands were compressed. The marked thinning of the uterine wall was evidently due to great pressure from the exudate. Judging from these results it appears that Corynebacterium equi is of low toxicity as compared to Corynebacterium pyogenes. However, since only one strain was used it is not possible to draw any definite conclusion from these results.

Staphylococcus albus gave rise to a typical catarrhal inflammation in early stages. Towards the later stage (after 7 days) the exudate was greatly increased in amount and became slightly purulent. It took about 15 days to give rise to lesions comparable to those produced by Corynebacterium pyogenes in 10 days. The histopathological changes seemed to pass from an acute stage to sub-acute or chronic stage, resulting in thickening of the mucosa, epithelial necrosis and prominent cellular infiltration of under-

:lying connective/



Fig. 1. Normal uterus of cow ♀ dorsal view (including the Fallopian tubes, ovaries and the broad ligaments)



Fig. 2 - Catarrhal endometritis, showing catarrhal exudate around the cotyledons and persistent corpus luteum in the left ovary. (Case 99).

Fig. 3 - Puerperal endometritis, showing complete necrosis of endometrium which is studded with purulent foci. (Case 214).



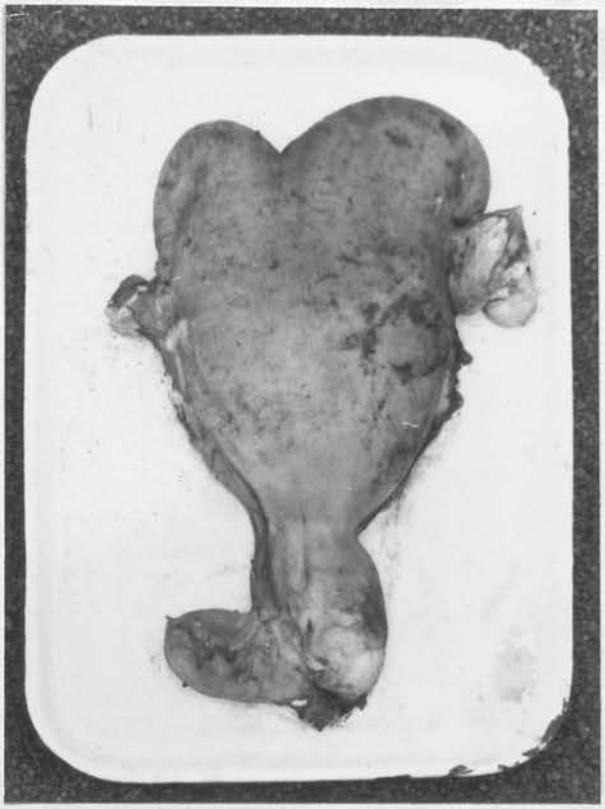


Fig. 4. Pyometra - dorsal view. (Case No. 45)
Fig. 5. Same as above, lateral view to show the folding in of the cornu. The pointer shows the persistent corpus luteum in the right ovary.

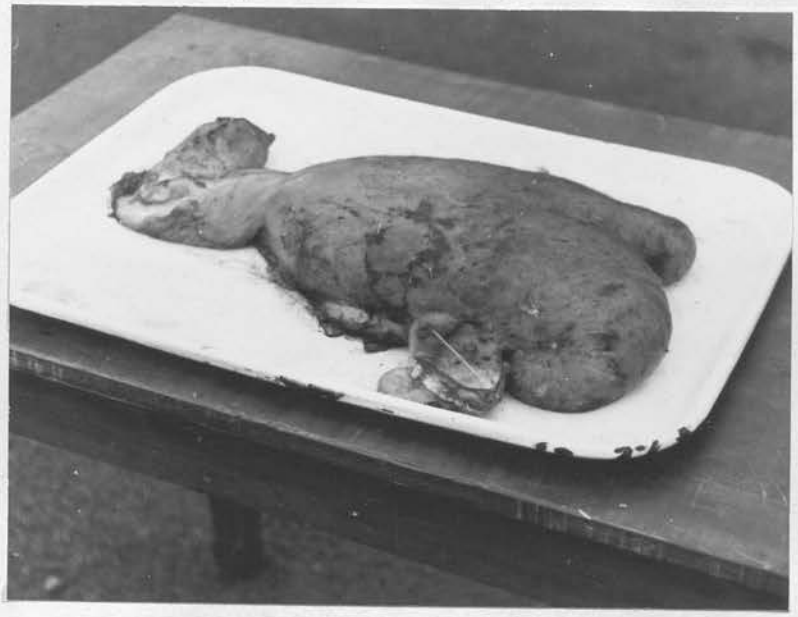




Fig. 6. Pyometra - dorsal view. Note the stenosed cervix and corpus luteum in the right ovary. (Case No. 43).

Fig. 7. Uterus with hyperplastic endometritis and cystic ovary, left. (Case No. 188).





Fig. 8. Tuberculous endometritis. The left cornu slit open shows the tubercles, the Fallopian tubes, ovaries and broad ligaments also show tubercles (Case No. 160)

Fig. 9 same as 8, with the left ovary sectioned, showing complete caseation.



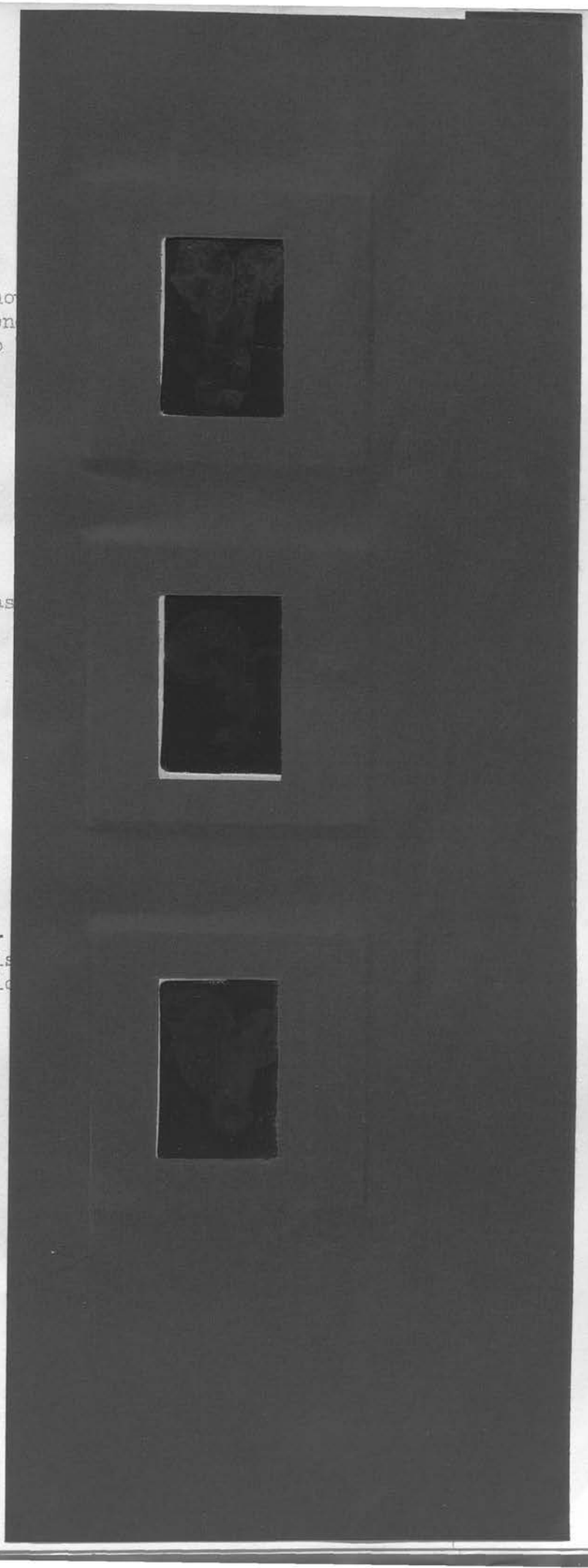


Fig. 10. Normal uterus sho
streaks on the en
os uterus (48 to

Fig. 11. Hydrometra. (Cas

Fig. 12. Early pyometra -
areas of necrosis
acute inflammatio



Fig. 13.

Sections of normal uterine wall showing the serous, muscular and mucous coats. A cotyledon is visible on the right side of each photograph. X-10. Haematoxylin- eosin.

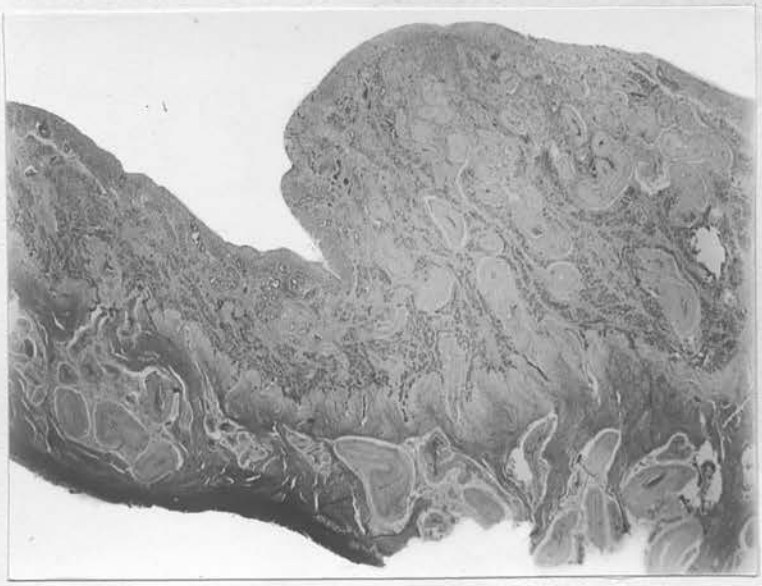


Fig. 14.



Fig. 15 - Section of a normal endometrium showing dense superficial and loose deep connective tissue with uterine glands. Haematoxylin-eosin. X-10.



Fig. 16 - Section as for 15 showing the columnar epithelial lining of the mucous surface.
Haematoxylin-eosin. X 50.

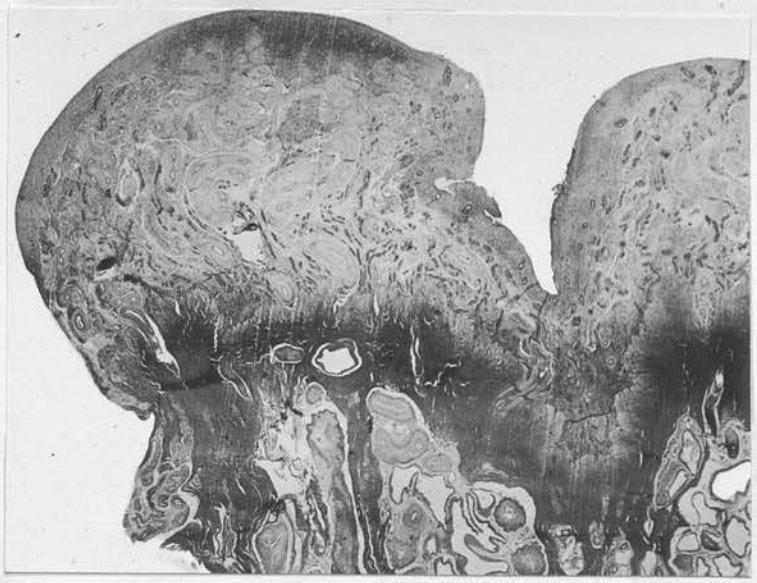


Fig. 17. Section through a normal cotyledon showing dense superficial and deep loose connective layer. Note the congestion of blood vessels (about 48 to 70 hours after the beginning of heat).
Haematoxylin-eosin. X 10

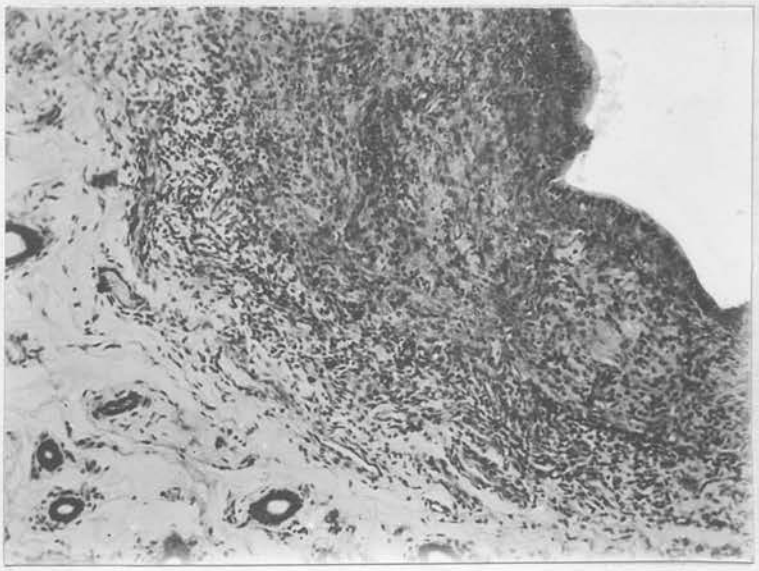


Fig. 18. Section through mucosa (catarrhal endometritis, case 168), showing metaplasia and infiltration.
Haematoxylin-eosin. X 100

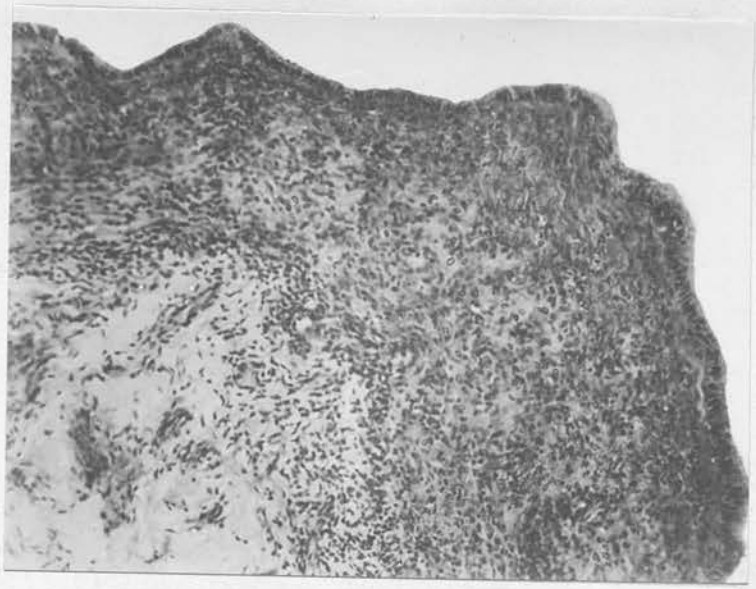


Fig. 19. Section through mucosa (catarrhal endometritis, Case 154), showing stratification and infiltration with granulation tissue. Haematoxylin-eosin. X 100.

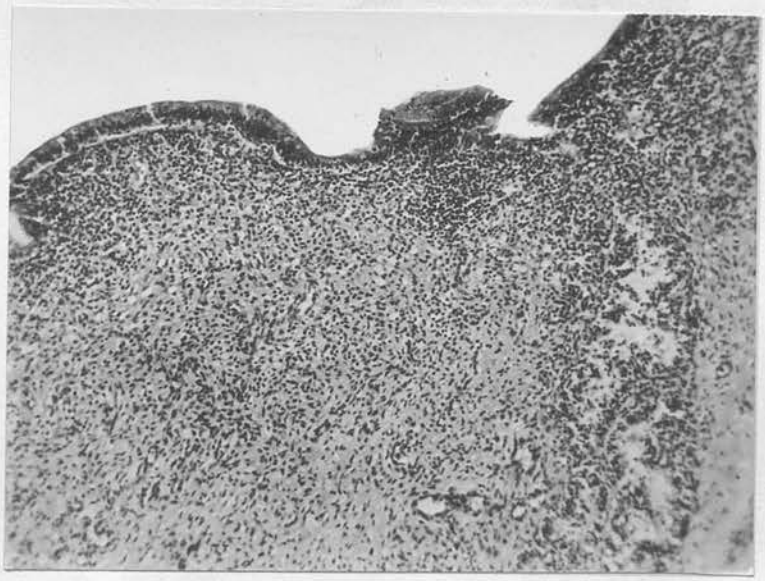


Fig. 20. Section of mucosa(catarrhal endometritis, case 236) showing infiltration of granulation tissue and destruction of the lining of the glands. Haematoxylin-eosin. X 100.



Fig. 21. Section of mucosa (catarrhal endometritis, case 128), showing epithelial desquamation, oedema of submucous layer and destruction of the lining of the superficial glands. Haematoxylin-eosin. X 100.

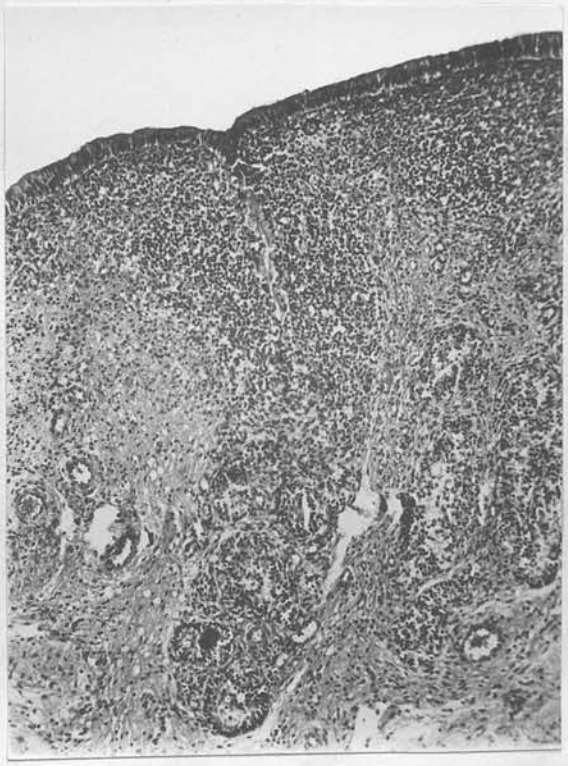


Fig. 22. Section of mucosa (catarrhal endometritis, case 126), showing subepithelial periglandular cellular infiltration; most of the superficial glands are filled with cells and cell debris. Haematoxylin-eosin. X 100.

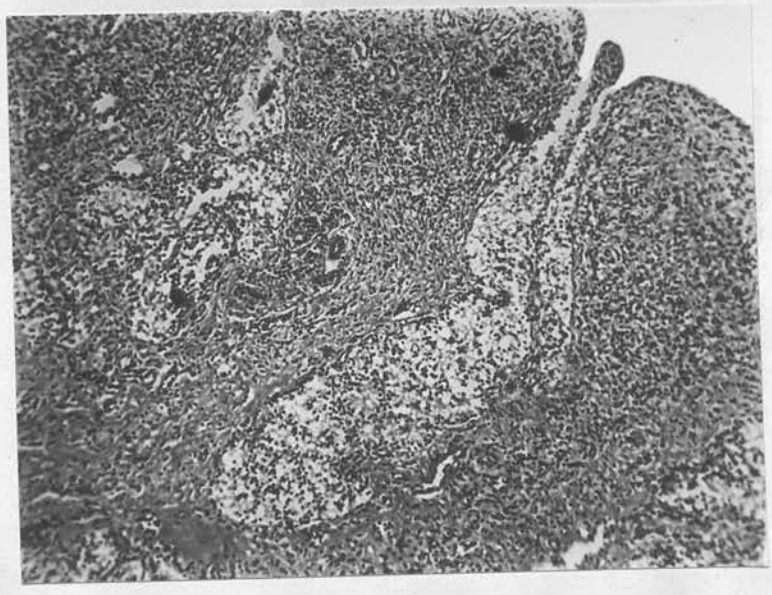


Fig. 23. Section (catarrhal endometritis, Case 128), showing destruction of the lining epithelium of uterine glands, lumen being filled with cells and cell debris. Haematoxylin-eosin. X 150.

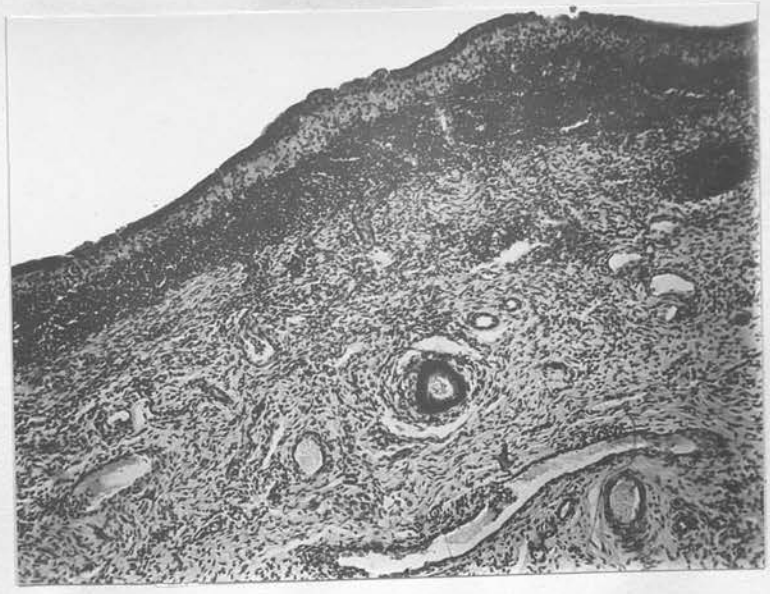


Fig. 24. Section of endometrium (acute suppurative, Case 45), showing necrosis of the epithelium. Note the thick barrier of leucocytic infiltration of Sub-epithelial tissues and dilatation of the capillaries. Haematoxylin-eosin. X 100.

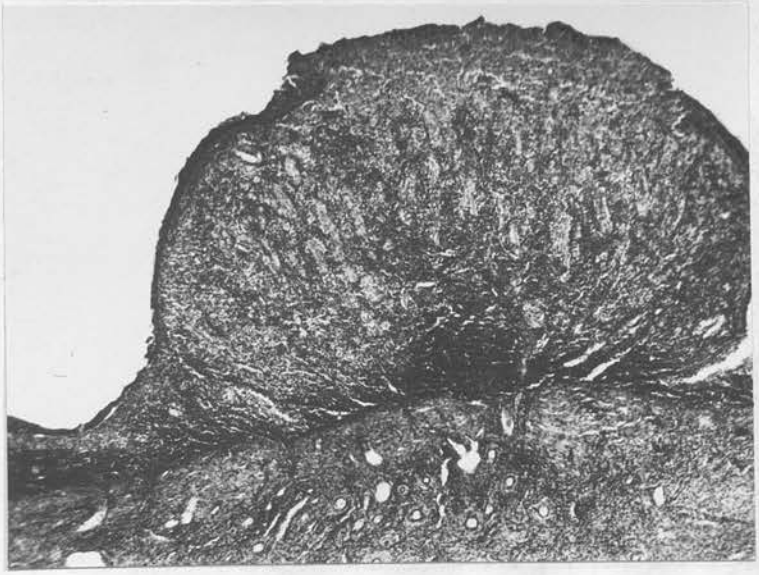


Fig. 25. Section through a cotyledon (s/acute suppurative) Case 90, showing epithelial degeneration and necrosis; note the heavy infiltration of leucocytes especially at the base of the cotyledon.
Haematoxylin-eosin X 50.

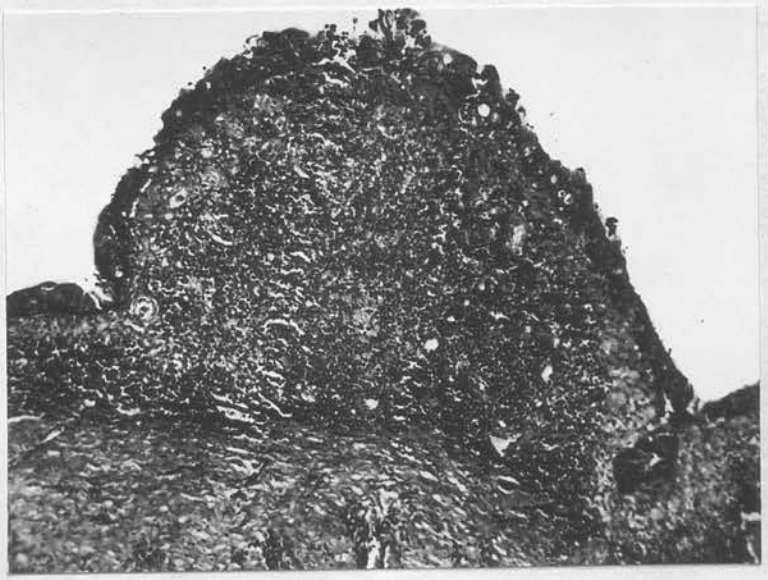


Fig. 26. Section through a cotyledon (S/acute suppurative) showing extensive destruction and necrosis. (Case 143)
Haematoxylin-eosin. X 50.

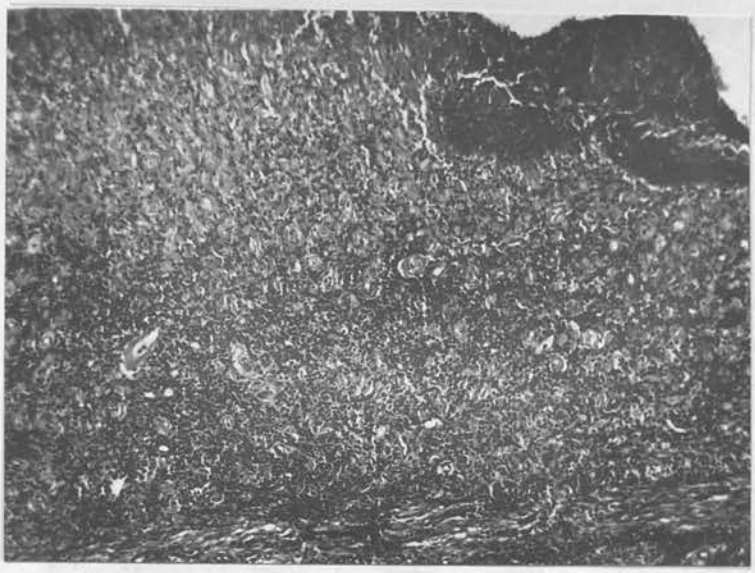


Fig. 27. Section through endometrium (pyometra, Case 166) showing complete necrosis of the epithelium which is covered by a purulent mass. The glands are alsmost destroyed.
Haematoxylin-eosin. X 100.

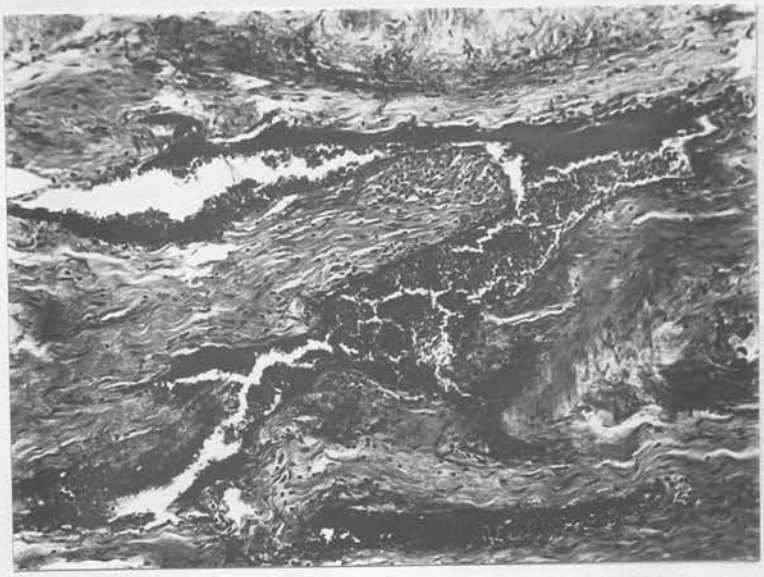


Fig. 28. Section (pyometra, case 45), showing purulent tracts penetrating the myometrium; this burrowing type of infection is a common feature of C. pyogenes infection.
Haematoxylin-eosin. X 150.

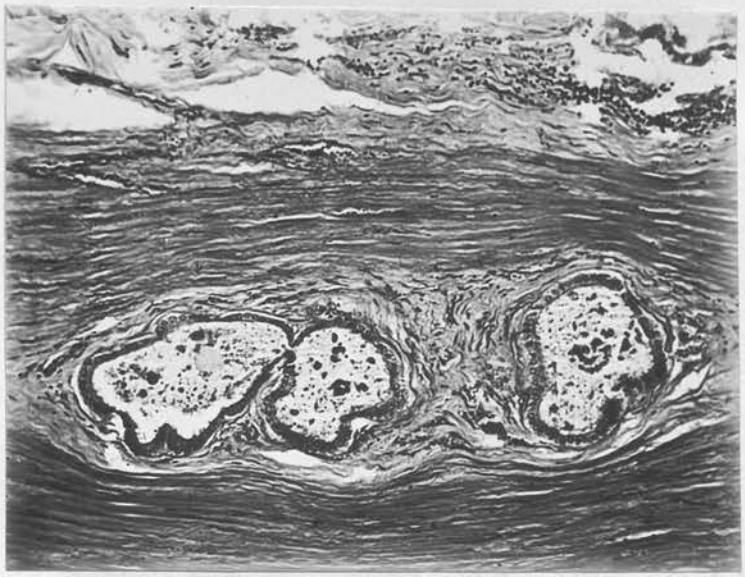


Fig. 29. Section (pyometra, case 45), showing endometrial glands and stroma surrounded by myometrium.
Haematoxylin-eosin. X 150.

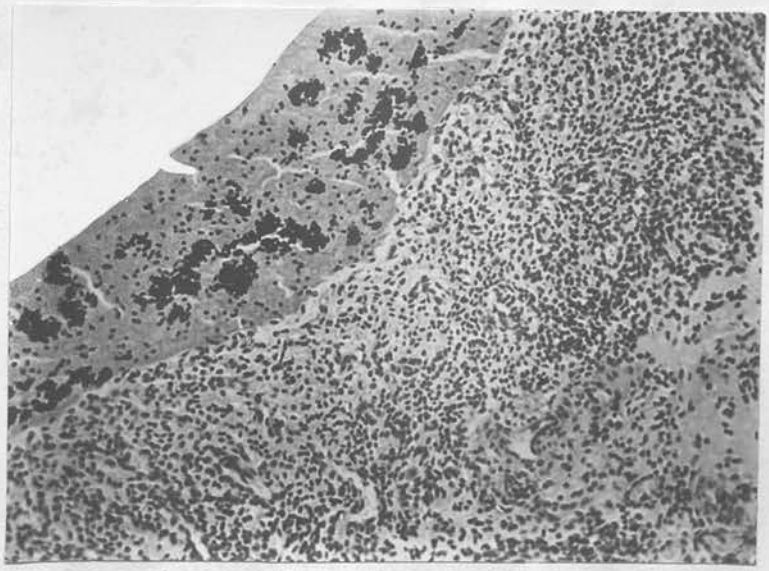


Fig. 30. Section of mucosa (atrophic endometritis, Case 71), showing complete necrosis of superficial endometrium, which is replaced by cell debris; note the infiltration of connective tissue with fibroblasts and the absence of glands. Haematoxylin-eosin. X 100.

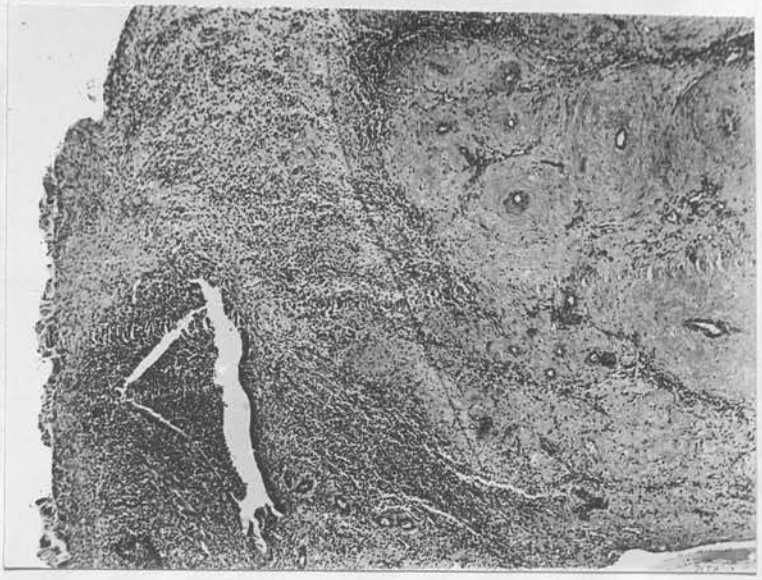


Fig. 31. Section (atrophic endometritis, case 71), showing superficial inflammatory changes and the blood vessels whose intima is much thickened (endarteritis obliterans). Haematoxylin-eosin. X 100.

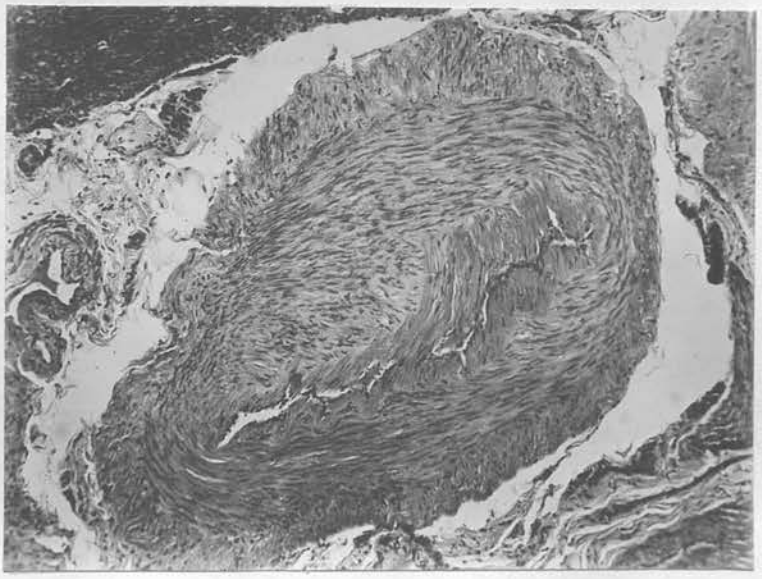


Fig. 32. Section (as for 31) showing the almost complete obliteration of the lumen of the vessel. Haematoxylin-eosin. X 150.

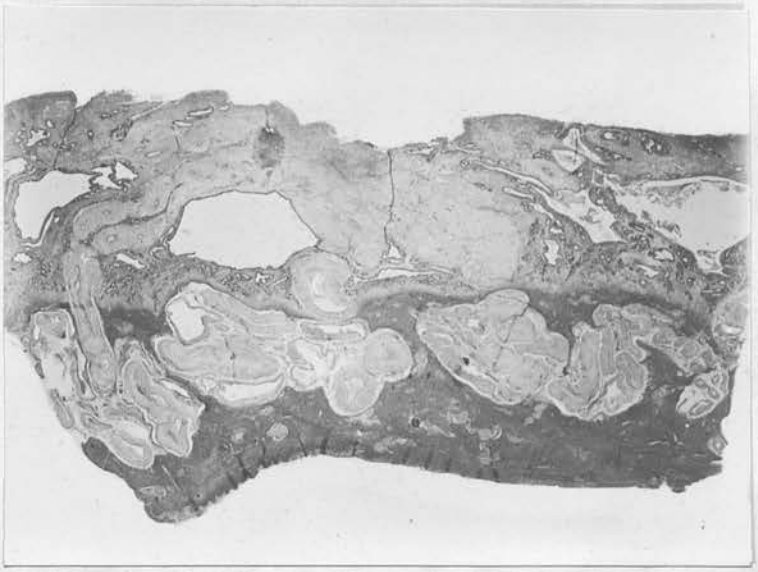


Fig. 33. Section through uterine wall (Case 73), showing hyperplasia of the endometrium; note the dilated glands. Haematoxylin-eosin. X 10.

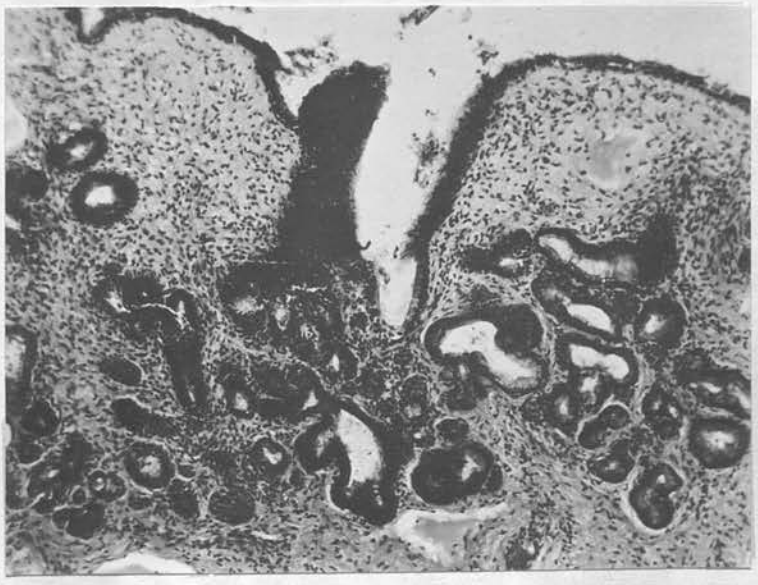
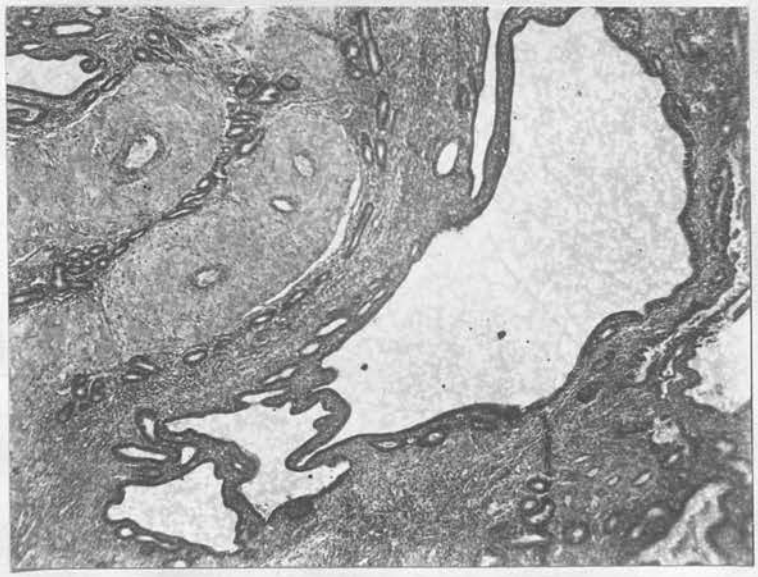
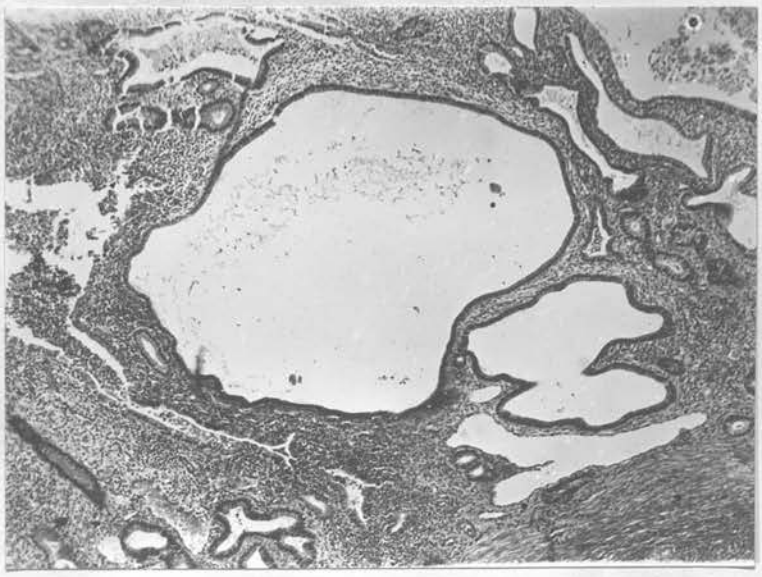


Fig. 34. Section through endometrium (Case 188), showing numerous enlarged glands, the commencement of hyperplasia. Haematoxylin-eosin. X 50.



Figs. 35, 36. (Case 73). Endometrial hyperplasia. "Swiss cheese" appearance due to cystic dilation of endometrial glands.

Haematoxylin-eosin. X 1oo.



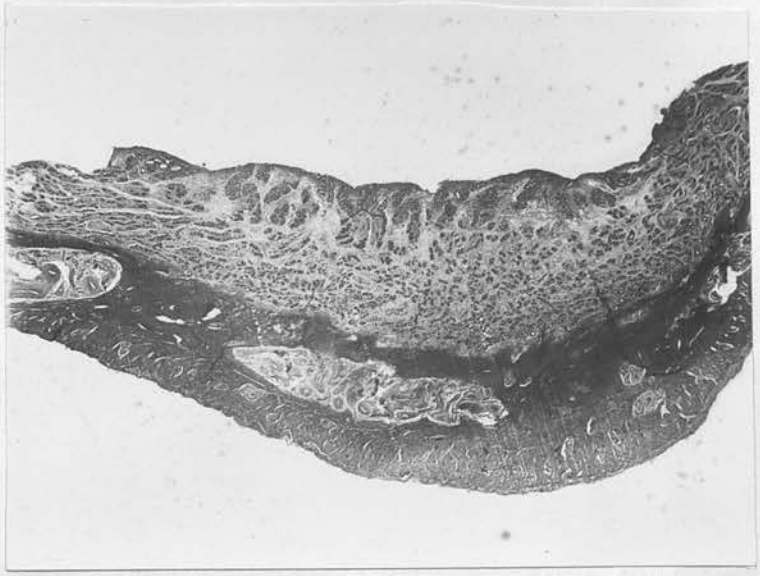


Fig. 37. Section through a hydrometric uterus (Case 167), showing numerous tortuous glands opening freely on the surface.
Haematoxylin-eosin. X 10.



Fig. 38. (as for 37). Section through endometrium, showing increase in number and size of glands.
Haematoxylin-eosin. X 200.

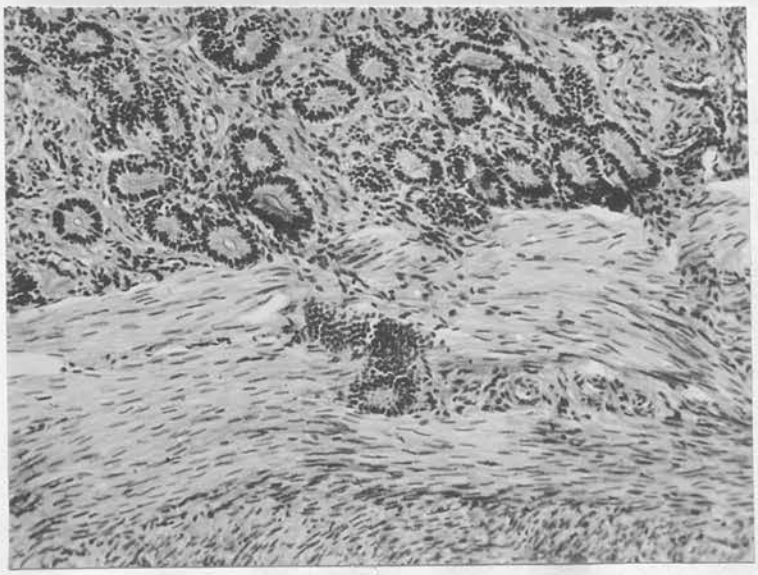


Fig. 39. Section (hydrometra, Case 167), showing glands in an active secretory state; note the glands in the myometrium. Haematoxylin-eosin. X 150

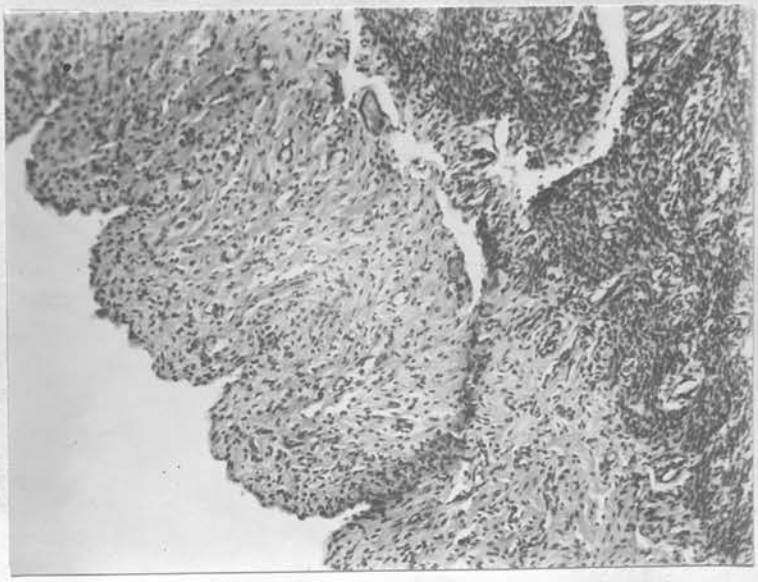


Fig. 40. Section through serosa of a hydrometric uterus (Case 167) showing marked thickening.
Haematoxylin-eosin. X 150.



Fig. 41. Section through endometrium (Case 160), showing an early tuberculous nodule underneath the epithelium, which shows desquamation.
Haematoxylin-eosin. X 150.



Fig. 42. Bilateral salpingitis - note the swollen deeply convoluted Fallopian tubes; only the apices of uterine cornua are shown in the picture. (Case 224).

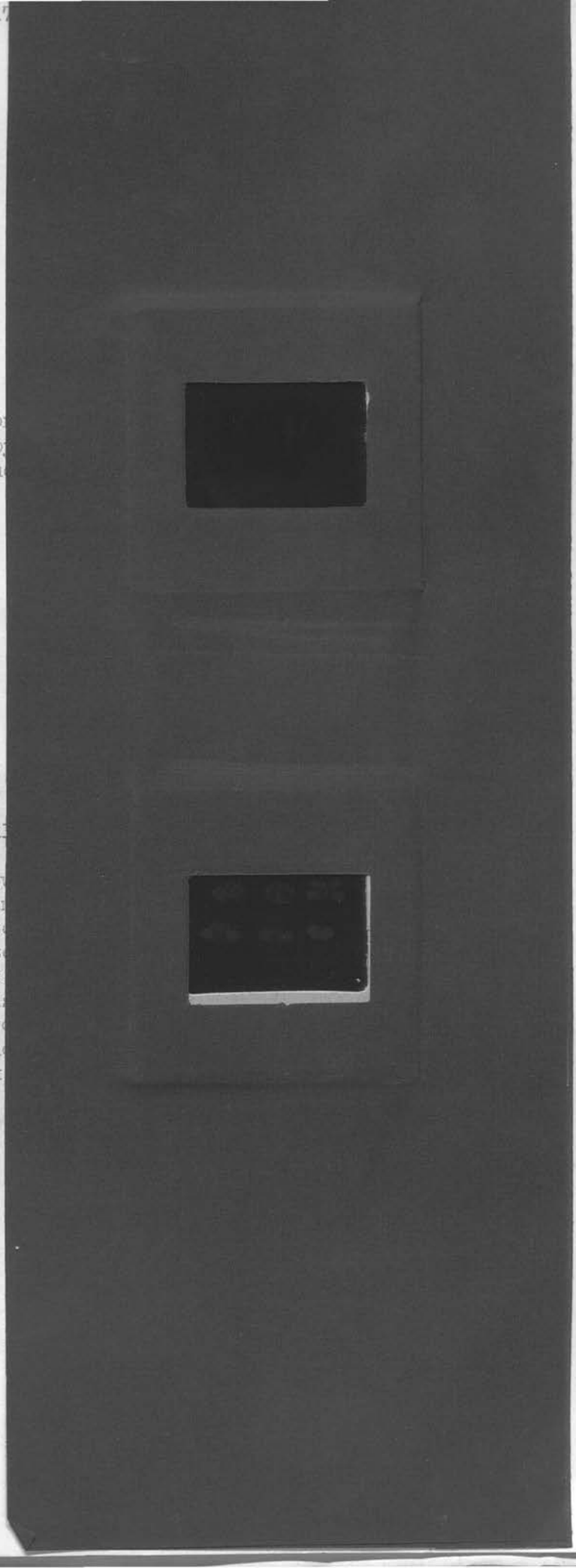


Fig. 43. Ovary sectioned lo
corpus luteum of p
other ovarian stru

Fig. 44. Normal and abnorma
longitudinally.
JR. Ovary containing t
JL. Ovary containing s
L. Ovary ⊖ corpus lut
S. nnOvary - Corpus lut
R. Ovary ⊖ persistent
the embedded corpu
K. Ovary - corpus lut
luteum occupies th
rounded by a thick



Fig. 45. Film of broth culture of C. equi showing pleomorphism and beaded staining.
Methylene blue stain X 1000.

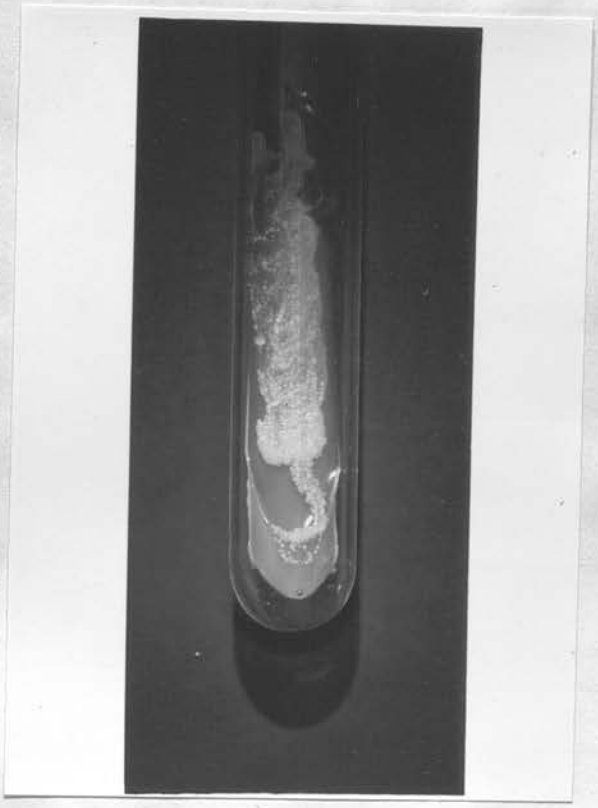


Fig. 46. Culture of C. equi on agar slope showing the flowing nature of the growth.

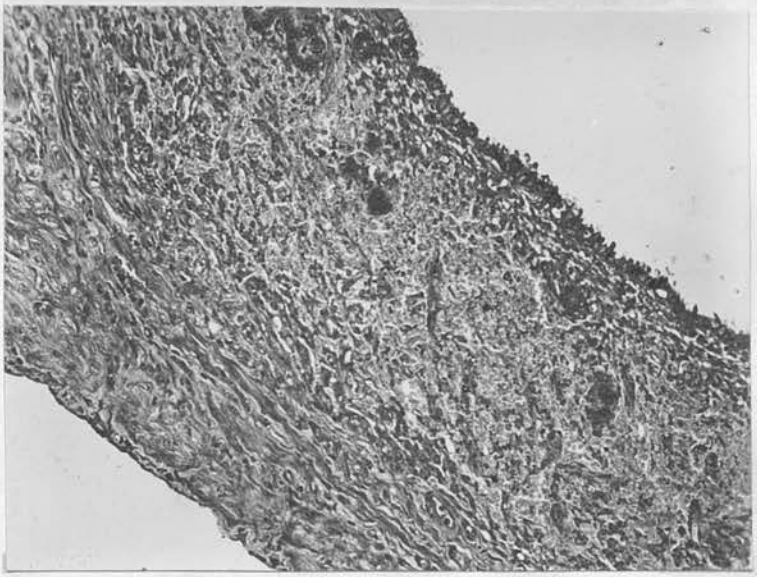


Fig. 47. C. pyogenes infection of guinea pig's uterus. Section of a four day lesion showing epithelial degeneration, leucocytic infiltration, capillary engorgement with haemorrhage and oedema of the connective tissue. Haematoxylin-eosin. X 200

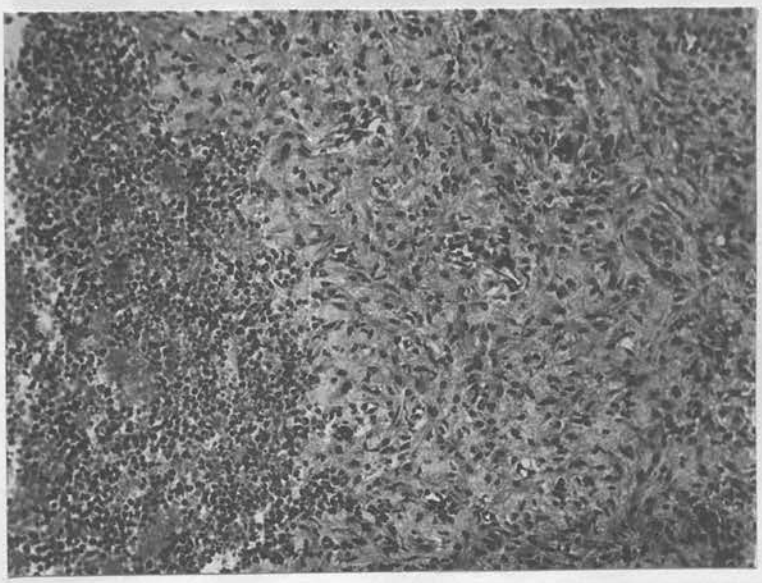


Fig. 48. C. pyogenes infection of guinea pig's uterus. Section of aseven day lesion showing necrosis of the superficial layers of the endometrium and their replacement with purulent exudate; the underlying connective tissue is oedematous and shows infiltration; the glands have largely been obliterated.
Haematoxylin-eosin. X 200

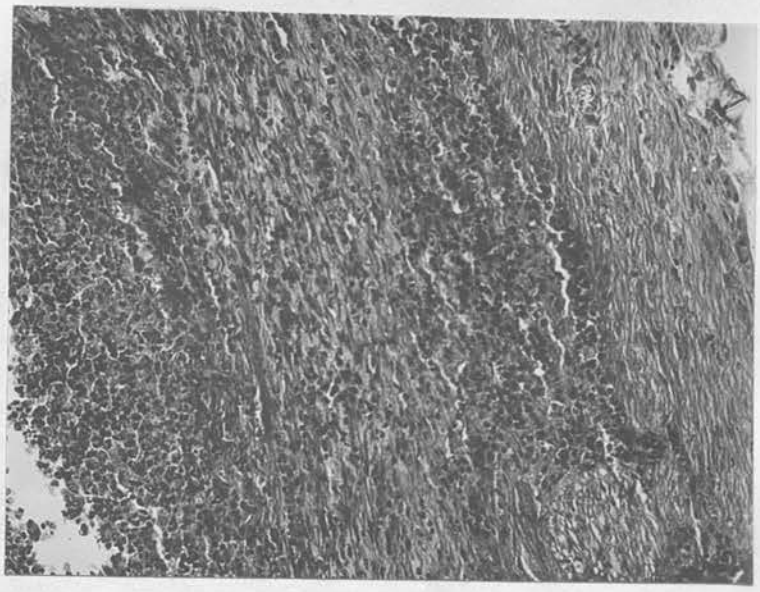


Fig. 49. C. pyogenes infection of guinea pig's uterus. Section of a ten day lesion showing superficial necrosis of endometrium; purulent tracts penetrate deeply into the wall reaching the muscular layer.
Haematoxylin-eosin. X 200

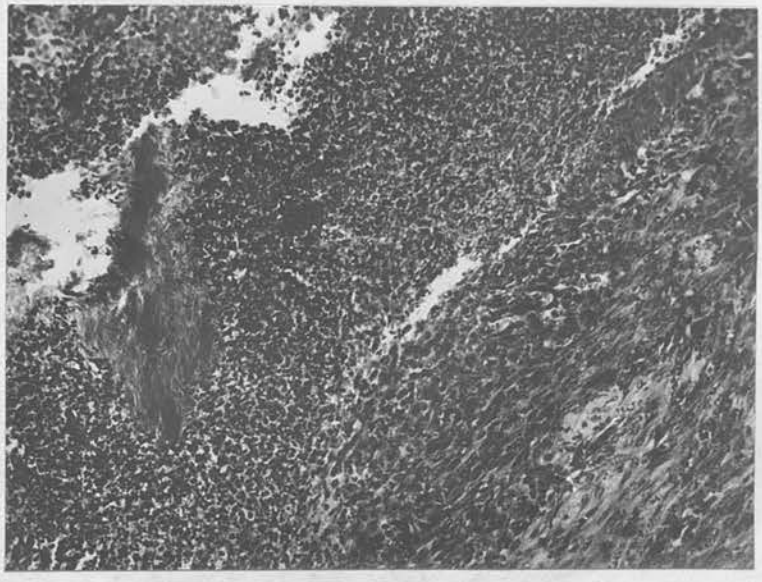


Fig. 50. C. Pyogenes infection of guinea pig's uterus. Section of a fifteen day lesion showing extensive necrosis of endometrium which appears to be breaking away from its attachment; clumps of pus are visible to the left of the photograph.
Haematoxylin-eosin. X 200

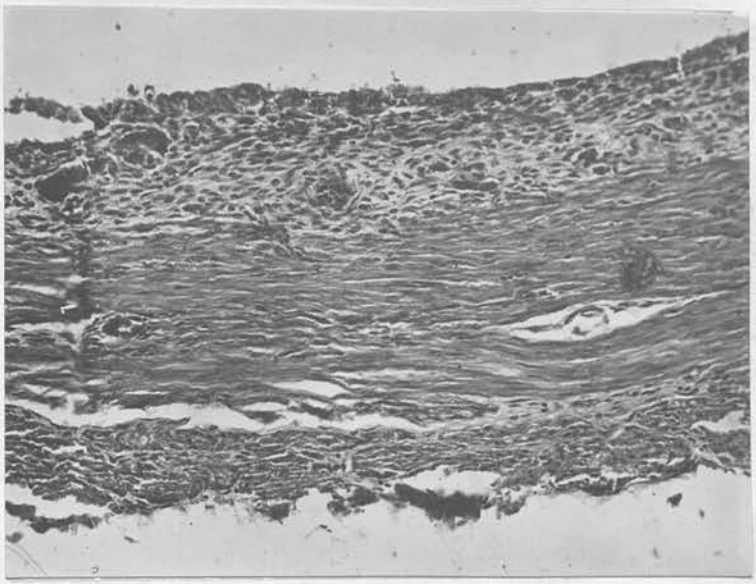


Fig. 51. C. equi infection of guinea-pig's uterus. Section of fifteen day lesion showing degeneration of the epithelium and glands with subepithelial infiltration; note the marked thinning of the uterine wall resulting from the distension of the horn with exudate.
Haematoxylin-eosin. X 200

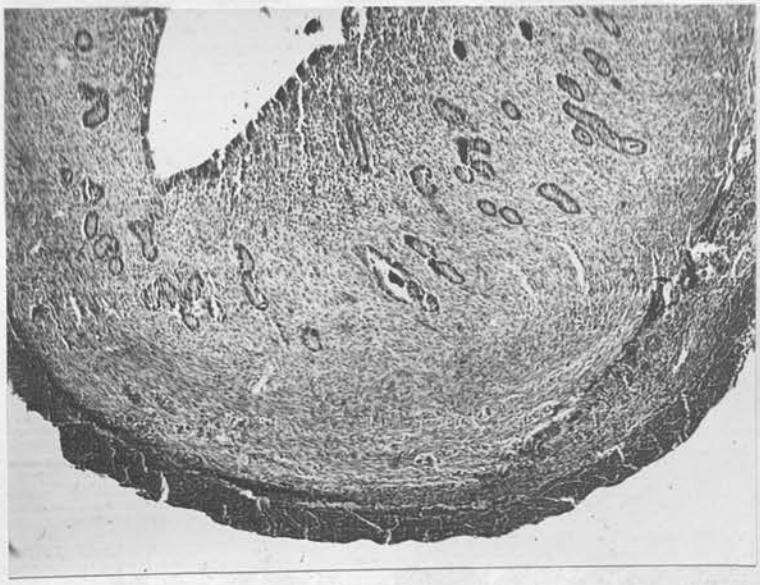


Fig. 52. Section of the uninoculated control horn of the 15 day lesion (above) of C. equi.
Haematoxylin-eosin. X 100.



Fig. 53. Staph. albus infection of guinea-pig's uterus. Section of a ten day lesion showing degeneration of epithelium with subepithelial cellular infiltration; the connective tissue shows cloudy changes with congestion of blood vessels.
Haematoxylin-eosin. X 200.

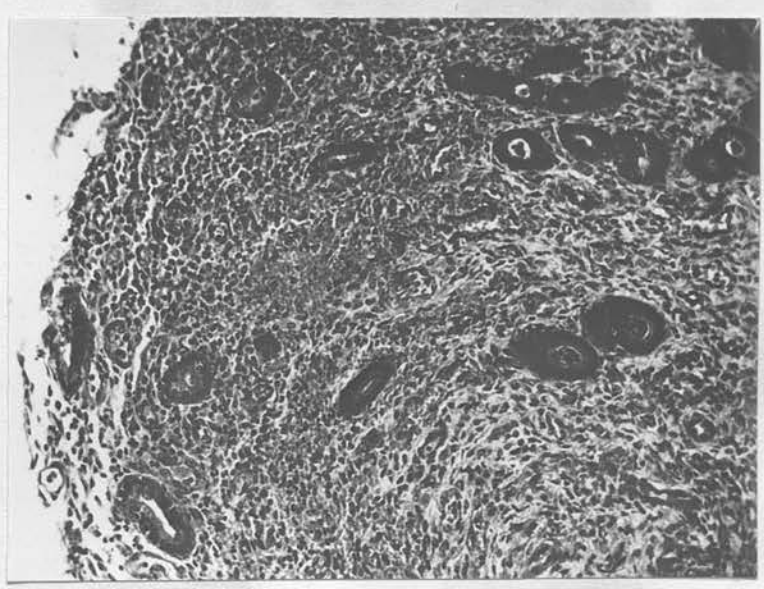


Fig. 54. Staph. albus infection of guinea-pig's uterus. Section of a fifteen day lesion showing epithelial destruction and prominent cellular infiltration of underlying connective tissue; the glandular epithelium is degenerating, the lumen of many being filled with cell debris.
Haematoxylin-eosin. X 200



Fig. 55
Uterus of guinea pig showing a 15 day lesion in the right horn (left in photo) produced by Staph. albus. The broad ligaments which are included in the picture show the blood supply to the uterus.

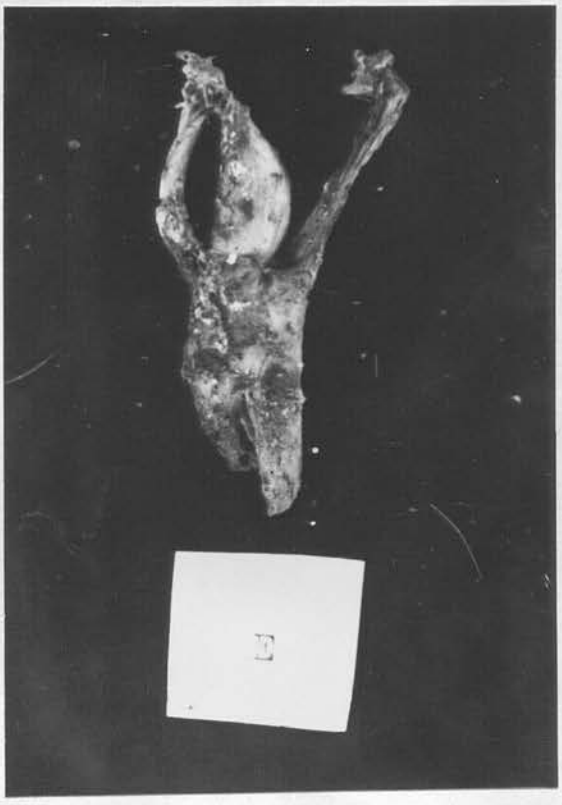


Fig. 56. - Uterus of guinea pig showing a 15 day lesion in the right horn (left in photo) produced by C. pyogenes.

DISCUSSION.

The bacteriological examination of normal genital tracts has shown that 49% of the non-pregnant and 32.2% of the pregnant tracts contained bacteria in one or more sites examined (Tables 11 and V11). These figures are in close agreement with those of Day (1917) who secured bacterial growths from 56% of non-pregnant and 32% of pregnant tracts, while they differ greatly from Hagan's (1917 a) findings which were 80% and 87.5% respectively. Hagan's higher percentages were no doubt due to the fact that his material consisted of both normal and grossly pathological tracts with metritis and pyometra. Carpenter (1920) obtained 64% and 72% positives for the pregnant and non-pregnant genital tracts respectively and Conklin, McCarthy, Thompson and Pugsley (1931) reported 88.7% of infections in the pregnant uter; while the former's materialcame from cows with abnormal breeding histories, 19 out of 80 uteri examined by the latter were grossly pathological.

The present study of the nature and incidence of the bacteria in the normal genital tracts revealed that micrococci were isolated most frequently (18%). The next in order were corynebacteria (16%); staphylococci (15%); coliform bacilli (9%); streptococci (9%); bacilli - Gram positive aerobic sporulating rods (3%); sarcinae (1%) and alcaligenes (1%).

Williams and Carpenter (1917) reported micrococci in 66.68%, streptococci in 20.66% and sarcinae in 13.33%; while Conklin et al., (1931) isolated micrococci in 35%, streptococci in 21.2%, sarcinae in 3.7%, alcaligenes in 17.5% and corynebacteria in 1.4%

of uteri studied. Neither Williams and Carpenter (1917) nor Hagan (1917 a) reported staphylococci but Day (1917) and Conklin et al., (1931) isolated them in 25% and 10% of cases respectively.

Data on the incidence of Gram-positive sporulating rods is very variable if not deficient. Conklin et al., (1931) reported bacteria belonging to the genus "Bacillus" in 26.2% of uteri, while Day (1917), Hagan (1917 a) and Williams and Carpenter (1917) make no mention of these bacteria.

With regard to data on Gram-negative non sporing aerobic rods there has been a great deal of confusion and uncertainty since they were all regarded by previous investigators as colon or para-colon or just "short bacilli", and no attempt was made to classify them. Hence it is rather difficult to guess even the generic position of the organisms isolated by these workers.

Thus it will be seen that it is impossible to compare effectively the results of bacteriological examination obtained by different workers owing to different materials, methods and standards followed. The great majority of them have included in their study grossly pathological genital tracts and have not attempted any classification of the bacteria isolated beyond grouping them under genera or simply stating them as rods or cocci.

The type and incidence of bacteria found in the non-pregnant and pregnant genital tracts are essentially alike (Table V). The incidence of micrococci, corynebacteria/

corynebacteria and streptococci is about the same in both, while that of staphylococci and coliform bacilli is greater in the non pregnant uteri. Identical bacteria were isolated from the uterochorionic space and the amniotic fluid in all the five pregnant uteri that yielded bacteria, while the amniotic fluid alone contained bacteria in one case (Table VIII). This slightly higher incidence in the latter is probably explained by the fact that there might be a better distribution of bacteria in the fluid than in the uterochorionic space.. Besides, in the mode of obtaining inocula from the uterochorionic space a comparatively small area was touched with the loop and consequently the volume of inoculum was limited. Whereas a greater volume of amniotic fluid at least 5 c.c. were inoculated into media.

This naturally raises the question of the origin of bacteria in the amniotic fluid. Hagan (1917 b) suggested that the infection came from the uterochorionic space and was absorbed into the foetal fluids through the necrotic tip of the chorion, which is said to be a common condition in cattle. In the absence of experimental evidence it is not possible to offer the correct explanation. It is reasonable to expect, however, as shown in this work, that these organisms existed in the cavum uteri to begin with and then passed through the foetal membranes into the foetal fluids. However, in the case of certain bacteria the possibility of a haematogenous infection of the uterus and/

and foetal fluids should be borne in mind.

The comparatively low incidence of coliform bacilli in the non-gravid uterus and their complete absence from gravid ones is interesting. It was isolated from nine non-gravid and one gravid uteri in all. Of the 13 sites it was isolated from in the non-gravid uteri, 9 were from cervix uteri, 2 from corpus uteri, one each from right and left uterine horns, and only once from the cervix uteri of a gravid uterus. Carpenter (1920) isolated members of "colon group" only five times, two of which were from the vagina. Judging from the infrequent occurrence of these coliform bacilli it seems doubtful if many cases of calf-scours and calf pneumonia, generally attributed to these organisms (Hagan, 1917 b; and others) can have their origin in the intra-uterine infection of calves.

The results of this investigation have shown clearly that 26% of normal uteri (excluding cervix) of cows with normal breeding history contained bacteria, thus supporting Beller's (1925) conclusion that, "The uterus of domestic animals under wholly physiological conditions tolerates a latent bacterial growth without necessarily causing injury to either mother or foetus." Acceptance of this view naturally leads to a consider-:ation of the source of bacteria in the uterus of adult cattle. It is not clear whether the infection is present at birth or acquired subsequently. A knowledge of the bacterial content of the genital tracts/

tracts of foetuses, calves and virgin heifers will throw light on this problem. Carpenter (1920) investigated the bacterial flora of the genital tract of foetuses, calves and virgin heifers and concluded, "It seems evident that a certain percentage carry infection in their genital canals from calfhood to puberty and that this infection is borne there either by the blood or lymph stream." He was also of the opinion that some became infected during pregnancy or afterwards.

An analysis of the distribution of bacteria in the genital tracts in this study brings out certain interesting features. The incidence of bacteria in the cervix uteri was 41%; corpus uteri 9%; right uterine cornu 20%; left uterine cornu 9%; and Fallopian tubes 2% (Graph 1). It appears from these data that the normal uterus (excluding cervix) should be free from bacteria; that in some cases bacteria traverse the cervix up the uterus and that a healthy cervix acts as a barrier against infection.

Another feature of interest revealed by the graph is that the right uterine horn is the more frequent seat of bacteria than the left uterine horn or the corpus uteri. It would appear that this is probably due to the fact that the available area in the uterine body is smaller when compared to that of the horns and that the right horn is more frequently gravid and hence larger than the left one as already pointed out. It is a matter of surmise that as a result of frequent pregnancy/

pregnancy and parturition there may be more chances of bacteria reaching and surviving in the right uterine horn.

Among the bacteria isolated from the normal genital tracts (Table XIII) only Corynebacterium bovis and staphylococci would seem to be of pathogenic significance, since they alone have been subsequently isolated from abnormal uteri in significant numbers. The comparatively low incidence (9%) of streptococci and the total absence of mastitis groups (Lancefield's group B, Minett's groups II and III) seem to clear the uterus of a role as a possible source of the bacteria in mastitis infection. Though Corynebacterium renale has been reported (Weitz, 1947) as occurring in about forty per cent of normal bovine vaginae, it was isolated only twice from the cervix uteri of normal genital tracts but never from the abnormal genital tracts. This would seem to suggest that Corynebacterium renale is normally confined as a pathogen to the urinary tract of cattle and thus is present only in the external urinary meatus and posterior vagina. The failure to isolate Corynebacterium pyogenes and Brucella abortus even though special media and incubation technique were used suggests that they do not contribute to the bacterial flora of the normal uterus.

These results with regard to Brucella abortus are in agreement with those of Wacherbarth (1937) who examined 22 uteri from non pregnant cows (with a titre of over 500 for brucellosis); neither culturally nor by/

by animal inoculation could Brucella abortus be demonstrated in any instance.

Though there is an apparent group similarity between the bacterial flora of the normal and abnormal genital tracts (Tables XIII and XX) certain significant differences stand out prominently. Corynebacterium pyogenes, Corynebacterium equi, Staphylococcus aureus, Klebsiella pneumoniae, Proteus vulgaris, Pseudomonas aeruginosa, Mycobacterium tuberculosis and streptococci of Lancefield's groups C and G were present only in the pathological uteri. Also, the incidence of Staphylococcus albus was increased to 25% as compared to 9.1% in the normal uteri and the respective figures for Corynebacterium bovis being 5% and 1.5% and for Escherichia coli 14% and 7.6%. Further, these bacteria were isolated in pure culture in large numbers from most sites whereas in the normal uteri the bacteria were few and sparsely distributed in the uterus.

The bacteria listed above were all associated with endometritis of one type or another. It can be seen that there is a definite correlation between the type of organisms present and the nature of lesions produced. Thus staphylococci, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris, Escherichia coli and streptococci were associated with catarrhal endometritis, while Corynebacterium pyogenes, Corynebacterium bovis and Corynebacterium equi were associated with suppurative endometritis either in pure culture or mixed with other bacteria.

Staphylococci were the largest group of bacteria associated/

associated with catarrhal inflammations of the genital tract having been isolated from 50% of cases of catarrhal endometritis, in 40% of which they were present in pure culture. Eight of these strains were typically Staphylococcus aureus. All the 25 strains of Staphylococcus albus were coagulase-negative as judged by the tube method with human blood plasma; but 48% of these gave clear zones of haemolysis on horse blood plates and fermented mannitol.

The pathogenicity of Staphylococcus aureus is accepted but this is not so with the coagulase-negative Staphylococcus albus strains. Whether these organisms were responsible or not for the lesions is a matter that deserves consideration.

Bell (1940) tested 61 strains of staphylococci (isolated from horse, ox, sheep, goat, dog, cat and pig) for the production of toxin, pigment, haemolysin, coagulase and fermentation of mannitol. 54 of these strains were Staphylococcus aureus and the rest Staphylococcus albus. Only one of the albus strains was haemolytic, while about half the number of aureus strains produced alpha toxin and some of them beta toxin as well. He reported perfect correlation between the ability to produce alpha toxin and the coagulation of human and equine plasma. Mannitol was fermented not only by toxin forming strains but also by many non-toxin producers as well.

Kourilsky and Mercier (1942) reported that while the production of haemolysis was almost invariably

a/

a characteristic of pathogenic strains, the fermentation of mannitol and a positive coagulase reaction was a constant feature of such strains. Field and Smith (1945) examined 124 strains of staphylococci from cow's udders, and found a perfect correlation between production of haemolysis and coagulation of fibrinogen. Recently Smith (1947) arrived at the conclusion that production of coagulase was the only absolute criterion of pathogenicity among strains of staphylococci. The production of beta-haemolysis on sheep blood agar, liquefaction of solid serum, production of fibrinolysin, haemotoxin, dermotoxin and lethal toxin and the lethal effect of the organisms themselves were properties exhibited only by pathogenic strains. The possession of any of these properties might be accepted as evidence of pathogenicity, although its absence was without significance. Further, he considered that pigment production, action on litmus milk, the liquefaction of gelatin, the fermentation of mannitol and other carbohydrates were of little value in the detection of pathogenic strains.

In contrast to the above conclusion Christie, North and Parkin (1946) reported that alpha-toxin production was most closely associated with pathogenicity and that the test was more reliable as a criterion for pathogenicity than coagulase test.

These foregoing statements show clearly that there is no universal agreement upon any specific test or combination of tests which can be used to determine the pathogenicity of staphylococci.

The/

The results of inoculation of coagulase-negative Staphylococcus albus strains into guinea pig uteri showed clearly that they can give rise to a severe catarrhal inflammation with desquamation and degenerat-:ive changes in the endometrium - changes which are characteristic of catarrhal endometritis in the cow from which these bacteria were isolated.

Recently Pounden, Ferguson, Knoop and Krauss (1947) in America have reported the isolation of Staphylococcus albus from four cases of abortion in a herd of fifty cows. The herd bull was incriminated as a possible transmitter of the disease. Organisms of apparently similar characters were recovered from samples of semen obtained from the bull.

Thus it would seem that the criterion of judging the pathogenicity of staphylococci by their ability to produce coagulase is not a completely accurate guide for judging their pathogenicity in the uterus. Though staphylococci are normally present in about 15% of the uteri they appear to assume a pathogenic role under certain conditions which have yet to be understood. Since most cases of endometritis seem to follow on parturition it is probable that these organisms become pathogenic when the resistance of the tissues is lowered. In the light of these observations one cannot but agree with Beamer, Goodof and Smith (1944) in considering that any staphylococcus should be regarded as potentially pathogenic although the usual pathogenicity tests (including coagulase production and/

and lethal effect on laboratory animals) may be negative.

Encapsulatus genitalium - an organism apparently indistinguishable culturally and morphologically from Friedlander's bacillus has been reported as the cause of metritis in mares (Dimock and Edwards, 1927); the isolation of Klebsiella pneumoniae in this study emphasises the importance of this group as the causal organisms of catarrhal endometritis in mares and cows. Pseudomonas aeruginosa and Proteus vulgaris also seem to play a certain role in such inflammation and they might have been introduced into the uterus by the bull. Recent reports (Rollinson, 1948; Gunsalus, Salisbury and Willett, 1941; and Gilman, 1922) suggest that Pseudomonas aeruginosa plays an important part in sterility in the male bovine. Rollinson (1948) further points out that in the bull invasion occurs long before any suspicion of infertility is present. Thus it is more than likely that an infected bull becomes an active disseminator to as many cows as he may be called upon to serve before he is withdrawn from the herd.

One of the surprising results of this investigation has been the low incidence of streptococci in general (12%) as compared to staphylococci (33%) and the absence of any significant groups (except Lancefield's group C. isolated once from the uterus in association with Staphylococcus albus and group G. once from cervicitis). This is in marked contrast to the part played by streptococci in endometritis, and puerperal infections/

few and it is difficult to appreciate that failure to breed was the result of loss of functional tissue of the endometrium.

11 (42.3%) out of 26 cows with known breeding records in this group had failed to conceive even after three or more services, while the rest had had difficulty in settling; Quinlan (1929) in South Africa reported that chronic catarrhal endometritis was the cause of 66% of sterility in cows. The reason for the sterility in this group is not clear. Only seven cows had pathological ovaries to which the sterility could be attributed. Assuming that the bull was normal and of high fertility the failure to conceive might have been due to the mucinous nature of the pathological exudate interfering with the motility of spermatozoa on their onward journey or due to the toxic effects of the exudate on the spermatozoa. Wester (1921) carried out interesting work on the toxicity of various chemical substances and body fluids on the spermatozoa. He indicated the presence of toxic substances - spermatoxin - in the exudate from vaginitis. It appeared that there was something in the pathological exudate of vaginitis which was toxic to spermatozoa. Whether a similar result takes place in catarrhal endometritis is a matter requiring further investigation.

All the cases of suppurative endometritis were associated with Corynebacterium pyogenes, or Corynebacterium bovis or Corynebacterium equi in pure culture in the majority of cases (Table XV). Corynebacterium pyogenes was responsible for 89% of the cases/

cases, of which it was in pure culture in 68% In every case of closed pyometra it was found in pure and plentiful culture. In some cases of a sub-acute nature it could be isolated only in special enrichment media, thus indicating the need for such media in the diagnosis of these cases.

The constant production of pyometra by Coryne-:bacterium pyogenes in guinea pigs under experimental conditions suggests that it is responsible for the condition in nature. These experiments have also shown the severe damage this organism brought about in uterine structures. Thus it is clear that Corynebacterium pyogenes infection is the most important single factor in the causation of endometritis of a severe nature.

The absence of Corynebacterium pyogenes in the normal uterus as reported in this investigation and vagina (Weitz, 1947) makes a consideration of the source of infection from this organism rather interest-:ing. The most important question arising from this point of view is whether these infections are endogenous or exogenous.

In those cases of puerperal infection where the cervix is open the infection might arise from exogenous sources. Infection from outside sources stresses the vital importance of asepsis and antisepsis in handling dystokia and parturition cases.

But in some cases of closed pyometra and infection of pregnant uteri the sources of infection would appear to be endogenous. Francis (1941) isolated Coryne-:bacterium pyogenes/

pyogenes from 18 out of 100 pairs of bovine tonsils and once from vagina of a cow while Lovell (1943) re-:ported that it is not uncommon to isolate Coryne-:bacterium pyogenes from abscesses in the body, liver and kidneys of cattle. These findings suggest that bacteriaemia due to this organism is not uncommon in cattle. Lovell (1939) further concluded from a study of the normal anti-toxin content to Corynebacterium pyogenes in animals that there is evidence that the stimulus is a specific one and that the anti-toxin is provided by the latent infection with Corynebacterium pyogenes

In the present investigation, in three cases of puerperal endometritis due to Corynebacterium pyogenes infection the cows had suffered from suppurative mastitis and in a fourth case there were lesions of suppurative arthritis of knee joint at the time of alsughter; from all these situations Corynebacterium pyogenes was isolated; thus suggesting the possible spread of infection to the uterus from these sources. Observations such as these would seem to stress the possibility of Corynebacterium pyogenes occurring as a latent infective organism in extra genital sources and lend support to the hypothesis of endogenous infection.

The factors which stimulate the growth of Coryne-bacterium pyogenes in the uterus are not completely known. Trauma is undoubtedly an important factor, but possibly there are others which remain obscure.

In/

In striking contrast to catarrhal endometritis, suppurative endometritis was characterised by extensive destruction of the endometrium including sloughing of cotyledons; and usually involved all layers of the uterine wall, peri-uterine structures, the Fallopian tubes and the ovaries. Persistent corpus luteum was a constant feature of well established pyometra cases.

In the acute and chronic cases caused by Coryne-:bacterium pyogenes the damage to the functional structures of the uterus, especially the cotyledons, was so great that the breeding capacity of such cows could be considered as terminated.

In sub-acute cases the lesions were mostly con-:fined to the cotyledons and areas immediately surrounding them. In some the quantity of pus was very little and the lesions appeared to be not progressive, thus suggesting that the infection had started with the cotyledons and that a sort of balance had been established between the host and the bacteria. It is possible that these cows had a high Corynebacterium pyogenes anti-toxin content in their system owing to latent infection or previous contact with the antigen. This hypothesis is supported by the findings of Lovell (1939) that among the domestic animals cattle had the highest titre of Corynebacterium pyogenes anti-toxin in their blood. He further indicated that sex may play some part in the natural development of anti-toxin in sera, for there was a suggestion of higher values being more common in female than in male bovines.

This type of sub-acute endometritis presents

special problems to the clinician since it is not so obvious or strikingly apparent at a clinical examination as would puerperal endometritis or chronic pyometra where the uterus is distended with pus. That is because the alterations in the size and condition of the uterus are not sufficiently advanced to be appreciable on rectal examination and the os uteri usually appears normal. The usual history in such cases was that the cows had been returning to the bull regularly over a period of 5 to 8 months. From the available histories of 18 cows it was found that six (33.3%) had failed to conceive even after being served four to many times, and one after two services. The rest of the cows did not have a history of services even though they were slaughtered on an average of 5 - 8 months after calving.

Thus it would appear that this type of endometritis is responsible for impaired fertility or even total sterility. In such cases early diagnosis is very essential; bacteriological examination of uterine swabs and washings taken at frequent intervals will greatly help the clinician to appreciate the nature of infection. In the absence of such precautions the danger of infecting the bull and other cows in the herd is obvious.

The isolation of Corynebacterium pyogenes in pure culture from two pregnant uteri (age of foetuses - 10 weeks and 16 weeks) which were apparently normal externally, but internally contained pus mixed with foetus/

foetus and foetal membranes in a state of disintegration leads to two obvious conclusions viz. that the infection was most probably endogenous and had the cows been allowed to live they would have either aborted or developed a typical pyometra.

The abortion if it occurs is not likely to be spectacular since in Corynebacterium pyogenes infection the foetus and its membranes are usually completely dissolved and it will be marked by only a purulent discharge which is likely to be mistaken for a mere uterine infection. If, however, abortion does not occur the uterus is likely to become filled with pus, giving the apparent impression of being pregnant. This supposition is supported by the post-mortem findings and histories of case Nos. 15 and 43.

The isolation of Corynebacterium equi (2%) and Corynebacterium bovis (5%) from genital infections emphasises the great part played by corynebacteria in in the causation of suppurative endometritis in the bovines. Under experimental conditions in guinea pigs' uteri the reaction produced by Corynebacterium equi was rather slow and mild when compared to that of Corynebacterium pyogenes. It was characterised by an outpouring of abundant fluid in the early stages becoming purulent at a later stage. The structural changes in the uterine wall were not very marked except for the acute inflammatory degenerative changes in the endometrium. Thus it would appear that Corynebacterium equi is of low toxicity as compared to Corynebacterium pyogenes.

So/

So far as severe suppurative endometritis is concerned, the organism most frequently (86%) isolated, apart from Corynebacterium bovis and Corynebacterium equi was Corynebacterium pyogenes. A point of further interest is that in such cases mixed infections were rare.

The prominent structural changes met with in atrophic endometritis were extensive destruction and atrophy of the mucosa and its glands, contraction of the interstitial tissue and infiltration of lymphocytes and plasma cells, and intimal thickening of the arterial walls - endarteritis obliterans. In some there was complete occlusion of the lumen of blood vessels. The state of the uterine structures was such that it is hardly conceivable that these uteri would ever have regained their normal structure and function.

Such changes may be regarded as the late results of acute inflammation where there had been extensive destruction of the endometrium. This hypothesis is supported by history of the cows and bacteriological findings in the uteri. 50% of these uteri were sterile and the rest contained either Corynebacterium pyogenes or Proteus vulgaris, Staphylococcus albus or Klebsiella pneumoniae - organisms associated with endometritis. Four of the nine cows whose histories were known had had their uteri irrigated repeatedly with solutions of iodine. In spite of this treatment they proved sterile. It is not unlikely that others also would have been treated for uterine discharges by the usual irrigation methods/

methods. The treatment, in addition to clearing up the infection in some seems to have contributed to the damage of the tissue. It is not contended that all cases were due to the irritating effect of iodine. When the endometrium is in a badly damaged state, iodine will no doubt add to the damage. The great damage done by drastic methods of treatment has been described by Quinlan (1929). In a herd of 70 cows 45 of which had been treated for infectious vaginitis all were found to be suffering from stenosis of the vagina sufficient to cause sterility. This was attributed to the effect of some irritant disinfectant which had been recommended by a veterinary surgeon as an irrigant for the vagina. Treatment caused sloughing of the vaginal mucosa which was followed by cicatrixat-:ion and consequent stenosis.

Though iodine is a time honoured remedy for uterine infections in cows one is usually not aware of its irritating effects as there is no manner of estimating the damage to the uterine tissues while the animal is alive. Where a sensitive tissue like endometrium is concerned the choice of irrigating lotion should be one that has less of irritating effects and more bacteriostatic properties. Hence the careless use of strong solutions of iodine in uterine irrigation would seem to be contraindicated. It is well to remember as Pomayer (cited by Williams, 1939) points out that the superficial layers of the endometrium are far more readily killed than are bacteria, and the use of ordinary/

ordinary disinfectants can only be regarded as dangerous.

The histological changes met with in hyperplastic endometritis were quite different from those described above. They were chiefly characterised by hyperplasia of the endometrium and its glands, the presence of ovarian cysts and the absence of corpus luteum (except in one case where the cyst was lined by luteal cells). The absence of bacteria in about 82% of cases and the condition of the mucosa would seem to suggest that this affection could not have been the result of past or present infection. It would appear that the essential factor is the absence of ovulation. In the light of what is known of the endocrine balance in relation to fertility some of these changes are capable of a theoretical explanation.

The anterior pituitary gland elaborates two main hormones concerned with reproduction. They are (1) the follicle stimulating hormone which causes the follicle to develop and (2) the luteinising hormone which causes ovulation and the development of the corpus luteum. Further, these two hormones by their action on the ovaries give rise to oestrogen in the follicle and progesterone in the corpus luteum. In the normal functioning of the reproductive organs there is an even balance between these hormones. However, recent research shows that in the cow the luteinising hormone is in good supply but the follicle stimulating hormone is comparatively low and therefore there is a tendency in this species for the corpus luteum to persist (Hammond, 1948).

The folliculin or oestrone produced by the ripe Graafian follicle stimulates proliferative changes in the endometrium which are accompanied by hyperaemia up to the time of ovulation. The corpus luteum which then begins to form produces progestin which is responsible for the secretory and decidual changes in the endometrium. Progestin also inhibits ovulation as seen in pregnancy when the corpus luteum persists. In the normal non-gravid uteri these changes go on alternately, thus ensuring the normal oestros cycle.

If ovulation does not occur this hormonal equilibrium is upset and the proliferative changes due to folliculin go on unchecked as there is no corpus luteum formed and no progestin to complete the cycle. The hyperplastic condition of the endometrium may thus be indicative of uninterrupted action of oestrone. While it seems that these changes are secondary to cystic ovaries the cause of the latter remains obscure.

One usually hears of successful treatment of sterility by rupturing the ovarian cysts. These beneficial results are probably due to the fact that rupture of the cyst leads to the formation of fresh corpus luteum thus throwing the balance to the luteal side. Theoretically the same results could be obtained by injecting luteinising hormones.

The absence of bacteria in these uteri is rather interesting and difficult to explain. It is probably due to the tenacious nature of the mucus and its slightly acid reaction which in turn may be related to the altered/

altered blood levels of sex hormones. Further, this tenacious mucus will also inhibit the movement of the spermatozoa up the cervix and uterus. In the treatment of sterility due to hyperplastic endometritis, in addition to rupturing the ovarian cyst, it will be necessary to irrigate the uterus with an alkaline solution (Sodium bicarbonate) which will liquefy the mucus (Hammond, 1927) thus facilitating the movement of spermatozoa.

Though hydrometra has been dealt with under a separate heading, on a consideration of the structural changes which are essentially hyperplastic, it can as well be grouped along with hyperplastic endometritis. The majority of uterine glands were in an active proliferative and secretory state and opened freely on the endometrial surface. In the place of cystic glands being the most prominent picture, in the final stages a catarrhal reactions may supervene with lysis of the mucus leading to hydrometra. Quinlan (1929) met with a single case of hydrometra and expressed the view that, "The cause of hydrometra would appear to be cervical deformity which rendered the escape of oestral debris through the ostium uterinum impossible." The author does not entirely agree with this view since there was no cervical deformity in both of his cases, though the cervix was closed with a mucus seal and one of the cows had had seven calves, and was expected to be in calf at the time of slaughter, while the history of the other is not known. The essential change is the hyperplasia/

hyperplasia of the endometrium with actively secreting glands. Further, as in the case of hyperplastic endometritis bacteria were not isolated from hydrometra.

In view of these considerations it appears that hyperplastic endometritis (11.8%) represents a hormonal disturbance the cause of which remains unknown. It is of interest to mention here that a condition similar in many respects to this type of endometritis has been described in bitches by Hetzel (1955) and De Vita (1939) who consider that many cases previously regarded as pyometra in bitches could be termed glandular cystic hyperplasia. It is said to occur in virgin animals as well as in multipara and is the most common cause of sterility in the bitch. Histologically the endometrium showed complex glandular hyperplasia with, in many cases, abscess formation and necrosis. In most of the ovaries examined cystic ovarian follicles were present. With regard to the bacterial content of such uteri De Vita (1939) quotes, "Les bouyries and Barthelon in 1936 pointed out that the organisms found are those which ordinarily contribute the normal flora of the vaginal and vulvar mucosa." But from the literature very little information is available on the normal bacterial flora of the genital tract in the bitch.

The possibility of primary uterine tuberculosis occurring as a result of uterine irrigation, as suggested by the nature of the lesions and the history of the cow recorded herein, stresses the importance of observing strict/

strict aseptic and antiseptic precautions in dealing with uterine affections. A recent report of the Ministry of Agriculture and Fisheries (1948) records eleven cases of primary tuberculosis of the uterus due to irrigation. In dealing with a case of endometritis it is of the utmost importance that steps should be taken to ensure that the uterus is not affected with tuberculosis. This could be accomplished by examination of smears and swabs taken from the uterus. The danger of spread of disease to other animals in the herd and its obvious public health significance must not be overlooked.

Now coming to the question of the part played by Brucella abortus in the incidence of endometritis, it may be stated that Brucella abortus was not isolated from any of the genital tracts - normal or pathological. It is admitted that the examination of uterine material was confined to cultural methods only. The results of agglutination test for Brucella abortus infection do not entirely support Nielsen's (1926) contention that in herds infected with Brucella abortus the incidence of infertility was much higher than in uninfected herds due to greater facility in such cases for bacterial infection of the genital tracts to occur following abortion and retention of placenta. No doubt considered as a whole, the incidence of brucellosis in the endometritis group (43%) was higher than in normal group (35%). But when the results are considered separately according to the type of endometritis, certain/

certain interesting facts emerge. Out of 36 cases of suppurative endometritis (Table XXl) only 11 were positive and 25 negative for Brucella infection. For other groups the difference between the number of positive and negative results was slight, thus showing that the chances of infection in the latter groups are about equal, whether an animal is infected with Brucella abortus or not. But where an organism like Corynebacterium pyogenes is concerned, the infection does not seem to depend upon a previous abortion or retention of placenta, due to Brucella abortus infection.

The pH of the normal uterine fluids was slightly alkaline or neutral; the pathological exudates in bacterial endometritis were definitely alkaline being nearer the optimum for bacterial growth, whereas in the non-bacterial hyperplastic type the pH was slightly on the acid side (Table XXll). This acidity might explain the tenacious nature of the discharge and the absence of bacteria in the latter type.

The frequent association of cystic ovaries and persistent corpora lutea with pathological conditions of the uterus has been a matter of great interest and conflict among workers in this field.

Albrechtsen (1921) and others suggested that the immediate cause of cystic ovaries was infection which gained entrance to the ovary through the ruptured ovisac. If that were so one should be able to isolate bacteria from most of these cystic fluids. In the present study only three out of seventeen ovarian cysts yielded bacteria/

bacteria which were also isolated from the corresponding uteri. The rest of the ovaries contained a clear fluid and showed no sign of infection. One might argue the point that the absence of bacteria in the cyst is no indication that the ovary had not harboured bacteria earlier, but in such cases one would expect pathological changes in the fluid, which was crystal clear in every case excepting the three infected ones, where it was cloudy and milk-like. The hypothesis of Hess (1920) that ovarian change is primary would appear to be not unlikely.

Albrechtsen (1921), Nielsen (1926), Williams (1939), Quinlan (1929) and others looked upon persistent corpus luteum as secondary to inflammatory lesions in the genitalia while Hammond (1927) was uncertain if primary uterine infection was the cause of such a condition.

The results (Table XlX) obtained in this study on the relationship of persistent corpus luteum to inflammatory conditions in the genitalia are rather interesting. Out of the 75 cases of endometritis associated with bacterial infection eight had cystic ovaries, twenty persistent corpora lutea and one both corpus luteum and cystic ovary. In the non-bacterial group (hyperplastic endometritis) out of eleven cases, nine had cystic ovaries and two (hydrometra) persistent corpora lutea.

In the light of these findings there are at least two possible explanations of this problem. In the first instance it would appear that there is a close relationship/

relationship between infection and persistence of corpus luteum. Further, in the milder form of endometritis (catarrhal) the incidence of persistent corpora lutea was only 9.3% as compared to 48.3% in the severe suppurative type, due to infection with Corynebacterium pyogenes group, thus suggesting that the persistance of corpus luteum may be dependent upon the toxic nature of the infection. It would seem that the toxic products present in the uterus are absorbed into the blood, which thus influences the hormonal activity of the pituitary gland or the ovaries directly. Conversely it may also be due to the mere distension of the uterine walls with fluid as found in hydrometra from which no bacteria were recovered. Logically this would mean that removal of the sources of toxins or releasing the tension from the uterus must bring about a regression of the corpus luteum. Williams (1939) states that in trichomonad pyometra if the pus be syphoned out, the corpus luteum atrophies, ovulation occurs, and the uterine contents are expelled. It is not clear whether the regression of the corpus luteum was due to the removal of the toxic products (pus) from the uterus or the mechanical removal of pressure from the distended uterine walls.

There is much room for experimental investigation on this point and in determining whether the persistent corpus luteum is primary or secondary to uterine infection.

In conclusion it may be stated that the object of this/

this research has been to present information on the bacterial flora of normal genital tracts and the bacteriology and pathology of bovine endometritis. The results have shown that about 26% of the normal uteri of cows tolerate a bacterial flora which is non-pathogenic or of low virulence. The bacterial flora in pathological uteri differs from the normal flora and is composed of pathogenic bacteria which give rise to endometritis of various types, viz. catarrhal, suppurative, atrophic and tuberculous being responsible for 88% of cases. Hyperplastic endometritis (12%) on the other hand is not associated with bacteria and its origin remains obscure or at best attributed to hormonal disturbance.

The importance of endometritis in the causation of sterility is sufficiently obvious from the observations outlined in this discussion. This investigation has further shown that the problem of sterility in bovines cannot be solved by studying Brucella abortus or Trichomonas foetus alone as there are other bacteria at least equally important like corynebacteria and staphylococci.

When the causes of endometritis are considered it will be seen what an important role bacteria play in the production of endometritic sterility. In order to deal with this problem effectively both prophylactic and curative measures will have to be undertaken. But the emphasis should be on prevention, since uterine therapy in the cow is without doubt a somewhat tedious procedure/

procedure when endometritic sterility is widespread. If an effective method of immunisation were available the conditions for applying it would be very favourable; since most uterine infections seem to take place soon after calving, there are several months before parturition during which immunity could be induced. But unfortunately very little is known of the possibilities and use of such vaccines and toxoids in the prevention and treatment of endometritis. This has been probably due to lack of exact knowledge of the bacteria involved in such conditions.

Though chemotherapy holds the field today the development of a successful method of immunisation for endometritis - corynebacterial and staphylococcal - would render the tackling of the problem of sterility much less formidable. In the meanwhile reliance should be placed upon early diagnosis and remedial measures.

In every case where there is the slightest suspicion of a cow returning to the bull, in addition to clinical examination of the genital tract, uterine swabs taken at frequent intervals must be examined for their bacterial contents. A knowledge of the bacteria involved will help a great deal in the line of treatment to be adopted and also in the prevention of spread of disease to the bull and through it to the rest of the herd. This is very important especially in infection from Corynebacterium pyogenes where in early/

early stages passive immunisation could be tried by the injection of specific anti-serum. Finally it is emphasised that the herd bull should receive due attention since a bull with infected genitalia might be an active disseminator of infection.

This investigation has brought out the nature of endometritis and the bacteria involved; it is hoped that this knowledge will be of value to future investigators engaged in the treatment and prevention of sterility in bovines.

SUMMARY.

It has been aimed to present information on the bacterial flora of normal genital tracts, and bacteriology and pathology of endometritis in cows.

1. A survey of the bacterial flora of 100 normal non-pregnant and 31 normal pregnant genital tracts of dairy cows is reported. 49 per cent of non-pregnant and 32.2 per cent of pregnant genital tracts contained bacteria. The incidence of bacteria in the cervix uteri was 41%; corpus uteri 9%; right uterine cornu 20%; left uterine cornu 9%; and Fallopian tubes 2%. These results indicate that under normal conditions bacteria traverse the cervix up the uterus and a healthy cervix acts as a barrier against infection.

2. There was similarity between the bacterial flora of the non-pregnant and pregnant uteri; and also between that of the uterochorionic space and amniotic fluid.

3. Micrococci (18%) were the commonest bacteria in the genital tracts of non-pregnant cows, the next in order were corynebacteria (16%); staphylococci (15%); coliform bacilli (9%); streptococci (9%); Gram positive aerobic sporing rods (3%); sarcinae (1%) and Alcaligenes faecalis (1%).

4. Neither Corynebacterium pyogenes nor Brucella abortus nor mastitis groups of streptococci (Lancefield's group B. and Minett's groups 11 and 111) were isolated from the normal genital tracts.

5. One hundred abnormal genital tracts were examined for their bacterial contents and pathological changes; 93 had endometritis associated with cervicitis (32%) and salpingitis (29.3%), five primary cervicitis and two salpingitis only.

6. The bacterial flora of abnormal genital tracts differed significantly from that of normal tracts. Corynebacteria were the largest group (51%); the next in order were staphylococci (33%), coliform bacilli (14%), streptococci (12%), micrococci (10%), Klebsiella pneumoniae (4%), Proteus vulgaris (3%), Mycobacterium tuberculosis (2%), Bacillus mesentericus (2%) and Pseudomonas aeruginosa (1%).

7. The following bacteria were isolated from the abnormal genital tracts only - Corynebacterium pyogenes, Corynebacterium equi, Staphylococcus aureus (with one exception where it was isolated from a normal cervix) Klebsiella pneumoniae, streptococci of Lancefield's groups C. and G., Proteus vulgaris, Pseudomonas aeruginosa and Mycobacterium tuberculosis. Further, the incidence of Staphylococcus albus was increased to 25% in the pathological tracts as compared with 9.1% in the normal, the respective figures for Escherichia coli were 14% and 7.6% and Corynebacterium bovis 5% and 1.5%.

8. There was correlation between the type of endometritis and the bacteria present in the uteri. Staphylococci, Klebsiella pneumoniae, Proteus vulgaris, coliform/

coliform bacilli, streptococci and Pseudomonas aeruginosa were associated with catarrhal endometritis, whereas Corynebacterium pyogenes, Corynebacterium bovis and Corynebacterium equi in pure or mixed cultures were found in suppurative endometritis.

9. Corynebacterium pyogenes is considered the most important single factor in the causation of suppurative endometritis since it was isolated from 86% of such cases. Staphylococci were mostly associated with catarrhal endometritis and isolated from 50% of such cases. A new variety of coryne-:bacterium has been isolated and described. Tentatively it has been designated Corynebacterium bovis var metritis.

10. Trichomonas foetus was recorded in three cases of catarrhal endometritis. The cows from which these uteri were obtained belonged to three different farms in Ayrshire.

11. a. Five main types of endometritis were distinguished according to the pathological changes present viz., catarrhal endometritis (34.4%); suppurative endometritis (38.7%); atrophic endometritis (12.9%); tuberculous endometritis (2.1%) and hyperplastic endometritis (11.8%).

b. Catarrhal and suppurative endometritis were almost invariably associated with bacteria while only 50% of atrophic endometritis contained bacteria. Nine (82%) out of eleven cases of hyperplastic endometritis were sterile while two contained micrococci only.

12. a. The lesions observed in different cases of catarrhal endometritis were primarily those of catarrhal inflammation of endometrium with epithelial degeneration, squamous metaplasia and degeneration of glandular epithelium. These changes may be regarded as the result of infections of a mild character, though in the case of staphylococci and Trichomonas foetus the structural alterations were pronounced.

b. In striking contrast to the above, suppurative endometritis was characterised by extensive necrosis of endometrium including sloughing of cotyledons; and usually involved all layers of the uterine wall, periuterine structures and Fallopian tubes. Persistent corpus luteum was a constant feature of well established cases of pyometra. In the acute and chronic cases the damage to the functional structures of the uterus was so great that it is doubtful if they ever would have regained their normal function. In sub-acute cases the lesions were mainly confined to cotyledons. Since this sub-acute stage is not easily diagnosable clinically, bacteriological examination of uterine swabs is essential.

c. The prominent structural changes in atrophic endometritis were extensive necrosis and atrophy of mucosa, contraction of interstitial tissue and intimal thickening of the arterial walls. Such changes may be regarded as the late result of acute inflammation where there had been extensive destruction of the endometrium

d. Hyperplastic endometritis was characterised by hyperplasia of endometrium and its glands whose cystic dilatation was a prominent feature. It was invariably associated with cystic ovaries. This type of endometritis probably represents a hormonal dis-:turbance, the cause of which remains obscure.

13. The pathogenicity of Corynebacterium pyogenes, Corynebacterium equi and Staphylococcus albus all isolated from bovine endometritis was tested upon ligated uterine cornua of guinea pigs. A study of the progress of the lesions at various stages of infection showed that Corynebacterium pyogenes and Staphylococcus albus gave rise to typical lesions comparable to those met with in natural cases of endometritis in cows.

Fifty-two photographs illustrating the normal and abnormal uteri are included.

14. The pH of normal uterine fluid averaged 7.08; amniotic fluid 7.22; the pathological exudate in catarrhal endometritis averaged 7.50; suppurative endometritis 7.61; atrophic endometritis 7.48 and hyperplastic endometritis 7.01.

15. The significance of endometritis in relation to bacteria, ovarian abnormalities and sterility is discussed.

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A P P E N D I X

In this Appendix are given details concerning the history of the cows, gross post-mortem examination of genitalia and histological examination of the uterus.

Case No. 1 Identification No. 19 Date of Slaughter. 22.1.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	The vaginal mucosa presents numerous granular eruptions, which are congested and covered with mucoid discharge. Cervix 8 x 6 cms. width of wall 2.5cms. very flaccid, 1 st. cervical fold is ectropic. Cervical canal contains catarrhal viscid discharge. Mucosa pale. Uterine body 6 x 4cms. Right horn 40 x 4 cms. Thickness 1 cm. Left horn 30 x 3.8 cms. Thickness 0.9 cms. The mucosa is covered with a thick, catarrhal pea-soup like exudate about 180 c.c. The cotyledons are very small just protruding from the surface, centre is depressed and appears necrotic. Evidence of chronic inflammation. Both the Fallopian tubes are firm, thick and tortuous evidence of chronic thickening.	Right ovary, 3.6 x 2.5 x 2 cms. A small regressing Corpus luteum is seen on the surface measuring 11 m.m. in height and 5 m.m. in breadth. Left ovary, 3.6 x 1.9 x 0.9 cms. Smooth surface small specks of greyish white areas, representing Corpora albicantia are seen on the surface. Section shows small follicles and regressing Corpora rubra.	Uterus - areas of epithelial desquamation, squamous metaplasia, periglandular infiltration of cells.	Vaginitis cervicitis catarrhal endometritis bilateral salpingitis.

History not available.

Case No. 8 Identification No. Nil. Date of Slaughter. 31.2.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	5	Vagina contains a small quantity of thick muco-purulent discharge. Cervix 6.5 x 5 cms. relaxed, mucosa pale, contains clear mucus. Body 4cms. Right horn 42x4cms. Left horn 30x2.5cms. The uterine walls are tense. The right horn has bean sized cotyledons which are surrounded by thick lumps of yellowish pus. Underneath the pus the mucosa presents punctiform erosions. The rest of the endometrium appears normal. A peri-uterine abscess 2 x 2 cms. in size is enclosed in the broad ligaments close to the uterine body on its left side. The abscess contains thick creamy pus. Fallopian tubes - normal.	Right ovary 4 x 2.3 x 1.7 cms. Has a regressing Corpus luteum and a developing follicle. Left ovary 3.8 x 1.8 x 1.4 cms. Has a few small follicles.	Structure changes are confined to the cotyledons and their surrounding areas. The epithelium is necrotic and desquamated; necrotic changes with a dense infiltration of leucocytes in the superficial and deep connective tissue.	Sub-acute suppurative endometritis with peri-uterine abscess.
No. of calvings	8				
Date and nature of last calving	19.1.47. normal but retained placenta, removed manually.				
Has the cow ever aborted?	Yes, once.				
Has the cow been blood tested for brucella infection?	?				
Has the cow been vaccinated against Contg. abortion?	?				
History of services after last calving, etc.	The cow had suffered from chronic mastitis due to Str.agalactiae; was suspected for Johne's disease and hence destroyed 18 days post-partum.				

Case No. 5 Identification No.FDE 534 Date of Slaughter. 11.3.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. Not available.	Vagina is normal. Cervix 10 x 8 cms. thickness of wall 4 cms. Mucosa is pale yellowish in colour. The os admits the little finger. First cervical fold is protruding into the vagina. Canal contains a small amount of tough mucus mixed with creamy mucopurulent exudate. Body 6 x 4.5 cms. Right horn 34 x 3 cms. thickness of wall 1.5 cms. Left horn 55 x 8 cms. thickness of wall 1.7 cms. Serosa - normal. Endometrium is covered over with a thick catarrhal exudate and is of a dark brown colour. Cotyledons are more prominent in the left horn and measure about 1.5 - 2 cms. greyish rough surface, are surrounded by thick clumps of creamy pus. Fallopian tubes are normal.	Right ovary 3.5 x 1.8 x 1.3 cms. has lentil-sized follicles. Right ovary 3.3 x 2.4 x 2.4 cms. Surface shows many lentil-sized follicles and remains of corpora lutea. On section there is a large corpus luteum. 2.5 x 1.9 x 1.7 cms. Yellow in colour, somewhat soft and embedded in the ovary.	Endometrium is oedematous, with leucocytic infiltration of connective tissue. Cotyledons show necrosis of epithelium and sub-epithelial layers, with leucocytic infiltration.	Sub-acute suppurative endometritis, with persistent corpus luteum.

Case No. 15 Identification No. Minnie 6th Date of Slaughter. 2.4.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	5	Cervix 6 x 4 cms. closed; the cranial extremity contains muco-purulent exudate Body, 5 cms. Rt. horn 60 x 4 cms. thickening wall 1.3 cms. Left horn 68 x 12 cms. thickening wall 2.7 cms. Rt. horn contains in its upper third a macerating mass of tissue (12.5 x 5 cms) mixed with creamy pus. The pus is spreading to the other horn through the body of the uterus. The cotyledons are button-like. Mucosa shows area of ulceration and necrosis. Fallopian tubes are normal.	Right ovary. 2.7 x 1.5 x 1.4 cms., has many millet sized follicles. Left ovary 3.4 x 1.8 x 1.5 cm. has an embedded corpus luteum 2.5 cms. in diameter. The centre of the corpus luteum is cystic and contains an yellowish fluid.	Uterus - Extensive desquamation of epithelium, with necrosis of superficial layers. The interstitial connective tissue is infiltrated with leucocytes. Glands are in state of disintegration, lumen being filled with leucocytes. Cotyledons are necrotic.	Pyometra, persistent corpus luteum.
No. of calvings	2				
Date and nature of last calving	12.9.46 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	Yes Positive				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served five times: 13.11.46; 5:12:46 18:12:46 7:1:47 27.2.47. No unusual discharge; settled at first service in previous lactation.				

Case No. 18 Identification No. 851 Date of Slaughter. 10.4.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 5 No. of calvings 2 Date and nature of last calving 12.2.46. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? ? Has the cow been vaccinated against Cont. abortion? ? History of services after last calving, etc. Served six times as follows - 10.4.46, 28.4.46, 3.6.46, 23.6.46 Irrigated with iodine 15.7.46 served 25.8.46 Irrigated with iodine 8.11.46 Not in calf 1.3.47 Sold for slaughter 8.4.47.	Cervix 8.2 x 3.6 cms. Thick firm walls, first cervical fold protrudes far into the vagina, caval and os uterus show pin-head like glistening cysts protruding from the surface of mucosa. Body 5.4 cms. Right horn 28x4 cms. thickness of wall 1.4 cms. Both horns are symmetrical with flabby walls. Mucosa greatly thickened, smooth, covered with a glairy tenacious mucus in a thin layer. The cotyledons are barley to bean sized. The mucosa is studded with punctiform to pin-head like glistening greyish white cysts mostly confined to lower and middle third of the horn. Contains mucinous substance. Fallopian tubes both are distended with clear mucoid exudate.	Right ovary - 5x3.9x3.4cms. the whole of the ovary is occupied by a thick walled cyst, containing clear yellow tinged fluid. Left ovary- 3x2.4x1.9cms. Has many small follicles on surface.	Uterus - Epithelium is intact in most sections. Cystic dilatation of deep glands, hyperplasia of endometrium.	Hyperplastic endometritis; cystic ovary (right).

Case No. 19 Identification No. 850 Date of Slaughter. 10.4.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 3 Date and nature of last calving 7.8.46. Normal Has the cow ever aborted? Yes, third pregnancy on 29.6.45. Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Served twice (1) 20.8.46. Uterus irrigated with iodine solution on 8.11.46. Corpora lutea were expressed from both ovaries on 17.12.46. (2) Served on 21.12.46. Found to be not pregnant on 1.3.47.	Vaginal mucosa shows chronic thickening and rough surface. Cervix 7 x 4 x 2 cms. Thickness of walls 3 cms., firmer than normal; os uteri and 1st cervical fold are inflamed. Mucosa is brick red dry. Body 3.1 cms. Right horn 36 x 5 cms. Thickness of wall 1.5 cms. The serosa is highly inflamed with reddish patches all over. Mucosa is thickened and brick red, smeared with greyish slimy exudate. Cotyledons size of a large pea with depressed necrotic looking centres small areas of desquamation here and there. Fallopian tubes - thick, fluctuous contain yellowish slimy fluid.	Right ovary 3.8 x 2 x 1.6 cms Has one pea sized developing follicle and a half pea sized regressing corpus luteum Left ovary - 3.2 x 2.6 x 2.1 The surface is covered by many small barley sized follicles. On section the ovarian tissue is firm and greyish pink in colour.	Uterus - epithelial desquamation common, squamous metaplasia, connective tissue infiltrated with lymphocytes and plasma cells. Glands are in a state of desquamation, the lumen being filled with cell debris.	Catarrhal endometritis; bilateral salpingitis; cervicitis.

Case No. 20 Identification No. 852 Date of Slaughter. 10.4.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 8 No. of calvings One Date and nature of last calving 28.10.42 Retained placenta removed manually. Has the cow ever aborted? Yes, four times 14.8.42; 31.8.44; 21.6.45; 27.3.46; Has the cow been blood tested for Brucella infection? Yes, positive Has the cow been vaccinated against Cont. abortion? ? History of services after last calving, etc. Served thrice every time ended in abortion as stated above. Disposed of because of bad history of abortions.	Vagina - normal. Cervix - 5.2 x 3 cms. wall thickness 1.8 cms Flabby, relaxed, with the 1st cervical fold showing chronic thickness of mucosa. Right horn - 33x3 cms. Thickness of wall 1.1 cm. Left horn - 35 x 3 cms Thickness of wall 1.2 cm. Mucosa is smooth, thick, covered with yellowish catarrhal exudate. Cotyledons not visible. Fallopian tubes show slight thickening of walls, contain yellowish slimy discharge	Right ovary - 3.6 x 2.1 x 1.9 cms. Smooth even surface. Left ovary - 3.4 x 2.4 x 1.2 cms; one developing pea-sized follicle and a half-pea sized yellowish brown corpus luteum, projecting on the surface½	Uterus - epithelium intact. Interstitial connective tissue is increased in thickness being heavily infiltrated with granulation tissue. Glands are compressed in small groups and are much decreased in size.	Catarrhal endometritis salpingitis.

Case No. 24 Identification No. 887 Date of Slaughter. 19.4.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	4	Vagina - normal. Cervix - 7 x 3.6 cms. wall thickness 1.8 cms. Body 4 cms. Right horn 33 x 4 cms. wall thickness 1.1 cms. Left horn 25 x 3 cms. wall thickness 1.2 cms. Serosa is normal. Mucosa is smooth, brick red, lumen contains about 150 c.c. of thin soupy exudate. Cotyledons - are small half-pea sized, with greyish yellow summits. Right fallopian tube - narrow, flexuous. About 2 inches from the cornual end, there is a tense cyst - 1 cm. in diameter, immediately beside the wall of the tube, but not communicating with it. Left fallopian tube - normal.	Right ovary - 3.5 x 2 x 2 cms. Regressing Corpus luteum, 1 x $\frac{1}{2}$ cm. above the surface of the ovary, yellowish brown in colour and also three small barley sized follicles. Left ovary - 4 x 2 x 2 cms. Traces of Corpus luteum and three lentil sized follicles.	Uterus - Endometrium shows squamous metaplasia prominently in all sections.	Catarrhal endometritis. External cysts on the side of right Fallopian tube.
No. of calvings	?				
Date and nature of last calving.	?				
Has the cow ever aborted?	?				
Has the cow been blood tested for Brucella infection?	?				
Has the cow been vaccinated against Cont. abortion?	?				
History of services after last calving, etc.	?				

Case No. 26 Identification No. 808 Date of Slaughter. 19.4.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Vaginal mucosa is thickened, but smooth. Cervix - 10.5 x 5 cms. wall thickness 2.5 cms. Body 6.5 cms. Right horn 40 x 5 cms. wall thickness 1.6 cms. Left horn 39 x 4 cms. wall thickness 1.6 cms. Serosa is normal. Mucosa is thick, studded with penny sized haemorrhagic areas. Cotyledons are large pea sized, with greyish yellow depressed centres. The mucosa is covered evenly with a greyish slimy fluid. Fallopian tubes are normal.	Right ovary - 3x2.2 x 2 cms. Has one follicle 0.5 cms. in diameter and a regressing Corpus luteum. Left ovary - 3x1.8 x 1.2 cms. It is almond shaped and firm. The surface is uneven owing to depressions and small lentil sized follicles.	Uterus - epithelial desquamation, areas of stratification and glandular degeneration, with lymphocytic infiltration.	Catarrhal endometritis.

History not available.

Case No. 31 Identification No. FDL 361 Date of Slaughter. 11.6.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 4 No. of calvings 2 Date and nature of last calving March 1946. Has the cow ever aborted? ? Has the cow been blood tested for Brucella infection? ? Has the cow been vaccinated against Cont. abortion? ? History of services after last calving, etc. Not served.	Cervix - 8 x 3.5 cms. wall thickness 1.5 cms. Mucosa - normal. Body 3.3 cms. Both horns are symmetrical in appearance, 20 x 7 cms. wall thickness 0.6 cms. The genital tract appears rather disproportionate when compared to the cervix and body the horns appear small. Mucosa is dirty brown covered with a thin soupy fluid, with numerous yellowish floccules. Volume of exudate about 200 c.c. Cotyledons are about the size of small peas. Fallopian tube normal.	Right ovary - 3 x 2.5 x 2 cms. One small pea sized follicle and an yellowish brown Corpus luteum. Left ovary - 3 x 2 x 1.6 cms. Surface shows many small glistening lentil sized follicles.	Uterus - endometrium shows areas of squamous metaplasia 6 - 8 layers thick.	Catarrhal endometritis.

Case No. 32 Identification No. 526 Date of Slaughter. 20.6.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	4½	Cervix 10.5 x 7.5 cms. closed with plug of mucus. Right horn 60 x 40cms. Left horn 20 x 10 cms. The right is gravid. The foetal fluids are milky in consistency and are mixed with muco-purulent masses. The foetus is 26 cms. long, soft, friable comes off in bits. The foetal membranes and cotyledons are in a state of disintegration and necrosis. Inter-cotyledonary area of the endometrium appears normal. Fallopian tubes - normal.	Right ovary has Corpus luteum 2 cms. in diameter and protruding from the surface to a height of 2 cms. colour - chocolate to yellowish. Left ovary is small and sclerotic.	Cotyledons show necrotic changes, with heavy infiltration of leucocytes.	Pyometra (apparently pregnant uterus).
No. of calvings	2				
Date and nature of last calving	12.11.46. normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	Yes positive.				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served twice last being on 18.1.47				

Case No. 36 Identification No. 36 Date of Slaughter. 2.7.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 10 No. of calvings 7 Date and nature of last calving 8.8.46 Normal but retained placenta Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? ? History of services after last calving, etc. Served repeatedly; ovaries were massaged three weeks ago and served again without success	Cervix - 7 x 3 cms. wall thickness 1.5 cms rigid and closed. Body 2.5 cms. Right horn - 37 x 4 cms wall thickness 1.4 cms Left horn - 36 x 4 cms. wall thickness 1.5 cms. The serosa shows reddish yellow discolouration. The walls are thick and tumefied. The cavum uteri is partially filled with a greyish soupy fluid, measuring about 220 cc. Mucosa is greyish brown, thickened has small areas of erosions. Cotyledons are pea like with greyish black surface. Both Fallopian tubes are highly convoluted thickened 9 mm. in diameter filled with greyish exudate. Mucosa is pale studded with pinhead sized inflammatory areas.	Right ovary - 4 x 2 x 2.9 cms hard, with small velvetty growths on surface. On section shows small follicles and remains of corpus luteum. Left ovary - 3.8 x 2 x 2 cms. one mature follicle 1.2 cm. in diam. and a pea sized regressing corpus luteum.	Uterus - epithelial desquamation with increased lymphocytic infiltration of the endometrial stroma; glandular epithelium shows degenerative changes.	Catarrhal endometritis; bilateral salpingitis ovaritis.

Case No. 41 Identification No. 9 Date of Slaughter. 9.7.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	3½	Cervix 6 x 2.6 cms. closed and appears normal. Body 2.5 cms. Right horn 35 x 4 cms Left horn 35 x 4 cms Serosa and walls appear rather tense - The mucosa is covered over with thick muco-purulent exudate especially on and around the cotyledons which are large pea sized. The mucosa shows reddish inflammation patches. Fallopian tubes are normal.	Right ovary has one large follicle and a small pea-sized corpus luteum. Left ovary is smaller and has scars of corpora lutea.	Endometrium shows areas of epithelial desquamation and necrotic changes, mainly in and around the cotyledons; glands are in a state of disintegration and are surrounded by leucocytes.	Sub-acute suppurative endometritis.
No. of calvings	1				
Date and nature of last calving	October, 1946 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes				
History of services after last calving, etc.	Served, the last being on 24.6.47.				

Case No. 42 Identification No. 12 Date of Slaughter. 9.7.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3½ No. of calvings 1 Date and nature of last calving May 1946 normal, calf died within a week. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. No.	Cervix 7 x 5 cms. wall thickness 2.3 cms. Mucosa pale, 1st cervical fold is ectropic and covered with dirty slate grey mucoid exudate. Body - 4 cms. Right horn - 40 x 4.5 cms. wall thickness 1.5 cms. Left Horn - 40 x 4.5 cms. wall thickness 1.0 cms. wall of the right horn is thick and tense with reddish brown serosa. Mucosa is covered with thick pea soup like exudate, foul odourous. Cotyledons are not visible. Mucosa is thick and roughened. Fallopian tubes are normal.	Right ovary, 3.5 x 2 x 2 cms. Surface shows three pea sized follicles. Left ovary - 4 x 2 x 2 cms. Has one Corpus luteum yellowish grey 1 cm. in diameter and ½ cm. in height. Also has three small barley sized follicles.	Uterus - endometrium shows degenerative changes in the epithelial structures. Stroma and glands show heavy lymphocytic infiltration.	Catarrhal endometritis.

Case No. 43 Identification No. 13 Date of Slaughter. 9.7.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years $3\frac{1}{2}$ No. of calvings Nil Date and nature of last calving - Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. The heifer was served successfully in January, 1946 showed signs of pregnancy and was expected to calve in October. As she did not calve far beyond the expected date, she was fattened and slaughtered	Cervix is stenosed and closed with uterine seal of mucus. Right horn 68 cms long x 50 cms. in circumference. Left horn 13 cms. long x 6 cms in circumference. The right horn is greatly enlarged and simulates pregnancy. Serosa shows greyish black discolouration on palpation in addition to fluctuation, hard bony structures grating against one another are felt. On section the uterus is found to be packed with light creamy pus mixed with macerating remains of a fully developed foetus. The soft tissues are decaying, leaving free the skeleton. The pus is foul-smelling and is about 20 litres in volume. Cotyledons are represented by shallow necrotic areas. Mucosa bluish black, necrosed with a nodular surface. Fallopian tubes are thickened and distended with pus.	Right ovary 4.5 x 2 x 2 cms. Has a yellowish pink corpus luteum 2.1 cms. in diam. embedded in the substance of the ovary; difficult to enucleate. Left ovary 4 x 1.5 x 1.5 cms. has one large sized follicle and a few smaller ones on the surface; remains of corpora lutea are also seen.	Endometrium shows extensive areas of necrosis; glands are more or less destroyed; purulent tracts are seen in the endometrium and myometrium; a few glands surrounded by dense connective tissue infiltrated with neutrophils, lymphocytes and round cells are seen in the myometrium.	Chronic suppurative endometritis (pyometra) bilateral salpingitis; persistent corpus luteum.

Case No. 45 Identification No. 17 Date of Slaughter. 9.4.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3 No. of calvings 1 Date and nature of last calving December, 1946 normal. Has the cow ever aborted? Is said to have aborted about 4 weeks before slaughter. Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not known.	Cervix 9 x 9 cms. closed with a plug of mucus as seen in pregnancy, anterior vagina contains a small amount of thick muco-purulent discharge. Body 30 cms. long, 56 cms. in circumference. Right horn 31 cms. long and 30 cms. in circumference; Left horn 21 cms. long and 15 cms. in circumference. The body is greatly enlarged, the horns are pouch like, folded anteriorly. Serosa is sticky and greyish black On palpation the uterus is doughy with slight fluctuation. The cavum uteri contains about 20 litres of evil smelling creamy pus mixed with blackish floccules. Neither foetus nor foetal membranes are seen. The uterine wall is thin, mucosa necrosed, bluish black with ulcerated areas; cotyledons are bean like and necrosed. Fallopian tubes highly fluctuous, thickened and filled with creamy purulent material.	Right ovary 3.8 x 2.6 x 2 cms. has one large Corpus luteum 3.2 x 2 cms. partly embedded in the ovary and only small portion 0.7 cms. in height protruding from the surface. Left ovary 2 x 1 x 1 cms. sclerotic, contains a few lentil sized follicles.	Epithelium and sub-epithelial layers show necrotic changes, with a heavy infiltration of leucocytes. Periglandular infiltration of leucocytes. Myometrium shows degenerative changes and purulent tracts and areas of necrosis and glands. Cotyledons show advanced necrosis.	Acute suppurative endometritis; bilateraly pyosalpingitis; persistent Corpus luteum (right ovary).

Case No. 46 Identification No. 196 Date of Slaughter. 16.7.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 4 No. of calvings One Date and nature of last calving August, 1945 Normal Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes in 1944 History of services after last calving, etc. Never sought the bull. Always had a discharge, thick whitish, creamy in colour.	Cervix 5.8 x 3.2 cms. wall thickness 1.5 cm. Normal. Body 5 x 3 cms. Right horn 18 x 8 cms. wall thickness 3.4 cms. Left horn 20 x 8 cms. wall thickness 3 cms. The free extremity of the horns are folded and enclosed in a mass of adhesions Mucosa is dark brownish has no cotyledons; thick yellowish catarrhal exudate fills the narrow cavum uteri. Both the fallopian tubes are enclosed in adhesions and are highly convoluted with thick hard walls. diameter 1 cm. contain straw-coloured fluid.	The ovaries are not recognisable as such, as they are both enclosed along with their bursae in thick flaky growths. On section the parenchyma is not recognisable; it is replaced by a yellowish cheesy mass, resembling pus. No bacteria were seen; on examination (microscopic) after Gram's and Ziehl-Neelsen's staining.	Endometrium shows epithelial desquamation; thickening of connective tissue stroma with an infiltration of lymphocytes and fibroblasts. Muscular layer is highly thickened and fibrosed.	Catarrhal endometritis perimetritis Hydrosalpinx periovaritis.

Case No. 47 Identification No. 198 Date of Slaughter. 16.7.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	7	Cervix 8 x 3.5 cms wall thickness 1.5 cms Normal Body 4.5 cms. Right horn 26 x 3 cms. wall thickness 0.9 cms Left horn 32 x 4 cms. wall thickness 1.0 cm. Serosa - normal. Mucosa is smooth, pale brown, covered with a thick pea-soup like exudate, mixed with shreads of tough mucus Fallopian tubes - normal.	Right ovary 4.2 x 2.5 x 2.1 cm contains one large fully developed corpus luteum measuring 1.8 cms in diameter and 1.3 cms. high brownish yellow, easily enucleated. Surface has four small barly sized follicles. Left ovary - 3.8 x 2.2 x 1.8 cms. Contains regressing corpora lutea and lentil sized follicles.	Uterus - endometritium shows slight infiltration of lymphocytes and plasma cells; glands are about normal. Chronic inflammatory changes are not pronounced.	Catarrhal endometritis.
No. of calvings	4				
Date and nature of last calving	March, 1945				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served repeatedly but proved sterile.				

Case No. 49 Identification No. 2 Date of Slaughter. 20.8.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years ?	Cervix - 9 x 7 x 3 cms os uterus is greatly enlarged and hard. Mucosa is pale, moist. Right horn 33 x 4 x 1.8 cms. Left horn 33 x 3.5 x 1.6 cms. The walls in general are thick and tense. Mucosa is thick, oedematous, dull brown, with greyish yellow penny sized patches all over; cotyledons are reduced to small, lentil sized elevations with blackish necrotic surface. The mucosa is covered thickly with greyish catarrhal exudate thick in epithelial cells. The reaction is more advanced in the right and appears to spread to the left horn via the body of the uterus. Fallopian tubes normal in appearance.	The ovaries are enclosed in their respective bursae being covered with inflammatory growths; one can hardly make the condition of the ovaries externally. Right ovary on section contains a follicle ½ cm. in diameter and regressing corpora lutea. Evidently it has been functioning normally. Left ovary has many small follicles on surface.	Uterus - extensive areas of epithelial desquamation; local areas of squamous metaplasia. Glands in a state of disintegration with their lumen being filled with cell debris. Slight infiltration of myometrium with fibroblasts.	Catarrhal endometritis. Bilateral ovaritis and bursitis.
No. of calvings ?				
Date and nature of last calving ?				
Has the cow ever aborted? ?				
Has the cow been blood tested for Brucella infection? ?				
Has the cow been vaccinated against Cont. abortion? ?				
History of services after last calving, etc. This animal had been sterile with no apparent lesions and had been examined by sterility officers. Slaughtered because of incurable sterility. Aetiology - ?				

Case No. 56 Identification No. 118 Date of Slaughter. 9.9.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	9	Cervix 10 x 6 cms. thickness of wall 2.5 cms. thickened, indurated and partially open, contains thick mucoid discharge. Horns 40 x 4 cms. thickness of wall 1.5 cms. the horns are symmetrical in their appearance with flabby walls, serosa shows patches of reddish discolouration. Mucosa is pale brown, lustreless; greyish, translucent, pin-head to barley sized greyish cysts are seen just protruding from the mucosal surface, which is covered with a thick coating of glairy, stringy mucus. Cotyledons are pea-sized with greyish brown surface. Fallopian tubes - normal.	Right ovary - 5 x 3.8 x 3.3cms. contains one large (2.8 cms in diameter) thick walled cysts, which is difficult to rupture. No Corpus luteum. Left ovary, small firm almond shaped, smooth surface. On section shows small follicles.	Uterus - endometrium is markedly thickened, deep glands are cystic and dilated, round to ovoid in shape, lined by cuboidal to flat epithelium.	Hyperplastic endometritis. Cystic ovary (right).
No. of calvings	6				
Date and nature of last calving	Sept. 1946. Normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Developed severe symptoms of nymphomania and was a nuisance to the other cows in the herd hence slaughtered.				

Case No. 57 Identification No. 102 Date of Slaughter. 9.9.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years $7\frac{1}{2}$ No. of calvings 5 Date and nature of last calving 15.4.47 Normal but retained placenta. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Served three times, last being 15th August She was generally difficult to settle	Cervix - 6 x 3.5 cms. wall thickness 1.6 cms normal. Right horn 38 x 4 cms. wall thickness 1.0 cms. Left horn, " Serosa normal. The mucosa is covered with a cloudy albuminous fluid measuring about 150 cc. The left horn contains more exudate and advanced lesions. The mucosa is oedematous with punctiform erosions Cotyledons - split pea like with brownish grey areas. Fallopian tubes are normal.	Right ovary 2 x 1 x 1 x 1.8cms Has one developing follicle and remains of regressing corpora lutea. Left ovary 2.9 x 1.8 x 1.2 cms. surface shows depressions and elevations. On section shows small follicles but no corpus luteum.	Endometrium shows epithelial desquamation with areas of squamous metaplasia 6 - 8 layers thick. Perigländular infiltration of cells, and destruction of the superficial glands.	Catarrhal endometritis.

Case No. 58 Identification No. 130 Date of Slaughter. 9.9.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	7	Cervix 8 x 3 cms. relaxed, mucosa is pale yellow, canal contains glairy clear mucus. Right horn 50x4 cms. Left horn 45 x 3.5 cms. Both horns are thickened with tense walls and serosa. Mucosa is pale lustreless, rough and smeared with yellowish purulent exudate. Cotyledons are bean like with depressed necrotic centres about 5 m.m. in diameter. Fallopian tubes - normal.	Right ovary has a developing follicle 1 cm. in diameter and a Corpus luteum measuring 1.5 x 1 cms. Left ovary 1 x 0.6 x 0.6 cms. small, sclerotic.	Endometrium shows epithelial necrosis and leucocytic infiltration of connective tissue. Local areas of squamous metaplasia is also evident. Cotyledons show advanced necrotic changes.	Sub-acute suppurative endometritis.
No. of calvings	4				
Date and nature of last calving	April 1947 normal, but retained placenta.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Cow showed "whites" after last calving; was served twice the last being on 10th July.				

Case No. 59 Identification No. 121 Date of Slaughter. 9.9.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	4	Cervix 7 x 4 cms. Mucosa pale yellow with tenacious mucoid discharge. Right horn 46x 4 cms. thickness of wall 1.2 cms. Left horn 42 x 3.5 cms. thickness of wall 1cm. The walls are a little tenser than normal. Mucosa is brick red and petechiated. Cotyledons are bean like greyish black, surrounded by thick coloured muco-purulent exudate. Underneath the pus punctiform necrosis is seen. Fallopian tubes are normal.	Right ovary .3 x 2.5 x 2cms. has small follicles and regressing Corpora lutea. Left ovary 2.8 x 2 x 2 cms. firm, uneven surface, covered with lentil sized follicles.	Necrosis of cotyledons and their surrounding areas is prominent. The intercotyledonal structures show inflammatory changes.	Sub-acute suppurative endometritis.
No. of calvings	1				
Date and nature of last calving	February 1947 normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes				
History of services after last calving, etc.	Not served.				

Case No. 61 Identification No. 68 Date of Slaughter. 15.9.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	7	Cervix 4.5 x 2.8 cms. wall thickness 1.3 cms. Right horn 40 x 3.8 cms wall thickness 1.6 cms. Left horn 40 x 3.8 cms wall thickness 1.6 cms Serosa is normal mucosa is light pinkish oedematous; cotyledons are large bean-shaped and show a diffuse elevation; surface is mottled with greyish yellow spots. Fallopian tubes. Right is highly thickened, to 1 cm., in diameter, filled with thick yellowish floccules. Left is similar but less thick.	Right ovary - 1.5 x 1 x 1 cm. Surface has small lentil sized follicles. Left ovary - 1.5 x 1 x 1 cm. Firm, smooth surface.	Endometrium shows epithelial desquamation confined to cotyledons. Interstitial stroma infiltrated with granulation tissue.	Catarrhal endometritis. Bilateral salpingitis.
No. of calvings	4				
Date and nature of last calving	24.1.47 Normal but retained placenta				
Has the cow ever aborted?	Yes, 12.2.45.				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served three times; was always difficult to settle.				

Case No. 64 Identification No. 31 Date of Slaughter. 15.9.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	6	Cervix 9 x 4.5 cms. thickness of wall 2.2 cms. partially open and contains stringy tough glairy mucus. Right horn 36 x 4.5 cms. thickness of wall 2cms. Left horn 34 x 4.5 cms. thickness of wall 2 cms The walls are thick and tense. Mucosa is about 8 m.m. thick pale brown, smooth, with small greyish areas all over it. Lumen is partially filled with a tough glaisy mucus which is sticking tenaciously to the mucosa. Fallopian tubes - normal.	Right ovary 5x2.5x2.5cms. is lemon shaped, fluctuates is almost completely occupied by two cysts which are divided by a septum, and contains clear fluid; has no Corpus luteum Left ovary is small and sclerotic.	Uterus - epithelim is intact; superficial areas of necrosis; cystic dilatation of deep glands, which are of various shapes and sizes; hyperplasia of connective tissue.	Hyperplastic endometritis cystic ovary (right).
No. of calvings	3				
Date and nature of last calving	25.1.47. Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Not known. No history of discharge from cervix.				

Case No.71 Identification No. 34 Date of Slaughter. 24.9.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 15 No. of calvings 11 Date and nature of last calving April, 1946. Normal. Has the cow ever aborted? ? Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Served frequently, was running with the bull all summer; showed "whites" after calving; was examined by a veterinary surgeon, uterus was washed out two or three times but the treatment did not help.	Cervix - flabby partially open, with a pale brownish mucosa. Body 7.5 cms. Both the horns are uniformly enlarged to a length of 50 cms. with a circumference of 18 cms. Serosa - lustreless with reddish yellow inflammatory patches. Walls are soft, toneless friable, break up to pieces when pressed by handle of a forceps or even by fingers. The lumen contain about 150 cc. of foul-smelling, greyish white curdy exudate, resembling infected lochial discharge. Mucosa atrophic, with a rough, pitted, brick-red surface; cotyledons are not seen. Fallopian tubes are apparently normal.	Right ovary 6 x 5 cms. consists of two thick walled cysts of 2.5 cms each containing clear fluid. Both the cysts are separated by a thick complete septum; corpus luteum not seen. Left ovary 2.8 x 2.5 x 2 cm. Has one pea-sized corpus luteum and a few lentil sized follicles.	Endometrium - shows atrophic changes. The epithelium is necrosed and replaced by a thick cell debris and pyknotic nuclei; superficial glands are absent or in a state of disintegration. Blood vessels show intimal thickening; myometrium shows degenerative changes.	Atrophic endometritis cystic ovary (right).

Case No. 73 Identification No. FHT 58 Date of Slaughter. 24.9.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	8	Cervix 10 x 10 cms. thickness of wall 3.5 cms. thick rigid walls. Body 10 cms. Horns 15 x 6 cms. thickness of wall 1.6 cms. The uterus is disproportionate in that the body is large and the horns are pouch like and end abruptly into the fallopian tubes. Serosa is inflamed walls are doughy and soft. The lumen of the horns and body is packed with a stringy, tough glairy mucus resembling the cervical seal of mucus, odourless, difficult to dislodge or break up. The whole of it comes as a mould intact. The mucosa is pale brown, smooth, with marked thickening. Fallopian tubes are thick and distended with mucoid exudate.	Right ovary is ovoid 5 cms. in diameter, fluctuates, is completely occupied by a thick walled cyst, containing clear fluid. No Corpus luteum is visible. Left ovary 2.5 x 1.2 x 1 cms. firm and sclerotic.	Marked hyperplasia of endometrium with prominent cystic dilatation of uterine glands. Epithelium intact. Interstitial stroma is increased in amount.	Hyperplastic endometritis; cystic ovary (right). bilateral salpingitis
No. of calvings	4				
Date and nature of last calving	30.9.46. Normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes, 1942.				
History of services after last calving, etc.	Not served.				

Case No. 82 Identification No. 108 Date of Slaughter. 8.10.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	9	Vaginal mucosa shows inflammatory streaks covered with creamy pus. Cervix 6 x 4cms. rigid and closed. Horns are tubular and 30 cms. in length. Serosa is normal. Endometrium is pale pink, smooth and moist. Clumps of yellowish muco-purulent exudate is scattered all over the right horn especially around the cotyledons which are bean like with a blackish necrotic surface. Fallopian tubes are normal.	Right ovary has small follicles only. Left ovary has one follicle about 1.3 cms. in diameter and split pea like remains of Corpus luteum.	Cotyledonary mucosa is necrosed and the base of the cotyledon is heavily infiltrated with leucocytes. Blood vessels are dilated. Intercotyledonary areas show oedematous changes.	Sub-acute suppurative endometritis, vaginitis.
No. of calvings	6				
Date and nature of last calving	December 1946 normal.				
Has the cow ever aborted?	Yes. aborted six weeks before slaughter.				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Not served.				

Case No. 83 Identification No. 173 Date of Slaughter. 8.10.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	10	Vagina is stenosed, mucosa is brick red with greyish areas covered with mucoid discharge. Cervix is partially open and contains muco-purulent slimy discharge in the canal. Body 4 cms. Right horn 33 x 4 cms. thickness of wall 1.2 cms. Left horn 30x4cms. thickness of wall 1.0 cms. serosa shows reddish inflammatory patches. Mucosa is of a dull brick red colour, thickened, lustreless and smeared with slimy muco-purulent exudate. Cotyledons are about the size of large peas, with dark necrotic spots on the surface. Fallopian tubes - normal.	Right ovary 3 x 2 x 2 cms. has one large thick walled cyst of 2 cms. in diameter; atrophic remains of Corpora lutea are also present. Left ovary 2 x 1 x 1 cms. Small, sclerotic has no follicles.	Endometrium shows various stages of necrosis; degenerative and necrotic changes are more advanced in the cotyledons. Myometrium shows slight oedematous changes.	Sub-acute suppurative endometritis with cystic ovary, vaginitis and cervicitis.
No. of calvings	6				
Date and nature of last calving	November 1946 normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	Yes Negative.				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Nil.				

Case No. 86 Identification No. 118 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia: Genital Tract	Post-mortem examination of genitalia: Ovaries	Histological Examination	REMARKS
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. History not available.	Vaginal mucosa is dirty red and covered with mucoid discharge. Cervix is partially open, admits index finger easily, contains sticky mucoid discharge. Body 4cms. Right horn 40x8cms. Left horn 35x6cms. Serosa is normal. Mucosa of right horn is smooth pink, with round to ovoid halfpenny sized, slightly raised cotyledons which appear to be in a state of involution. Mucosa is covered with blood stained slimy mucus. Left horn has smaller cotyledons and has no exudate. Right fallopian tube is thickened to 5 m.m. in diameter and is distended to about half its length from the cornual end with a purulent fluid. Left horn is normal.	Right ovary has many small follicles and regressing Corpora lutea. Left ovary is smaller than the right and has no Corpus luteum.	Endometrium is swollen and congested. There is a thick barrier of leucocytes under the epithelium, glands are dilated and surrounded by leucocytes.	Sub-acute suppurative endometritis.

Case No. 87 Identification No. 142 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 4 Date and nature of last calving 27.2.47 Normal Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. No definite history of services is known except that the cow was running with the bull.	Cervix is rigid and contains a purulent catarrhal discharge. Body 4.5 cm. long Rt. horn 42 x 4.5 cms. Left horn 50 x 5 cms. Serosa - normal. Mucosa pale, lustreless covered with a thin layer of muco-purulent soupy exudate. Cotyledons are not distinguishable. Fallopian tubes are normal.	Right ovary ovoid, 2 cms. in diameter Has small follicles and regressing corpora lutea. Left ovary resembles a lemon in size and shape - firm, with a smooth surface. On section the whole of the parenchyma is occupied by a greyish yellow corpus luteum. Measuring 5 x 2.5 cms. Corpus luteum is enclosed in its ovarian tunic.	Small areas of desquamation and necrosis with leucocytic infiltration; periglandular cellular infiltration; connective tissue shows oedema and cellular infiltration.	Subacute suppurative endometritis with persistent corpus luteum.

Case No. 88 Identification No. 119 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Vagina normal. cervix appears normal and is closed with a uterine seal of mucus. Uterine shows fluctuation and appears gravid. Right horn contains foetus 8 cms. in length. The foetal fluids are turbid purulent mixed with numerous yellowish flakes. Foetus is soft, and shows greyish black discolouration. Cotyledons are small. Endometrium is brick red, and oedematous and smooth. Fallopian tubes are normal.	Right ovary has Corpus luteum of pregnancy. It is 2.3 cms. in diameter and orange yellow in colour. Left ovary is firm, sclerotic; has pinhead sized follicles.	Uterine wall shows inflammatory changes, with necrosis of epithelium.	Pyometra. Apparently normal gravid uterus with infection of foetus and foetal fluids.

History not available.

Case No. 90 Identification No. 154 Date of Slaughter. 9.10.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	10	Cervix 10 x 6 cms. shows thickenings and fibrosis. Mucosa is yellowish brown and petechiated. Body 4 cms. Right horn 35 x 4 cms. Left horn 30 x 4 cms. walls are tense while, the serosa is inflamed. Endometrium is pale brown, oedematous while the cotyledons are small, about the size of a split pea with a greyish black surface. Small clumps of creamy muco-purulent exudate is found scattered on the mucosa especially around the cotyledons The Fallopian tubes are slightly thickened and contain mucoid exudate.	Right ovary 3.3 x 2.4 x 1.8 cms has one pea sized follicle and a small regressing corpus luteum. Left ovary 3.1 x 2.8 x 1.4 cms. has a few barley sized follicles and old corpora lutea.	Endometrium shows early degenerative changes while the epithelium of the cotyledons is necrosed and covered with pus.	Subacute suppurative endometritis with bilateral salpingitis.
No. of calvings	7				
Date and nature of last calving	16.12.46 Normal				
Has the cow ever aborted?	Yes, 1940				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Not served				

Case No. 91 Identification No. 154 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix 10 x 6 cms. cervical mucosais yellowish brown and petechiated. Canal is open and contains a catarrhal exudate. Both the horns are tubular and symmetrical with tense walls and reddish brown seras. They measure 35 x 5 cms The endometrium is pale brown smooth and sticky while the cotyledons are bean like and are covered by clumps of yellowish muco-purulent exudate. The exudation is more in the left horn. The Fallopian tubes are of normal size but are packed with a yellowish mucoid exudate.	Right ovary has small follicles and a regressing corpus luteum. Left ovary has lentil sized follicles.	Necrotic changes are continued to the cotyledons. Endometrium is infiltrated with lymphocytes and shows local areas of squamous metaplasia.	Sub-acute suppurative endometritis with bilateral salpingitis.

History not available

Case No. 92 Identification No. F.H.T. 171 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	History not available.	Cervix 12 x 6 cms. partially open and contains muco-purulent exudate mixed with flairy mucus. Body 5 cms. Right horn 30 x 3 cms thickness of horn 2 cms. Left horn 28 x 3 cms. thickness of horn 1.5 cms. Serosa is normal. The endometrium is yellowish pink with punctiform erosions. The cotyledons are bean-like and are covered with creamy exudate. All the cotyledons in the left horn are affected whereas only the lower third of the right horn shows similar changes. Fallopian tubes are normal.	Right ovary has small follicles and corpora rubra. Left ovary has one follicle of 1 cm. in diameter and a similar sized corpus luteum.	Epithelial desquamation and leucocytic infiltration of sub-epithelial structures. Cotyledons show necrosis of the superficial layers of mucosa. Myometrium shows infiltration with fibroblasts.	Subacute suppurative endometritis.

Case No. 93 Identification No. 156 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix is soft and flabby with a total absence of tone, mucosa thin, of a brick red colour with greyish spots, lustreless and rough. Right horn 28x3cms. Left horn 24x3cms. thickness of wall 1cm. The uterus presents a collapsed appearance, the serosa is of a yellowish brown discolouration. The walls are soft, with a complete lack of tone, friable, comes off in bits when pressed between fingers. The mucosa is atrophic, rough and pitted with a mottled appearance as though bran had been sprinkled on it. The lumen is occupied by four longitudinal thin ridges, covered with necrotic looking mucosa, the ridges come off in bits when handled. Cotyledons are absent. Fallopian tubes soft and atrophic.	Right ovary 6 x 3.5x3.5 cms. Has one large cyst of about 3.7cms. in diameter and another smaller cyst. Both are thick walled, difficult to rupture, contain clear yellowish fluid. Corpus luteum not seen. Left ovary 5 x 2.5 x 2.5cms. surface shows many barley sized follicles.	Marked atrophic changes in the endometrium, with its complete necrosis in some areas, glands are absent or filled with cell debris. Myometrium is also atrophic. intimal thickening of blood vessels is prominent, lumen of some vessels is almost completely obliterated.	Atrophic endometritis. Cystic ovary (right).

History not Available.

Case No. 94 Identification No. 175 Date of Slaughter. 9.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	History not available	Cervix is partially open and contains yellowish muco-purulent discharge. Body 5 cms. Horns 50 x 5 cms. thickness of wall 2 cms Serosa is reddish yellow Endometrium is thick pale and has pinhead like necrotic spots. Cotyledons are about the size of pea. The mucosa is lightly covered with creamy muco-purulent exudate Fallopian tubes. NORMAL	Left ovary has a freshly formed reddish soft corpus luteum about 4 days old. Right ovary small sclerotic.	Suppurative necrotic changes in the uterine wall.	Sub-acute suppurative endometritis.

Case No. 99 Identification No. 58 Date of Slaughter. 15.10.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	2½	Vaginal mucosa normal Cervix 10 x 6 cms. wall thickness 2.6 cms os uterus and anterior vagina contain yellowish cloudy thick catarrhal exudate. Horns 35 x 4 cms. wall thickness 1.0 cms. The horns are symmetrical in appearance, with flabby walls. Serosa presents yellowish red discolouration. Both horns are more or less completely filled with a greyish yellow exudate containing numerous yellowish flocoules. Volume of exudate 300 cc. Mucosa is light pink but shows punctiform erosions around cotyledons which are bean-sized. Fallopian tubes - normal.	Right ovary - 3.1 x 2.8 x 2 cms. Smooth surface Many small follicles under the capsule. Left ovary is ovoid 5 cms. in diameter. Contains a thick walled cyst with a diameter of 3.8 cms. Fluctuates but difficult to rupture. Also has a large embedded corpus luteum 2.5 cms. in diameter and 2.2 cms. in height. It is noteworthy that a cyst and a corpus luteum exist together. Cystic fluid - clear, colourless.	Endometrium shows scattered areas of epithelial desquamation with superficial areas of necrosis. Glands are slightly dilated. Connective tissue - shows oedematous changes.	Catarrhal endometritis; cervicitis; cystic ovary and persistent corpus luteum (both in left ovary).
No. of calvings	None				
Date and nature of last calving	-				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes, October, 1945.				
History of services after last calving, etc.	Not served; did not come on heat any time.				

Case No. 102 Identification No. 37 Date of Slaughter. 15.10.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	13	Vagina contains creamy muco-purulent discharge Cervix 12.5 x 5 cms. Body 6 cms. Right horn 30 x 4 cms. thickness of wall 2 cms. Left horn 26 x 3.5 cms. thickness of wall 1.8 cms. cervix is partially open, with a brick red mucosa, covered with muco-purulent discharge. Endometritium shows penny sized brick red patches. Cotyledons are 2-4 m.m. in diameter. Scattered over the mucosa are clumps of creamy muco-purulent exudate. Fallopian tubes are normal.	Right ovary 3.5 x 2.5 x 1.3 cms. Contains small follicles. Left ovary 6.3 x 5 x 5.2 cms. It is thick walled and shows slight fluctuation, contains yellowish fluid. When sectioned after fixation in formalin, shows a central cyst occupied by a translucent mass lined by a band of luteal cells to a thickness of 5-7mm. The diameter of the central cyst is 3.2 cms. at its widest part. Has one small follicle and two specks of Corpora rubra.	Epithelium shows desquamation and necrosis; focal areas of stratified epithelium is also present. Uterine glands are reduced in number and size and are surrounded by dense connective tissue stroma infiltrated with leucocytes.	Sub-acute suppurative endometritis with persistent (cystic) Corpus luteum.
No. of calvings	9				
Date and nature of last calving	February 1947 normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served, last service being in October.				

Case No. 108 Identification No. 202 Date of Slaughter. 22.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 8 No. of calvings 6 Date and nature of last calving Spring 1947. Normal. Has the cow ever aborted? Yes in 1943. Has the cow been blood tested for Brucella infection? No. Has the cow been vaccinated against Cont. abortion? No. History of services after last calving, etc. Not served.	Cervix 10x6.5 cms. thickness of wall 2.5cms. cervix is thick firm shows chronic inflammatory changes, and catarrho-purulent discharge. Right horn 30x5.5 cms. Left horn 20x5cms. thickness of wall 0.9cm. The uterus presents a collapsed appearance walls are soft and friable with a dirty discoloured serosa. Mucosa - dry, atrophic mottled with greyish yellow bran like spots and areas of necrosis. Cotyledons are present in the left horn and are small split pea sized, with black ink spots. Fallopian tubes are thickened to 9m.m. with soft walls. Mucosa brick red, atrophic; contains a small amount of curdy exudate.	Right ovary 3x1.8x1.4 cms. has many small developing follicles. Left ovary 2.8x1x1 cms. has one pea-sized follicle and a regressing corpus luteum.	Extensive necrosis of endometrium, glands are absent or in a state of disintegration. Intimal thickening of the blood vessels is prominent with atrophy of the myometrium.	Atrophic endometritis; bilateral salpingitis

Case No. 109 Identification No. 207 Date of Slaughter. 22.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3 No. of calvings One Date and nature of last calving November, 1946 Normal, retention doubtful. Has the cow ever aborted? Yes: about the 6th month of last pregnancy Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not put to the bull since she had a discharge after abortion. There is a history of abortion in this herd about 8 years back when almost every cow aborted in the 4th to 5th month of pregnancy.	Vaginal mucosa shows granular elevations and haemorrhagic streaks. Cervix - 10 x 6 cms. wall thickness 2.5 cms. partially open, first and second cervical; folds are protruding in the vagina; glairy sanguineous discharge all round the os uterus. The canal is inflamed, wall hard to cut through. Body 5 cms. Both horns are symmetrically enlarged - 30 x 6.5 cms wall thickness 1.8 cms The walls are thick and flabby with a slightly inflamed serosa. On section milky, catarrhal exudate containing yellowish flakes is found covering the mucosa to a depth of about 3 mm. Mucosa is dirty brick red, with streaks of inflammation and pitted surface. Cotyledons small split pea like with greyish white surface. Fallopian tubes normal.	Right ovary - 3 x 2 x 1.3 cms. firm to touch, contain minute follicles and traces of old corpora lutea. Left ovary - 3.5 x 2 x 2.5 cms Has two Graafian follicles placed side by side each one cm. in diameter and a small pea-sized corpus luteum resembling a firm clot of blood.	Uterus - Mucosa shows superficial areas of squamous metaplasia and desquamation. Glands are in a state of disintegration being filled with cell debris. Heavy lymphocytic infiltration of connective tissue stroma.	Catarrhal endometritis; vaginitis; cervicitis; Numerous Trichomon foetus seen microscopically on post-mortem examination of cervical and uterine exudate.

Case No. 115 Identification No. 204 Date of Slaughter. 28.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving History not available. Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix 8x6 cms. thickness of wall 2.5 cms. tightly closed with a plug of brownish mucus. Horns are symmetrical with a uniform enlargement measuring 20x4cms. thickness of wall 1.7cm. walls are thick and doughy to touch. The cavum uteri is packed with a jelly like chocolate coloured mucoid exudate. The mucosa is 3 to 4 times the normal thickness, dark brown with wrinkled appearance, has pin-head sized translucent glistening cysts partly embedded in the mucosa. Similar cysts are also seen in the cervical canal. Fallopian tubes - normal.	Right ovary 4x3x2 cms. ovoid to irregular in shape, firm. On section shows a thick fleshy walled cyst completely occupying the ovarian substance. Cyst contains clear yellowish fluid. Left ovary 2x2x1 cms. sclerotic with an uneven surface has small follicles.	Endometrium shows superficial necrosis of the sub-epithelial layers, hyperplasia of endometrial glands is seen prominently.	Hyperplastic endometritis; cystic ovary (right).

Case No. 119 Identification No. 251 Date of Slaughter. 28.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. History not available.	Cervix - 6.4 cms. wall thickness 1.8 cms. The mucosa shows brick red discolouration, contains glairy mucoid exudate. Body 4 cms. Right horn 30 x 3.5cms. wall thickness 1.4cms. Left horn 25 x 3 cms. thickness of wall 1.2 cms. The serosa of the right horn shows reddish inflammatory patches and the wall is tense. Mucosa is brick red and smeared with thick mucoid exudate. The lower third of the right horn shows prominent cotyledons measuring 1-1.5 cms. The middle and upper two thirds had no cotyledons. Left horn has a normal mucosa, the discharge is spreading to its lower third from its companion horn. Fallopian tubes - right is distended with mucus left is similar to right tube.	Right ovary 3.1 x 2. x 1.2 cms. Has one yellowish grey regressing Corpus luteum and a pea like follicle. Left ovary - almond shaped 2.3x 1.2 x 1 cms. Shows traces of Corpora lutea and minute follicles on surface.	Uterus - slight epithelial desquamation and round cell infiltration of connective tissue stroma.	Catarrhal endometritis; cervicitis, bilateral salpingitis.

Case No. 123 Identification No. 254 Date of Slaughter. 28.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix 5 x 3 cms. thickness of wall 1.4 cms. normal. Right horn 25x 3 cms. thickness of wall 0.9 cms. Left horn 24 x 3 cms. thickness of wall 0.9 cms. Serosa shows reddish yellow discolouration and is slightly thickened. Mucosa is oedematous, greyish brown penny sized patches. Cotyledons are absent. Lumen contains thick pea soup like exudate mixed with yellowish flakes. Fallopian tubes are normal.	Right ovary 3.4x 2 x 2 cms. Left ovary is ovoid 3.1 cms. in diameter. The whole ovary fluctuates and is thick walled, on section it is found the ovary is occupied completely by the cyst which is lined by a thin band of luteal cells about 2 m.m. in thickness. Contains a yellowish green turbid fluid.	Uterus - endometrium shows squamous metaplasia - 6 to 9 layers thick periglandular cellular infiltration slight thickening of blood vessels.	Catarrhal endometritis. Cystic ovary (left).

History not available.

Case No. 124. Identification No. 193. Date of Slaughter. 28.10.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. History not available.	Cervix is soft, flabby and inflamed, the first and second cervical folds are protruding into the vagina which contains a curdy discharge. Right horn 25x 3 cms. Left horn 24x 3cms. Thickness of wall 0.9 cms. The uterus presents a collapsed and boiled appearance. The walls are soft and friable. Mucosa atrophic, brick red in colour mottled with bran-like necrotic spots Cotyledons are small 5m.m. in height, come off in bits when handled. Fallopian tubes - normal.	Right ovary 3.8x 2.4x2.1 cms. Left ovary 3.2x 2x2.0 cms. has two small regressing corpora lutea and a developing pea-sized follicle.	Endometrium is completely necrosed being replaced by a structureless purulent mass containing deeply staining nuclei. Lumen of blood vessels is more-less completely obliterated.	Atrophic endometritis cervicitis.

Case No. 126 Identification No. 126 Date of Slaughter. 17.12.47

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 10 No. of calvings 7 Date and nature of last calving April, 1947. Normal but retained placenta. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Served four times, without success.	Cervix - 10 x 6 cms. thickness of wall 2.5 cms. partially open, contains thick mucoid exudate; mucosa is pale yellowish lustreless and thickened. Both horns are symmetrical, with thick flabby walls. 20 x 4 cm thickness of wall 1.5 cms. The lumen is filled with thick sauce-like whitish exudate, slimy to touch. Mucosa - pale and rough, lustreless. Cotyledons are absent. Smears reveal numerous catarrhal cells and Gram negative rods. Fallopian tubes normal	Right ovary resembles a fluctuating lobulated mass contains two large thick walled cysts each measuring 1.8 cms. in diameter separated by a thick septum, difficult to rupture, contains clear straw coloured fluid. Left ovary has one small cyst 0.9 cm. in diameter but thick walled. No sign of a corpus luteum.	Uterus - endometrium shows areas of, epithelial degeneration. Lymphocytic infiltration of connective tissue stroma.	Catarrhal endometritis; cervicitis; cystic ovary (right).

Case No. 128 Identification No. 135 Date of Slaughter. 6.11.47

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 5 Date and nature of last calving July, 1947 Normal Has the cow ever aborted? Pregnant after last calving but aborted in the 3rd month Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes History of services after last calving, etc. Was not served as the cow was showing discharge after abortion. Had suffered from Staphylococcal mastitis; no previous history of abortion in the herd	Vaginal walls are smeared with a greyish white catarrh. The mucosa has brownish black patches around the meatus and sides of the vagina. Cervix 9 x 5 cms. thickness of wall 2 cms. Inflamed flabby contains catarrhal exudate. Right horn 37 x 4 cms. wall thickness 1.5 cms Left horn 37 x 4 cms. wall thickness 1.1 cms Serosa is normal. Thick milky catarrhal exudate partially fills both horns about 75 cc. in each The exudate is not purulent. Mucosa shows penny sized reddish patches and rest of the surface is smooth and pinkish. Fallopian tubes - normal.	Right ovary 3.1 x 2 x 1.9 cms. Contain one small regressing corpus luteum and a small pea like follicle. Left ovary 3 x 2 x 2 cms. firm capsule shows traces of corpora lutea and small follicles.	Uterus - surface epithelium of body and horns shows mucoid degeneration and desquamated areas sub-epithelial layers are densely infiltrated with lymphocytes and a few leucocytes. The uterine glands show marked atrophic changes. The myometrium is oedematous.	Catarrhal endometritis, vaginitis, cervicitis, Trichomonas foetus seen in uterine and cervical exudates on post-mortem examination.

Case No. 131 Identification No. 103 Date of Slaughter. 5.11.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	6	Vagina contains a small quantity of opaque tenacious mucus. Mucosa is pale pink. Cervix 10 x 7 cms. thickness of wall 3.1cm os uterus contains catarrhal exudate. Body 10 x 3.1 cms. Right horn 20 x 3 cms. thickness of wall 1 cms. Left horn 20 x 2.8 cms. thickness of wall 0.75 cms. The right horn has bean sized cotyledons with greyish red mucosa, covered over with thick mucoid exudate. Mucosa of left horn is pale pink smooth, oedematous. The right horn appears to be in a state of involution. Both the Fallopian tubes are thick, firm - 7 mm in diameter; contain albuminous fluid.	Right ovary - 4 x 3 x 2 cms. firm in consistency has a corpus luteum 1 cm. in diameter and projecting on the surface to a height of 3 mm; dull yellowish in colour them. Has also a pea sized follicle. Left ovary - 4 x 3 x 1.8 cm. Has one mature follicle and a number of smaller ones.	Right horn - shows extensive thickening of the mucosa, with squamous metaplasia, glands are intact but are compressed by the tense connective tissue surrounding	Catarrhal endometritis; bilateral salpingitis; cervicitis.
No. of calvings	3				
Date and nature of last calving	8.4.1946 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served thrice without success, last service being in July, 1948.				

Case No. 133 Identification No. 126 Date of Slaughter. 5.11.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	8½	Cervix 8 x 6 cms. rigid, closed covered with mucoid discharge Right horn 36 x 4 cms. thickness of wall 1.2 cms. Left horn 33 x 4 cms. thickness of wall 1.2 cms. Serosa is normal. Endometrium is of a brick red colour with a pitted surface smeared over with a muco-purulent exudate. Cotyledons are about the size of a pea and of a greyish black colour containing creamy pus. Fallopian tubes are normal.	Right ovary has one regressing yellowish corpus luteum of 1 cm. in diameter Left ovary has one pea sized corpus luteum and four barley sized follicles.	Extensive necrosis of superficial layers of endometrium and disintegration of glands.	Subacute suppurative endometritis.
No. of calvings	6				
Date and nature of last calving	April, 1947 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes				
History of services after last calving, etc.	Not served.				

Case No. 134 Identification No. 130 Date of Slaughter. 5.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3 No. of calvings 1 Date and nature of last calving 12.1.47. Aborted an 8 months old bulldog calf. Has the cow ever aborted? Yes Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes History of services after last calving, etc. Served four times, last being on 14.7.47. Since last abortion her uterus has been irrigated several times.	Cervix 10x6 cms. thickness of wall 2.5 cms. Thick rigid walls, smooth pale mucosa smeared over with a yellowish mucoid exudate. Horns 33x5 cms. thickness of wall 1.5 cms. Serosa - normal. Mucosa is light pink, smooth and glistening. Cotyledons bean-sized. Lentil sized greyish translucent tubercles are present in the endometrium, the right horn has more of these than the left. Thick yellowish specks of mucoid exudate are sticking to the mucosa. The tubercles contain a greyish caseating material. These exudates are rich in acid-alcohol fast bacteria identical with mycobacterium tuberculosis. Fallopian tubes - normal.	Right ovary 4.3 x 2 x 1 cms., has small follicles and Corpora rubra. Left ovary 2 x 1x 1 cms., has two pea-like developing follicles.	Uterus - Typical tubercles are present just underneath the epithelium and in the interstitial stroma. Glands are also invaded by tubercles. Areas of ulceration filled with epitheliod cells are also common. Older lesions show caseation and areas of calcification. Typical acid-fast bacteria are seen in the lesions.	Tuberculous endometritis (primary).

Case No. 135 Identification No. 122 Date of Slaughter. 5.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 9 No. of calvings 6 Date and nature of last calving 16.4.47 Normal, but placenta retained Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not served.	Cervix 9 x 4.5 cms. Mucosa is brick red and shows ulcerated areas. Body 3.5 cms. Right horn 43 x 3.2 cms Left horn 42 x 3 cms. Serosa is greyish yellow. Uterine walls are soft and friable. Endometrium is pinkish yellow, atrophic, rough with a pitted surface. Cotyledons are about 2 - 4 mm. in diameter, with an eroded surface. Thick creamy muco-purulent exudate is scattered all over the mucosa and the cotyledons. Fallopian tubes are normal.	Right ovary 4.6 x 3.2 x 2 cms. has a large corpus luteum of 2.1 cm. in diameter firmly embedded in the ovarian stroma. Left ovary 4.4 x 2.2 x 1.5. Has many small follicles and remains of corpora rubra.	Purulent necrotic changes are prominent	Sub-acute suppurative endometritis with persistent corpus luteum.

Case No. 136 Identification No. 101 Date of Slaughter. 5.11.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	10	Cervix 10 x 6 cms. thickness of wall 2.5 cms. rigid walls with pale smooth mucosa, canal is partially open. Right horn 37x4.5cms. thickness of wall 1.9 cms. Left horn 35x4cms. thickness of wall 1.8 cms. Both horns present a normal appearance, though the walls are thick and tough. The cavum uteri is packed with a jelly like chocolate coloured odourless exudate. Mucosa is 3 to 4 times the normal thickness, brownish red colour, smooth punctiform to pin-head like glistening cysts are embedded in mucosa of middle and lower third of horn, and cranial extremity of cervix. Fallopian tubes normal.	Right ovary 3.9 x 3x2cms. The ovary seems to consist of only a large cyst 2.8 cms. in diameter with a thick tough wall, cystic fluid is clear with an yellowish tinge one small lentil sized follicle is also present, but has no Corpus luteum. Left ovary 2.1 x 1 x 1 cms. has many barley sized follicles on surface.	Uterine mucosa shows great thickening, with cystic enlargement of glands which are filled with mucin. Glandular epithelium is cuboidal to flat, glands are also seen encroaching upon the myometrium, which is also hyperplastic.	Hyperplastic endometritis, cystic ovary (right).
No. of calvings	6				
Date and nature of last calving	April, 1946. Normal.				
Has the cow ever aborted?	Yes, first calf.				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Was served all through 1946, without success; no evidence of oestrum in 1947.				

Case No. 140 Identification No. 102 Date of Slaughter. 5.11.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	10	Cervix 6x4.5 cms. thickness of wall 1.8 cms. partially open, contains mucoid discharge. Right horn 25x4 cms. thickness of wall 0.8 cms. Left horn 20x3cms thickness of wall 0.7 cms. serosa - yellowish brown. The horns are toneless, flaccid collapsed, flat; walls are soft, thin and friable, easily crushed between fingers. Mucosa - atrophic brick red, lustreless studded with necrotic pinhead sized spots. No exudate in the lumen. Fallopian tubes - 7mm. in diameter, kinked, contains curdy exudate.	Right ovary has one pea sized follicle and a regressing Corpus luteum on surface. Left ovary, sclerotic with an uneven surface due to small follicles.	Endometrium replaced by a structureless mass containing masses of pyknotic nuclei. glands are filled with cell debris and infiltrated with leucocytes Intimal thickening of blood vessels with atrophic changes in myometrium.	Atrophic endometritis. bilateral salpingitis.
No. of calvings	7				
Date and nature of last calving	26.12.46. Normal.				
Has the cow ever aborted?	Yes				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Not served.				

Case No. 143 Identification No. 16 Date of Slaughter. 12.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 5½ No. of calvings 2 Date and nature of last calving May, 1947 placenta retained Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not served. The cow was disposed off as she was a bad kicker.	Cervix 10 x 4 cms. Normal. Body 4 cms. Right horn 32 x 3 cms. Left horn 39 x 3 cms. Left horn is thicker than the right. The mucosa is smooth, pale pink. Cotyledons are ovoid about 2 cms in diameter slightly raised from the surface. The cotyledons show greyish areas of necrosis and are covered by muco-purulent exudate which is malodourous. Fallopian tubes are normal.	Right ovary 5 x 3 x 2.5 cms. has many barley sized follicles. Left ovary 5 x 3 x 2.5 cms. Has a light yellowish corpus luteum of 2.5 cms in diameter embedded in the centre of the ovarian stroma. Follicles are not visible macroscopically.	Suppurative changes mainly confined to the cotyledons.	Subacute suppurative endometritis with persistent corpus luteum.

Case No. 145 Identification No. 33 Date of Slaughter. 12.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix 7x5 cms. thickness of wall 2 cms. open with flabby walls. Right horn 28x3 cms. Left horn 26x3 cms. thickness of wall 0.9 cms. serosa - greyish blood, horns are collapsed, toneless, friable mucosa brick red, studded with necrotic and ulcerated areas covered with purulent material. Cotyledons are replaced by shallow necrotic areas about 6-8 m.m. in diameter. Fallopian tubes are apparently normal looking.	Right ovary 4x3x 2 cms. has two large corpora lutea 2.4x2.3cms. each. slightly projecting from the surface of the ovary, has a constriction or neck at the line of junction with the ovary. No follicles are seen. Left ovary 4x2.5x 2.3 cms. has regressing corpora rubra and small follicles.	Extensive desquamation and necrosis of epithelium. Contraction of the interstitial stroma and atrophy of glands. Intimal changes in the blood vessels.	Atrophic endometritis, persistent corpora lutea.

History not available.

Case No.150 Identification No. 7 Date of Slaughter. 12.11.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	5½	Cervix 8 x 4 cms. normal. Body 3.8 cms Right horn 37 x 4 cms. thickness of wall 2 cms Left horn 35 x 4 cms. thickness of wall 2 cms Both horns are symmetrical with tense thick walls. On section the cavum uteri is partially filled with a greyish purulent exudate containing blackish floccules. Endometrium is thickened and shows punctiform erosions. Cotyledons are about the size of peas with depressed necrotic areas. Fallopian tubes are normal.	Right ovary 3.6 x 2 x 2 cms. Has one follicle of 1.3 cms. in diameter and a corpus luteum of similar size protruding on the surface. Left ovary 3 x 2 x 2 cms. has several small follicles on surface.	Suppurative changes in the endometrium with extensive necrosis of cotyledons.	Sub-acute suppurative endometritis.
No. of calvings	2				
Date and nature of last calving	3.11.46 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes, as a yearling.				
History of services after last calving, etc.	In spite of ovarian massage and repeated services the cow remained sterile.				

Case No. 151 Identification No. 22 Date of Slaughter. 12.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 4 Date and nature of last calving 9.4.47 Normal Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes History of services after last calving, etc. Served on 16th July and 22nd, September but did not settle Slaughtered because of sterility.	Cervix 6.5 x 3 cms. thickness of wall 1.5 cms. Normal. Right horn 40 x 4 cms. thickness of wall 1.4 cms. Left horn 40x4 cms thickness of wall Serosa is normal. 1.5cm The walls are thick and tense. Mucosa is light pink to brownish. Cotyledons are absent and are represented by shallow areas up to 4 mm. to 8 mm. in diameter. The mucosa is thickly covered with a brownish yellow slimy exudate about 100 cc. in volume. Mucosa shows pinhead sized greyish erosions. Fallopian tubes - normal.	Right ovary 3.8 x 2.6 x 2 cms Has one pea sized follicle and a regressing corpus luteum. Left ovary - 3.6 x 2.4 x 2.1 Many lentil sized follicles are seen on section.	Uterus - epithelium is largely desquamated; the connective tissue stroma shows heavy infiltration with lymphocytes. The glands are much reduced in size and are surrounded by dense connective tissue stroma.	Catarrhal endometritis.

Case No. 153 Identification No. 74 Date of Slaughter. 19.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 12 No. of calvings 9 Date and nature of last calving March 1947 normal. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not served.	Vaginal mucosa shows inflammatory streaks. Cervix 7 x 4.2 cms. is flaccid and open, canal contains greyish foul smelling putrid discharge. Os uterus shows inflamed areas. Body 8 cms. Right Horn 20 x 5 cms. Left Horn 26 x 7 cms. thickness of wall 1.5 cms. The serosa is highly inflamed with petechial spots. The endometrium is inflamed with petechial spots and is covered over with a slimy muco-purulent exudate. The cotyledons are about 1 cm. in diameter with an eroded surface. The upper thrid of the left horn shows a melonotic area of 5.5 x 1 cm. The distal halves of the Fallopian tubes are distended (7m.m.) with purulent exudate. The pavilions and burnae are thickened, contains putrid discharge.	Right ovary 3 x 2 x 2 cms. Has a mature follicle, 1.3 cms. in diameter and a regressing Corpus luteum about 5 m.m. in diameter. Left ovary 2.5 x 2 x 2 cms. Has a large Corpus luteum of 2 cms. in diameter embedded in the substance. It is not visible on the ovarian surface. Difficult to enucleate.	Oedema of the connective tissue stroma with necrosis of superficial layers of endometrium.	Sub-acute suppurative endometritis, with persistent Corpus luteum, bilateral salpingitis pavilionitis and bursitis.

Case No. 154 Identification No. 52 Date of Slaughter. 19.11.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	16	Cervix - 6x3x2 cms. Mucosa shows brick red discolouration covered with thick mucus. Body 5 cms. Right horn 26 x 6 cms. thickness of wall 1.2 cms. Left horn 26 x 5.5 cms. thickness of wall 1 cm. Serosa normal. Mucosa is normal smooth, pinkish, covered with a mucoid exudate. Fallopian tubes are normal.	Right ovary 4.5 x 3.5 x 2.5 cms. Has one large corpus luteum embedded in the stroma 2 x 0.5 cms in size, pinkish brown in colour difficult to enucleate; one small barley sized follicle is also present alongside it. Ovary is enclosed in bursa which has tufts of inflammatory growths. Left ovary 3.5 x 2.5 x 2 cms. Has a follicle 1 cm. in diameter and a corpus rubrum 2 mm. in diameter Fallopian tubes are normal.	Endometrium shows chronic catarrhal changes, with squamous metaplasia.	Catarrhal endometritis with persistent corpus luteum and bursitis (right ovary).
No. of calvings	12				
Date and nature of last calving	July, 1946 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Never came on heat after last calving.				

Case No. 159 Identification No. 690 Date of Slaughter. 19.11.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	7	Vagina - normal. Cervix 8x5cms. has pale smooth mucosa, the os contains greyish tenacious mucus. Body 8x4cms. Right horn 28x5cms. thickness of wall 1.3 cms. Left horn 25x4.5cms. thickness of wall 1.2cms. Serosa is of a dirty brown colour moist and sticky. Endometrium is of a brick red colour. Cotyledons are about 6m.m. in diameter in the right horn while they are absent in the left horn. The mucosa is evenly smeared with a catarrhal exudate mixed with yellowish blumps of pus, being more around the cotyledons. The lower third of the Fallopian tubes are normal, while the middle and upper thirds including the pavilion are distended with a creamy pus like exudate. The broad ligaments are thickened and are covered by inflammatory growths. The peritoneum shows signs of suppurative inflammation.	Right ovary 3.4 x 2.2 x 2.2 cms. Has one large pea sized and two barley sized follicles on surface which also shows chocolate coloured soft adventitious growths. The ovarian bursa is thickened and adherent to the anterior pole of the ovary. Left ovary - 3.5 x 3 x 2.2 cms. ovary is soft and oedematous, surface has velvetty, chocolate coloured adventitious growths.	The uterus presents atrophic and degenerative changes in the epithelial structures. The stroma and some glands show evidence of suppurative infection as is shown by increased connective tissue infiltrated with polymorphonuclear and mononuclear types of cells. The myometrium shows fibrotic changes.	Sub-acute suppurative endometritis with salpingitis and bursitis. Peritoneum shows suppurative lesions. C. pyogenes was isolated from the uterus as well as the peritoneal lesions in pure culture.
No. of calvings	4				
Date and nature of last calving	June, 1947. dystokia.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served four times, without success.				

Case No. 160 Identification No. 263 Date of Slaughter. 19.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. History not available.	Cervix 9 x 4 cms. wall thickness 2.5 cms. pale pink mucosa, with a little mucoid exudate Horns 28 x 5 cms. wall thickness 1.2 cms. serosa and broad ligaments show numerous brittle glistening grape like lesions. Mucosa pale pink, velvetty. Cotyledons absent. Upper and middle third of the horns show pinhead to lentil sized tubercles in the endometrium, the older lesions are present near the tubal end with no lesions in the body and lower third. Tubercles contain a caseous material which is rich in acid-alcohol fast bacteria. Fallopian tubes are thickened, convoluted and hard, contains caseous brittle material. Mucosa is ulcerated and contains tubercles.	Both the ovaries are enclosed in their respective bursae, which show pea-like brittle nodules on their surface. The substance of the ovaries is converted into a yellowish caseous material which is acid alcohol fast bacteria, not unlike mycotuberculosis. Tuberculous lesions present in peritoneum. Right ovary resembles a large ping pong ball with a diameter of 5.8 cms. Left ovary consists of two ovoid masses connected by an isthmus, measures 5 x 4 x 5 cms.	Endometrium shows typical tuberculous lesions, which are more advanced in the upper third of the horns and the Fallopian tubes. Typical acid fast bacteria are seen in the histological sections when stained by Ziehl-Neelsen's stain.	Tuberculous endometritis (descending from the peritoneum).

Case No. 162 Identification No. 274 Date of Slaughter. 26.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings History Date and nature of last calving Not Has the cow ever Available. aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix 11x7 cms. thickness of wall 3cms. rigid and occluded by cauliflower like growths on the cervical folds. Right horn 27x4 cms. Left horn 27x4 cms. thickness of wall 2 cms. serosa lustreless with reddish yellow discolouration. Horns are collapsed with soft friable walls Mucosa - greyish brown, dry, necrotic, with no cotyledons. The lumen is occupied by three thin ridge like longitudinal folds with necrotic areas. Fallobian tubes are normal.	Right ovary 3x2x2 cms. small pea sized reddish brown corpus luteum on surface. Left Ovary 3x2x 1.5 cms. Uneven surface, with small follicles.	Mucosa is replaced by a necrotic layer, glands are in a state of disintegration, areas of necrosis seen in the myometrium, intimal thickening of the blood vessels.	Atrophic endometritis.

Case No. 166 Identification No. 120 Date of Slaughter. 10.12.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years ?	Cervix 5.5 x 3 cms. closed with a false uterine seal, shows sub-acute inflammation of the mucosa. Body 5x 8.5 cms. Right horn 33x 6.2 cms. Left horn 25x 4.6 cms. Horns are distended with a pouch like anterior extremities. Serosa shows haemorrhagic patches. Uterus fluctuates on palpation. On section about 3 litres of creamy, evil smelling pus flowed out. Mucosa is brick red, shows superficial areas of necrosis and ulceration. Different stages of necrosis are present. Cotyledons are not visible. Fallopian tubes are thickened (6 m.m.) and their lower half is distended with pus. The mucosa is brick red, studded with punctiform necrosis.	Right ovary 2 x 2 x 1.5 cms. has one pea sized Corpus luteum and four small follicles. Left ovary 3.6 x 2 x 1.5 cms. has a firm smooth surface with two lentil sized follicles. On section contains a yellowish brown Corpus luteum of 2.5 cms. in diameter embedded and enclosed by a thick capsule.	Endometrium shows extensive epithelial desquamation, necrosis of superficial areas with heavy leucocytic infiltration. Glands are surrounded by dense connective tissue which is infiltrated with leucocytes. Myometrium shows oedematous and degenerative changes.	Chronic suppurative endometritis; bilateral pyosalpingitis and persistent Corpus luteum.
No. of calvings ?				
Date and nature of last calving ?				
Has the cow ever aborted? ?				
Has the cow been blood tested for Brucella infection? ?				
Has the cow been vaccinated against Cont. abortion? ?				
History of services after last calving, etc. ?				

Case No. 167 Identification No. 112 Date of Slaughter. 10.12.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 10 No. of calvings 7 Date and nature of last calving May 1947 normal, twin calves. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Was running with the bull and was expected to be in calf again. Took some time to rally after last calving.	Cervix is tightly closed and sealed by a thin plug of mucus as seen in pregnancy. Right horn 38 x 12 cms. thickness of wall 5m.m. Left horn 20 x 4 cms. thickenss of wall 1.2 cms. The right horn is enlarged, fluctuates and simulates pregnancy uterus. serous coat of right horn is congested reddish blue, leathery to touch. The left horn is tubular, small with thick walls, and normal serosa. The right horn is distended with a slimy coffee coloured fluid about 2 litres in volume. No sign of foetus or foetal membranes or cotyledons could be seen. Mucosa is thickened, oedematous and brick red in colour, mottled with yellowish grey spots about 2-4m.m. in diameter. Fallopian tubes - normal.	Right ovary 3 x 2.5 x 2 cms. Has one large Corpus luteum, 2 cms.in diameter, firmly embedded in the ovarian stroma yellowish in colour. No follicles are present. Left ovary 2.5 x 2 x 1.5 cms. firm sclerotic no follicles seen on surface.	Endometrium shows ~~ovary~~ focal necrosis superficially, but the epithelium is intact. Increase in the interstitial connective tissue, glands are increased in number and size. They are in an active secretory phase with jaw toothed inner surface. Myometrium is thin, but the serosa is highly thickened and infiltrated with fibroblasts.	Hydrometra (hyplastic endometritis) persistent Corpus luteum.

Case No. 168 Identification No. 108 Date of Slaughter. 10.12.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 2 No. of calvings None Date and nature of last calving - Has the cow ever aborted? - Has the cow been blood tested for Brucella infection? ? Has the cow been vaccinated against Cont. abortion? ? History of services after last calving, etc. Never came on heat, hence slaughtered.	Cervix 7 x 4 cms. thickness of wall 2 cms. firmly closed; mucosa shows numerous brick red spots and dirty mucoid exudate. Right horn 32 x 2.5 cms thickness of wall 1 cm Left horn 31 x 2.5 cms. thickness of wall 0.8 cms. The serosa is normal. Mucosa is brick red. Cotyledons 4 - 8 mm. in size with greyish pinhead erosions. The lumen of the horns contains soup-like catarrhal exudate mixed with numerous yellowish floccules. Fallopian tubes are normal.	Right ovary has one regressing corpus luteum and a developing follicle. Left ovary - small, very firm, appears inactive. On section shows small follicles and traces of corpora lutea and rubra.	Uterus - epithelial desquamation, squamous metaplasia, hyaline degeneration of connective tissue. Glands are disintegrating and are filled with cell debris.	Catarrhal endometritis; cervicitis.

Case No.172 Identification No. 141 Date of Slaughter. 17.12.47.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	9	Vaginal mucosa pale pink. Cervix measures 9 x 7 cms. The cranial extremity is very narrow and contracted, while the os is enlarged and hard. Body 4 cms. Right horn 33 x 4.2 cms., thickness of wall 1.5 cms. Left horn 42 x 4.2 cms. thickness of wall 1.8 cms. The walls are tense with a reddish yellow discolouration of the serosa. Endometrium is light pink to brownish in colour with a smooth surface. The cotyledons are about 1 cm. in diameter, with a depressed necrotic surface covered with lumps of yellowish muco-purulent exudate. Fallopain tubes are normal.	Right ovary 4.2 x 2.2 x 1.8 cms. Has a freshly formed corpus luteum about the size of a split pea and resembling a clot, of blood. About six barley-sized follicles are also seen on the surface. Left ovary - 3.2 x 2.3 x 2 cms. surface has many small follicles.	The intercotyledonary area shows only slight structural departure from the normal, while the cotyledons show evidence of extensive necrosis.	Sub-acute suppurative endometritis.
No. of calvings	6				
Date and nature of last calving	February, 1947 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes, as a heifer				
History of services after last calving, etc.	Not served This cow was disposed of because she had a tendency since last two pregnancies to prolapse her uterus.				

Case No. 174 Identification No. 126 Date of Slaughter. 17.12.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix is thickened partially open, discharging a greyish purulent liquid into the vagina which shows chronic thickening. Right horn is 60 cms. long and 40 cms. in circumference, the respective measurements for the left horn being 30 x 15 cms. Serosa is moist, sticky and thickened with greyish black discolouration walls are thin and firm. On section about 8 litres of thick sauce like greyish yellow pus mixed with blackish floccules flows out of the horns. Mucosa is greyish black, nodular surface with necrosis and erosions. Cotyledons are not distinguishable. Fallopian tubes are thickened, the lower half is distended with pus to a diameter of 1 cm.	Right ovary 3.6 x 2.6 x 2 cms. The substance of the ovary is almost fully occupied by an orange yellow Corpus luteum of 2.5 cms. in diameter. Follicles are not visible macroscopically. Left ovary 2 x 1.5 x 1 cms. sclerotic has neither follicles nor Corpora lutea.	Superficial layers of endometrium is necrosed and covered with purulent materia Local areas of fibrosis and granulations are evident. Myometrium shows degeneration and purulent tracts, surrounded by fibroblasts.	Chronic suppurative endometritis with persistent Corpus luteum.

History not available.

Case No. 178 Identification No. 171 Date of Slaughter. 8.1.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. History not available.	Vagina contains a small quantity of clear mucus. Cervix 7 x 3.5 cms. thickness of wall 1.5 cms., normal mucosa, contains stringy mucoid discharge. Right horn 35 x 5 cms. Left horn 30 x 4 cms. Mucosa is pale pink, cotyledons appear as slightly raised elevations round to oval in shape. Both the Fallopian tubes are distended to 1 cm. in diameter being filled with dirty greyish mucoid exudate.	Right ovary - firm, almond shape has lentil sized follicles on surface. Left ovary - has a small split pea like Corpus luteum projecting on the surface. No follicles.	Uterus - endometrium shows chronic inflammatory changes. Fallopian tubes - epithelial desquamation especially at the summits of mucus folds.	Catarrhal endometritis. Bilateral salpingitis.

Case No. 179 Identification No. K.3. Date of Slaughter. 12.1.48

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 5 No. of calvings 2 Date and nature of last calving November, 1947 Normal Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes History of services after last calving, etc. Not served.	Cervix 9 x 4.3 cm. thickness of wall 1.5 cm. partially open with flabby walls and brick red mucosa. Body 7 x 5.5 cms. Right horn 26 x 3.5 cms Left Horn 24 x 3.4, cms. thickness of wall 0.4 cms. The walls are very thin and friable. Mucosa dry, atrophic, of dirty brick red colour. Coyledons are button like ½ cms. high with blackish spots. Fallopian tubes are slightly enlarged and contain cloudy fluid; mucosa shows granular surface.	Right ovary 3.6 x 1.6 x 1 cms; has many millet sized follicles and corpora rubra. Left ovary 3.3 x 1.5 x 1.1 cm Sclerotic with numerous adventitious growths on its surface. On section shows small follicles.	Atrophic changes in the endometrium and glands, with intimal thickening of blood vessels. Myometrium is reduced to a few degenerating fibres.	Atrophic endometritis bilateral salpingitis.

Case No.185 Identification No. 17 Date of Slaughter. 14.1.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 5 No. of calvings 2 Date and nature of last calving 9.9.47. Abortion at 5 months of pregnancy. Has the cow ever aborted? Yes Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. After the last abortion, uterus was irrigated several times with a solution of iodine. Poor milker	Cervix 8 x 3 cms. Firm, rigid, with chronic inflammation of the mucosa. Right horn 28 x 3.2 cms. Left horn 29 x 3 cms. Thickness of wall 0.7cm Serosa greyish black and lustreless; walls are very thin and friable with absolute loss of tone. Mucosa dark red with necrotic spots. Cotyledons are rudimentary and appear like thickened areas of necrosis. Lumen of the horns is traversed by thin longitudinal ridges. Fallopian tubes - normal.	Right ovary 4 x 3.5 x 3 cms. The ovary is a lobulated fluctuating mass and consists of three thick-walled cysts of diameter 2, 1.5 and 1 cms each. The largest cyst is haemorrhagic; the other two have clear fluid. Left ovary 2 x 1 x 1.2 cms. sclerotic.	Endometrium is replaced, by a structureless necrotic mass; myometrium is in a state of atrophic degeneration; marked thickening of the intima of blood vessels with narrowing of the lumen.	Atrophic endometritis cystic ovary (right

Case No. 188 Identification No. 38 Date of Slaughter. 21.1.48

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	3	Cervix 9 x 7 cms. thickness of wall 3.5 cms. thick firm wall, canal partially open and contains tenacious mucus as seen in pregnancy. Body 8 cms. Right horn 36 x 6 cms. thickness of wall 1.8 cms. Left horn 30 x 5 cms. thickness of wall 1.8 cms. Serosa shows dark brown patches, walls are thick and flabby. The cavum uteri is fully packed with a clear tenacious mucus which is just like the cervical plug of pregnancy. It can be rolled out of the horns as a compact mould. Mucosa is about 9m.m. thick, smooth, reddish brown with small greyish areas and pin-head like glistening cysts. Coryledons are absent Fallopian tubes - normal.	Right ovary 3.8 x 1 x 1 cms. firm, irregular surface with numerous small follicles. Left ovary 5 x 3.8 x 3.6 cms. ovoid, smooth surface, fluctuates appears to be cystic on section the whole of the parenchyma is found to consist of a thick-walled cyst, lined by a band of luteal cells about 2m.m. in thickness. The cystic fluid is clear, with an yellowish tinge.	Endometrium shows marked increase in connective tissue stroma, Glands are cystic with an irregular tortuous outline. The epithelial lining is low cuboidal in type. The myometrium shows hypertrophic changes.	Hyperplastic endometritis with cystic ovary (left).
No. of calvings	None				
Date and nature of last calving	-				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	Yes				
History of services after last calving, etc.	Went constantly with the bull but did not conceive, hence slaughtered.				

Case No. 190 Identification No. 29 Date of Slaughter. 21.1.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	$6\frac{1}{2}$	Cervix 10 x 6 cms. thickness of wall 2.2cm partially open. Contains glairy flocculent discharge, cranial extremity shows pin-head like glistening cysts. Right horn 39x5cms. thickness of wall 2cms. Left horn 37x4.5cms. thickness of wall 2cms. Serosa is normal, walls are thick and doughy. The lumen is packed with a glairy tenacious mucus which can be rolled out of the horn as a mould. Mucosa is smooth, pale pink, about 13 m.m. in thickness punctiform to pin-head sized greyish translucent cysts are seen embedded all over the mucous surface - cotyledons are not seen. Fallopian tubes - normal.	Right ovary 3.1 x 2.4 x 2 cms. has one large cyst 2cm indiameter, thick walled, containing clear fluid. Small specks of regressing Corpus luteum are also present. Left ovary, small firm and sclerotic.	Marked increase in the connective tissue stroma of endometrium Both superficial and deep glands are dilated, glands are also seen to penetrate the myometrium.	Hyperplastic endometritis; cystic ovary (right).
No. of calvings	4				
Date and nature of last calving	12.4.47 Normal.				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served several times, viz. 17.7.47, 19.9.47 29.12.47. without success.				

Case No. 192 Identification No. 22 Date of Slaughter. 28.1.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	3	Cervix 8 x 4 cms. thickness of wall 2 cms. Flabby walls mucosa shows subacute inflammation with slimy mucoid exudate One finger could be introduced into the canal, which contains slimy discharge. Right horn 38 x 4 cms thickness of wall 2 cms. Left horn 35 x 4 cms. thickness of wall 1.9 cms. Serosa shows reddish yellow discolouration Lumen contains about 100 cc. of soupy exudate. Mucosa is oedematous, with brownish to blackish penny sized areas. Fallopian tubes - translucent walls distended with albuminous fluid.	Right ovary 3 x 2.4 x 2 cms. has one developing follicle and remains of corpora lutea. Left ovary - 2.5 x 1.7 x 1.7 cms. Irregular surface due to small follicles.	Uterus - chronic thickening of endometrium with desquamation. Myometrium shows infiltration with fibroblasts. Fallopian tubes cuboidal epithelium loss of cilia. Marked thinning of muscular layers.	Catarrhal endometritis; cervicitis; bilateral salpingitis.
No. of calvings	None				
Date and nature of last calving	-				
Has the cow ever aborted?	-				
Has the cow been blood tested for Brucella infection?	?				
Has the cow been vaccinated against Cont. abortion?	?				
History of services after last calving, etc.	Ran with the bull but did not conceive.				

Case No. 195 Identification No. 31 Date of Slaughter. 28.1.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	$3\frac{1}{2}$	Vagina - congested with barley like granular elevations, covered with muco-purulent exudate. Cervix 6 x 3 cms. Mucosa is oedematous raspberry red, canal opens to admit small finger; mucoid discharge is sticking on the os uterus. Yellowish floccular discharge in the anterior vagina. Serosa is thickened shows blackish areas of discolouration. Right horn 32x4 cms. Left horn 30 x 4 cms. thickness of wall 2 cms. The lumen is partially filled with greyish yellow curdy mucoid discharge Cotyledons are split pea like with greyish necrotic spots. Mucosa is brownish yellow with penny sized dark greyish spots with pinpoint necrotic depressions. Fallopian tubes - normal.	Right ovary 3.5 x 2.4 x 1.8 cms. Has a developing follicle and a regressing corpus luteum. Left ovary - 2.7 x.9 x .9 cms. Has small lentil sized follicles on on surface.	Uterus - extensive epithelial desquamation with chronic thickening of the interstitial tissue; glands are disintegrating and are filled with cell debris; Myometrium shows chronic thickening.	Catarrhal endometritis; cervicitis; vaginitis.
No. of calvings	None				
Date and nature of last calving	-				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Ran with the bull, but did not settle.				

Case No. 197 Identification No. 30 Date of Slaughter. 28.1.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	3	Vagina - stensoed mucosa shows reddish inflammatory streaks. Cervix - 8 x 5 cms. thickness of wall 2cms. Os uterus enlarged, oedematous, raspberry red, with adherent sticky mucus. Both horns are symmetrical in appearance being 20 x 3 cms. thickness of wall 1 cm. Tense thick walls. The lumen is partially filled with a soupy catarrhal exudate about 250 c.c. in volume Mucosa, smooth, oedematous, pale brown. No cotyledons. Both Fallopian tubes are distended with albuminous fluid. Thickness of tube one cm.	Right ovary - 3.5 x 2.9 x 2cms. Has many lentil sized follicles and remains of Corpora lutea. Left ovary - 3 x 2.6 x 2 cms. firm, smooth surface. No follicles or Corpus luteum.	Uterus - oedema and chronic thickening of endometrium. Myometrium is normal.	Catarrhal endometritis; cervicitis bilateral salpingitis.
No. of calvings	None				
Date and nature of last calving	-				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	?				

Case No. 199 Identification No. 3 Date of Slaughter. 28.1.48

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 4 Date and nature of last calving August, 1946 Normal twin calves Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Kept returning to the bull regularly every three weeks; proved infertile; uterus was washed out with a solution of iodine.	Cervix 4 x 3 cms. flabby soft walls, with dry brick red mucosa. Body 4 cms. Right horn 30 x 3 cms. Left horn 30 x 3 cms. thickness of wall 0.7 cm. Horns are symmetrical, are in a state of collapse, soft and friable. Serosa reddish-yellow and lustreless. Mucosa - dry, atrophic, brick red, studded with pinhead sized necrotic spots. Fallopian tubes are a little thickened, and contain thick purulent material.	Right ovary 2.9 x 2.6 x 1.9 cms. Has one split-pea sized corpus luteum and two barley sized follicles. Left ovary 3.1 x 1.7 x 1.6 cms. Has a corpus luteum 1.5 cm in diameter. reddish brown in colour; a few lentil sized follicles.	Endometrium shows extensive areas of necrosis; glands are more or less destroyed; other uterine structures are atrophic and with great thickening of the intima of blood vessels.	Atrophic endometritis bilateral salpingitis.

Case No. 200 Identification No. 52 Date of Slaughter. 4.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 13 No. of calvings 10 Date and nature of last calving February, 1947 Normal but retained placenta. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Served three times last being in September, 1947.	Vaginal walls are very thick, mucosa shows dark brownish irregular spots. Cervix - 10 x 8 cms; thickness of wall 2.8 cms. stenosed with sclerotic walls, mucosa brick red, covered with brownish mucoid discharge. Right horn 44 x 5 cms. Left horn 42 x 5 cms. Thickness of wall 2 cms firm and tense. Serosa is normal. The lumen is filled with dark grey exudate mixed with yellowish floccules; mucosa is thick, oedematous with brownish discolouration. Cotyledons are half pea sized with necrotic depressed surface. Fallopian tubes - normal.	Right ovary - 3.8 x 2.4 x 2.1 cm Has a large orange yellow corpus luteum, occupying the whole area of the ovary and is embedded in the ovarian tunic; difficult to enucleate. Left ovary - 2.8 x 2 x 1.2 cm. irregular surface has a few small follicles.	Uterus - only cotyledonary areas show desquamation. Intercotyledonal mucosa intact but shows squamous metaplasia and periglandular infiltration.	Catarrhal endometritis; cervicitis; Persistent corpus luteum.

Case No. 202 Identification No. 57 Date of Slaughter. 4.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 6 No. of calvings 3 Date and nature of last calving August, 1946 Normal Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not served.	Cervix 7 x 4 cms. walls are flabby with a dark brown mucosa and contain brownish mucoid discharge. The horns are symmetrical measuring 33 cms. in length with a thickness of 1 cm. - walls are flabby and friable. Serosa is dry, parchment-like, with a yellowish brown discolouration; mucosa is atrophic, thin, brick-red, being studded with pinhead sized necrotic spots, giving the impression of being sprinkled with bran; cotyledons appear as small elevations with necrotic surface.	Right ovary 5 x 3 x 1.5 cm. has a large thick-walled cyst (2.1 cm. in diameter) containing a clear colourless fluid. Left ovary - 4 x 3 x 1 cm. irregular surface with small follicles.	Epithelial desquamation and superficial necrosis of endometrium. Periglandular infiltration of leucocytes and lymphocytes, Marked thinning of muscular layer.	Atrophic endometritis cystic ovary (right).

Case No. 205 Identification No. 78 Date of Slaughter. 11.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc. History not available.	Cervix closed with a plug of mucus. Right horn is gravid and contains a foetus 5 cms. in length. The foetal membranes are brownish yellow and at many points detached from the cotyledons which are greyish black, soft and necrotic. Endometrium is brownish black. Foetus is greyish black, friable, comes off in bits when handled, and is covered with curdy purulent fluid. Fallopian tubes are normal.	Right ovary 5 x 3.4 x 3.4 cms. whole ovary is occupied by a Corpus luteum 3 cms in diameter; yellowish with dark spots. Neither follicles nor Corpora rubra are present. Left ovary 2 x 1 x 1 cms. has small lentil sized follicles on surface.	Uterine wall shows inflammatory changes. Endometrium shows necrosis of superficial layers with heavy leucocytic infiltration which is specially marked in the cotyledons.	Pyometra, when unopened simulates a normal gravid uterus.

Case No. 206 Identification No. 72 Date of Slaughter. 11.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 6 No. of calvings 3 Date and nature of last calving July 1948 Normal. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes History of services after last calving, etc. Not served no discharge.	Cervix 10 x 6 cms. Thick flabby walls, canal is partially open and contains sticky glairy mucus, mucosa pale. Right horn 38x4 cms. thickness of wall 1.8cms. Left horn 40x5 cms. thickness of wall 2.1 cms. Serosa - normal. The lumen of the left horn contains glairy sticky mucus in its lower third, the mucus flows into the right horn through the Corpus uteri. Mucosa is smooth, pale, contains very minute glistening cysts on its surface, cysts are also present on the cranial extremity of cervix and extend in to the canal. Cotyledons are absent. Fallopian tubes - normal.	Right ovary 4x3.1x 3 cms. cystic, contains two cysts each 2cms. in diameter. The cysts have very thick (2m.m.) leathery walls, containing clear fluid. There are no Corpora lutea or follicles in the ovary. Left ovary 3x2.9x2 cms. Has one large thick walled cyst, about 2 cms. in diameter, difficult to rupture. Neither follicles nor Corpus luteum seen macroscopically.	Uterus - shows squamous metaplasia, mucosa propria shows round cell infiltration, glands are cystic and dilated, rounded, oval or irregular in shape, lined by cuboidal to flat epithelium. Zona muscularis is practically unchanged.	Hyperplastic endometritis; cystic ovaries (both).

Case No.207 Identification No. 85 Date of Slaughter. 11.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 4 Date and nature of last calving July, 1947 abortion. Has the cow ever aborted? Yes, as stated above. Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No. History of services after last calving, etc. Served five times 24th Sept., 2nd Nov., 15th Dec., 3rd Jan., and 21st Jan. but did not conceive. There is a history of abortions in the herd. Seven cows had aborted during the summer. One of them in spite of repeated services proved sterile.	Vaginal mucosa is inflamed. Cervix 9x6cms. Hard and closed. Mucosa is inflamed and covered with a brownish yellow discharge. Body 5 cms. Right horn 42 x 5 cms. thickness of wall 1.1 cms. Left horn 34 x 4cms. thickness of wall 1 cm. serosa is normal. Endometrium is thick smooth and petechiated. Cotyledons are about the size of a bean in the right horn while they are much smaller in the left. The right horn contains a brownish slimy exudate mixed with yellowish floccules. Left horn is normal anteriorly but towards the body the discharge from its companion is spreading. Fallopian tubes are normal.	Right ovary 3.2 x 2 x 2 cms. has many lentil sized follicles. Left ovary 3.4 x 2 x 1.8 cms. Has one developing follicle and a regressing Corpus luteum.	The endometrium presents atrophic and degenerative changes in the epithelial structures. The stroma and glands show an increase in connective tissue with a heavy leucocytic infiltration. The myometrium shows fibrotic changes.	Sub-acute suppurative endometritis.

Case No. 210 Identification No. Nil. Date of Slaughter. 11.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	Cervix and vagina contain thick creamy muco-purulent discharge. The right is enlarged and appears to be gravid The walls are very thin and leathery, on palpation only a hard mass is felt without fluctuation. A foetus about eight months old is lying free in the right horn without any foetal coverings or cotyledons. Thick creamy pus is filling up the space between the foetus and the uterine wall. Endometrium is blackish, necrosed and nodular in appearance, studded with purulent foci. The left horn is also filled with pus with necrosis of the endometrium. Fallopian tubes are distended (8 m.m.) with pus.	Right ovary contains an embedded persistent Corpus luteum. Left ovary firm and sclerotic.	Endometrium is completely necrosed and is covered with pus. Myometrium shows contraction and fibrosis and contains purulent tracts.	Pyometra with a macerating foetus persistent Corpus luteum.

History not known.

Case No. 211 Identification No. 73 Date of Slaughter. 11.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 11 No. of calvings 8 Date and nature of last calving March, 1947 Normal Has the cow ever aborted? Yes, 3rd month after last calving. Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes History of services after last calving, etc. Last served in July, 1947; showed discharge after 3 months; suspected to have aborted; again served without success; positive for Trichomoniasis on post-mortem examination. of uterus. Six weeks later three other heifers returned to the bull with a history of discharge. All these heifers had been served by the same bull	Vagina - normal. Cervix 11 x 6 cms. thickness of wall 2.6 cms. normal appearance Right horn 29 x 6 cms. thickness of wall 2 cms Left horn 22 x 4.3 cms thickness of wall 1.5 cms. Serosa shows reddish inflamed patches, rough and lustreless, tense walls. The mucosa is covered by a typically milky catarrhal exudate, as found in other trichomonas infections. The mucosa is thickened brownish red with punctiform erosions Cotyledons are like beans standing on their ends covered with necrotic spots and exudate. Fallopian tubes are normal.	Right ovary 4 x 3 x 2.5 cms. has a large thick walled cyst - 2.5 cm. in diam. and a small regressing corpus luteum. Left ovary 2 x 1 x 1 cm. small, firm. On section shows lentil sized follicles.	Uterus - mucosa shows local areas of desquamation squamous metaplasia prominent. Glands are in a state of disintegration.	Catarrhal endometritis; cystic ovary (right). Uterine exudate showed numerous Trichomonads foetus on microscopic examination.

Case No.214 Identification No.Bloomer II Date of Slaughter. 12.2.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 10½ No. of calvings 6 Date and nature of last calving 20.1.48. Retained placenta calf born alive but died within 10 days. Has the cow ever aborted? Yes, second pregnancy at 5 months. Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Not served, slaughtered three weeks after calving.	Vagina is discoloured with a greyish black purulent discharge. Cervix is flaccid and open; four fingers could be introduced easily; contains blackish purulent discharge. The uterus is enlarged with thick flabby partially involuted walls. Serosa is of a brick red colour, lustreless and sticky. On section both horns are partially filled with a greyish black pus mixed with decaying pieces of placenta. Mucosa is bluish black, thick, eroded, and nodular in appearance being studded with purulent foci. Cotyledons are about the size of beans, necrotic and gangrenous. Fallopian tubes are distended with pus.	Right ovary has a corpus luteum of 1.1 cms. in diameter. Left ovary is smaller and has small follicles.	Epithelium is necrosed and covered with pus. Connective tissue is filled with a thick barrier of leucocytes; glands are more or less disintegrating - blood vessles are dilated and congested.	Acute suppurative endometritis (puerperal) with bilateral pyosalpingitis.

Case No. 216 Identification No. EHT 123 Date of Slaughter. 8.1.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3 No. of calvings None Date and nature of last calving - Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Ran with the bull for two years from May to October but never settled.	Vagina - shows cystic dilatation of Gaertner's ducts. Cervix - normal. Horns are symmetrical and appear juvenile. Mucosa is smooth, brownish yellow, covered with a slimy yellowish exudate Cotyledons are not visible.	Not available.	Uterus chronic catarrhal changes in the endometrium.	Catarrhal endometritis.

Case No. 223 Identification No. Donala II Date of Slaughter. 22.9.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3 No. of calvings First Date and nature of last calving 9.9.47. dystokia apparently cleansed normally Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes, Strain 19 History of services after last calving, etc. Slaughtered on the 14th day after calving owing to suppurative mastitis.	Labial commissures and vaginal show parturition injuries Cervix is flaccid and open; contains dirty creamy foetid discharge There is complete absence of involution. Uterus is flaccid, toneless, with thin walls, whose serosa shows reddish inflammatory patches. The recently gravid left horn is enlarged and folded upon itself. Both the horns are doughy to touch and are fully packed with a semi-solid bran mash like purulent material mixed with decaying pieces of placenta and cotyledons. The cotyledons are large, necrotic and gangrenous Mucosa is bluish black necrosed with a nodular surface. Fallopian tubes - distended with creamy pus.	Right ovary 3 x 2 x 1.2 cms. has many small lentil-sized follicles. Left ovary 3.4 x 2 x 1.2 cms has one developing follicle and a corpus luteum of 1.8 cm. in diameter and dark yellow in colour.	Epithelium and sub-epithelial structures show necrotic changes, with a heavy infiltration of leucocytes. The endometrium shows degenerative changes. Necrotic areas are infiltrated with dense zone of leucocytes; the myometrium shows oedematous and degenerative changes. The capillaries are dilatated with extravasation of blood.	Acute suppurative endometritis (puerperal); preceded by suppurative mastitis due to C. pyogenes infection.

Case No. 224 Identification No. 22 Date of Slaughter. 21.1.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	6	Vagina shows areas of reddish streaks and patches. Cervix 10 x 6 cms. thickness of wall 2.5 cms. Hard firmly closed mucosa is discoloured and smeared with greyish catarrhal mucoid discharge. Right horn 34 x 5.5 cms. Left horn 32 x 4 cms. thickness of wall 1.5 cms. Serosa is inflamed, reddish grey patches. The horns are tense. Lumen contains yellowish grey slimy exudate. Mucosa is pinkish yellow with greyish areas. Cotyledons are pea sized with greyish surface. Fallopian tubes 7 mm. in diameter kinked, contains yellowish catarrhal exudate.	Right ovary has a regressing corpus luteum and a developing follicle about mid cyclic period. Left ovary - small, firm, inactive.	Chronic inflammatory changes with squamous metaplasia, periglandular infiltration of lymphocytes and leucocytes.	Catarrhal endometritis; bilateral salpingitis.
No. of calvings	3				
Date and nature of last calving	20.3.1947 Normal				
Has the cow ever aborted?	No				
Has the cow been blood tested for Brucella infection?	No				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	Served five times, last being on 4th October, 1947				

Case No. 231 Identification No. Nil Date of Slaughter. 1.3.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 3 No. of calvings First Date and nature of last calving 20.2.48. dystokia placenta retained. Has the cow ever aborted? Yes Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Slaughtered 10 days post-partem.	Vaginal mucosa shows parturition injuries; contains greyish black foetid discharge. Cervix flaccid and open; canal contains greyish black putrid discharge. The recently gravid left horn is flaccid and toneless; walls are so thin and parchment-like that the opaque bases of the cotyledons are seen on the serous surface. Left horn 52 cms. long x 75 cms. in circumference. Right horn 21 cms long x 22 cms in circumference. Serosa, sticky greyish with reddish inflammatory patches. Peri-uterine subserous abscesses about the size of a walnut are present on the dorsum of the body and horns. The left horn has three abscess in the upper half and the right horn has one near its anterior extremity. The abscesses are spongy in appearance and contain creamy pus. The cavum uteri is partially filled with greyish creamy pus mixed with necrotic pieces of tissue. The cotyledons are large, necrotic and gangrenous. Mucosa is necrosed and nodular in appearance. Fallopian tubes are impacted with muco-purulent exudate.	Right ovary 2.8 x 2 x 1.4 cms small barley sized follicles on surface. Left ovary 3 x 2 x 1.6 cms. Has no follicles but has one corpus luteum, 1.2 cm. in diam. and yellowish in colour.	Endometrium is not recognisable owing to complete necrosis; myometrium is very thin and degenerating uterine wall is heavily infiltrated with leucocytes.	Acute suppurative endometritis (puerperal) with periuterine abscesses and bilateral pyosalpingitis.

Case No. 232 Identification No. Casualty Date of Slaughter. 15.11.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 8 No. of calvings 5 Date and nature of last calving 30.10.47. Retained placenta Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Slaughtered two weeks post-partum, owing to post-partum paralysis.	Vaginal mucosa is thickened and discoloured with blackish necrotic patches. Cervix is flaccid and open. Parturition injuries in the form of laceration are present in the os uterus; the canal is filled with evil-smelling purulent discharge. The uterine walls are thinly toneless; the recently gravid right horn is enlarged and flaccid. The serosa is sticky and discoloured. The cavum uteri is partially filled with a creamy pus mixed with decaying placental remains and cotyledons which are necrotic, and gangrenous. Mucosa is blackish, and granular in appearance. The Fallopian tubes are distended with pus. Their mucosa is greyish brown, shows erosions.	Right ovary has one large pea sized corpus luteum which appears to be regressing. Left ovary is firm, with an uneven surface due to small barley sized follicles and remains of corpora lutea.	Acute suppurative inflammatory changes in the uterine wall.	Acute suppurative endometritis (puerperal) with bilateral pyosalpingitis.

Case No. 235 Identification No. 885 Date of Slaughter. 10.4.47.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years No. of calvings Date and nature of last calving Has the cow ever aborted? Has the cow been blood tested for Brucella infection? Has the cow been vaccinated against Cont. abortion? History of services after last calving, etc.	History not available.	Cervix 7 x 4 cms. closed with a plug of mucus as seen in pregnancy. Mucosa is pale yellow. Right horn 46 cms. long x 29 cms. in circumference. Left horn 39 cms. long x 23 cms in circumference. The uterus is enlarged distended with fluid, fluctuates, simulates pregnancy. Walls thin and flabby on section thin, cloudy, straw coloured viscid fluid about 3 litres in volume flows out, neither foetus, nor membranes, nor cotyledons are seen; mucosa is thick, smooth pale pink, with a brownish patchy colouration and wrinkled surface. Fallopian tubes are distended with fluid similar to the one in the uterus.	Right ovary 3.8 x 2 x 1.6 cms. Has one Corpus luteum 1.8 cms. in diameter embedded firmly in the ovarian stroma difficult to enucleate. Has no follicles. Left ovary 2 x 1.8 x 1.6 cms. almond shaped, has many small follicles on surface.	Hyperplasia of endometrium, glands are greatly increased in number and size, are filled with mucin and are in an active secretory phase opening freely on the surface, and are lined by tall columnar cells. Muscular is thin but serosa shows thickening.	Hydrometra (hyperplastic endometritis) persistent Corpus luteum.

Case No. 236 Identification No. 161 Date of Slaughter. 31.3.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 7 No. of calvings 4 Date and nature of last calving September 1947 normal. Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? No Has the cow been vaccinated against Cont. abortion? Yes, strain 19, 1942. History of services after last calving, etc. Not served.	Vaginal mucosa shows inflammatory patches and nodular thickening Cervix 13 x 8.5 cms. thickness of wall 4cms. The caudal end is enlarged and hard. 1st cervical fold shows polypoid growths, contain thick catarrhal discharge. Right horn 31 x 6.5 cms. Left horn 30 x 5 cms. thickness of wall 2.3 cms. The dorsum of the body contains an embedded cyst containing a clear fluid. Serosa is rough lustreless, discoloured About 300 c.c. of thick pea soup like exudate is partially filling the lumen of the horn. Mucosa is thick, brick red, with small erosions Cotyledons - barley sized, necrotic. Fallopian tubes 8 m.m. thick highly convoluted, packed with yellowish pus like exudate. In addition the right tube has small pea like cysts along its length on either side, pressing upon the tube, but they do not communicate with the tube.	Right ovary 4.2 x 2.4 x 1.8 cms. Surface shows 4-5 velvetty spots haemorrhagic looking. One section shows a developing follicle and regressing remains of Corpora rubra. Left ovary 4.2 x 3 x 2.1 cms. Has a small reddish Corpus luteum projecting above the surface with a constriction. There is thick walled cyst 3 cms. in diameter, containing milky cloudy fluid.	Uterus - mucosa shows extensive epithelial desquamation and infiltration with granulation tissue. Glands are more or less destroyed and filled with cell debris.	Catarrhal endometritis; bilateral salpingitis; vaginitis; cervicitis; cystic ovary (left).

Case No. 237 Identification No. 160 Date of Slaughter. 31.3.48.

History of the Cow	Post-mortem examination of genitalia		Histological Examination	REMARKS
	Genital Tract	Ovaries		
Age in Years 13 No. of calvings 9 Date and nature of last calving 14.4.1947 Normal Has the cow ever aborted? No Has the cow been blood tested for Brucella infection? Yes Negative Has the cow been vaccinated against Cont. abortion? No History of services after last calving, etc. Served 14 times the last being on 20th Feb. This cow was examined by a veterinary surgeon twice and its uterus washed out with an iodine solution each time. Yet the cow returned to service every 21 days.	Cervix 5 x 4 cms. closed and of normal appearance. Body 4 cms. Right horn 32 x 4 cms. Left horn 30 x 4 cms. thickness of wall 0.8 cms. The uterus gives the impression of being in a state of collapse with the walls lying flat on one another instead of the usual tubular appearance. The serosa is brownish yellow and dry. The walls are soft and friable. The mucosa is dry, atrophic, brick red being covered with yellowish flakes and necrotic spots. Cotyledons - very few, small and atrophic. Fallopian tubes show chronic thickening.	Right ovary 4 x 4 x 2.8 x 2.4 cms. Four barley sized follicles are present on the surface. Left ovary 4.4 x 2.6 x 1.4 cms contain one large pear shaped corpus luteum (3.8 x 2 cms.) embedded in the stroma; difficult to enucleate. No follicles.	Endometrium is replaced by a structureless necrotic mass, containing deeply staining necrotic nuclei, muscular layer is atrophic. Intimal thickening of the walls of blood vessels, some of which are completely occluded.	Atrophic endometritis; persistent corpus luteum.

Case No. 239 Identification No. Nil. Date of Slaughter. 5.4.48.

History of the Cow		Post-mortem examination of genitalia		Histological Examination	REMARKS
		Genital Tract	Ovaries		
Age in Years	10	Vagina is ballooned and inflamed contains yellowish purulent discharge. Cervix 15 x 12 cms. flaccid and open, with large inflammatory patches. Right horn 32 x 15 cms. Left horn 85 x 25 cms. The left horn is larger with thin walls. There is a total absence of involution of the uterus. Serosa is inflamed and petechiated. The cavum uteri is partially filled with creamy bran mash like fluid. The mucosa is dark brown to brownish red. Cotyledons are large ovoid to round or irregular in shape, 4-8 cms. in diameter. Left horn has larger and greater number of cotyledons. The exudate is mixed with small pieces of placental tissue undergoing disintegration. Fallopian tubes are normal.	Right ovary 3 x 2 x 1 cms. firm, has remains of Corpora lutea; but no follicles. Left ovary 2.5 x 2 x 1 cms. has one reddish brown Corpus luteum of 1.5cms. in diameter.	Acute inflammatory changes in the uterine wall.	Acute suppurative endometritis (puerperal) and mastitis, due to C. pyogenes.
No. of calvings	7				
Date and nature of last calving	3.4.48 normal.				
Has the cow ever aborted?	Yes				
Has the cow been blood tested for Brucella infection?	Yes Positive.				
Has the cow been vaccinated against Cont. abortion?	No				
History of services after last calving, etc.	No. Soon after parturition the cow developed severe suppurative mastitis due to C. pyogenes.				