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Report

of

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OÖPHORECTOMY AND OVARIECTOMY IN THE DOMESTIC ANIMALS

A thesis submitted to the
Faculty of the Graduate School of the
University of Minnesota

by

Joab Palmer Foster

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OÖPHORECTOMY AND OVARIECTOMY IN THE DOMESTIC ANIMALS

Terminology.

The operation for the surgical removal of the ovaries has been given a variety of names. Among the terms applied to this procedure by writers on human and veterinary surgery, are "castration of the female," "ablation of the ovaries," "ovariectomy," "ovariotomy," and "oöphorectomy." When the entire uterus, or the greater part of it, is removed with the ovaries, the terms "ovario-hysterectomy," "ovario-hysterotomy," "hystero-ovariectomy," "hystero-ovariotomy," "hystero-oöphorectomy," and "hystero-oöthecectomy" have been employed. "Spaying" is a term applied rather indiscriminately in veterinary medicine to either of the procedures just mentioned.

The terms "ovariotomy," "ovario-hysterotomy" and "hystero-ovariotomy" are misnomers, and never should be employed in referring to any operation for the removal (excision) of the ovaries alone, or in combination with any part of the uterus, because these terms mean merely to cut and not to cut out or excise. Although well informed authors of standard text-books and medical dictionaries refer to excision of the ovaries as "ovariotomy," it certainly is incorrect, and the only defense that can be advanced for the employment of the term is that of popular usage. The proper term for the removal of a normal ovary is "oöphorectomy." The proper term for the removal of an abnormal or diseased ovary is "ovariectomy." The suffix "otomy" properly used, means "to cut." The suffix "ectomy" means "to cut out; excise; remove." There is no more excuse for using the term "ovariotomy" in referring to an operation for removal of an ovary, than there would be for referring to "nephrectomy" as "nephrotomy;" to "splenectomy" as "splenotomy," or to "tonsilec-

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tomy" as "tonsilotomy." Therefore the distinction between "ovartomy" and "ovariectomy" is surgical, and distinguishes between cutting into an ovary, and cutting out (excising) an ovary. The distinction between "oöphorectomy" and "ovariectomy" is pathologic, and distinguishes between excising a normal, and an abnormal ovary.

General Statement.

Oöphorectomy and ovariectomy will be discussed in the mare, the cow, the ewe, the sow, the bitch, and the cat. Of the six species mentioned, three - the cow, the ewe, and the sow - are subjected to this operation for economic reasons based upon greater increase in weight, as well as enhanced food values following the procedure. The operation is seldom practiced on the ewe, or on the sow, for reasons that will be explained later.

The operation is indicated in mares suffering from nymphomania - when the condition is due to diseased ovaries - and has been practiced also on mares with normal ovaries to prevent oestrus. These different conditions will be discussed later.

In the bitch, and in the cat, the operation usually is performed in an effort to prevent the indecent behavior of these animals during the prolonged periods of oestrus peculiar to their species.

Based on the terminology already established, oöphorectomy is the operation usually performed on the cow, the ewe, the sow, the bitch, and the cat, for the reason that the operation generally is performed on animals possessing normal ovaries. Both oöphorectomy and ovariectomy (usually the latter) are performed on the mare.

HISTOLOGY OF THE OVARY.

The ovary consists of a framework, or stroma, composed of fibrous connective tissue with spindle shaped cells, unstriped muscle fibres, Graafian follicles, blood-vessels, lymphatics, and nerves. It is covered by the germinal epithelium consisting of columnar cells, beneath which is the tunica albuginea- apparently a condensation of the connective tissue cells of the stroma.

The ovary is divided into a cortex, and a medulla. The cortex is the peripheral zone, and contains the Graafian follicles and ova. The medulla is centrally located, and consists largely of blood-vessels.

The ova and the epithelium of the Graafian follicles originate from the epithelium of the embryo. Processes of epithelial cells (egg-tubes of Pflüger) grow down from the germinal epithelium into the stroma of the ovary, and are cut off by the rapidly developing connective tissue. This produces small isolated "nests" of epithelial cells, which later may represent Graffian follicles.

The Graafian follicles are found only in the cortex, and are the characteristic components of that zone. The less mature follicles consist of an ovum surrounded by one or more rows of cells. These immature follicles migrate toward the medulla as they grow larger, until the mature follicle may occupy the entire thickness of the cortex. The mature follicles appear as clear vesicles filled with fluid, sharply defined from the rest of the surrounding ovarian tissue by a condensed layer of connective tissue cells called the theca folliculi. Internal to the theca folliculi is the membrana granulosa, which consists of many layers of polyhedral epithelial cells. These bulge inward at one spot and form what might

be called an invagination, or heaping up of cells into the clear fluid (liquor folliculi). This mass is known as the discus proligerous, and the ovum is found lying within these cells surrounded by a distinct membrane, the zona pellucida, which is derived from the cells of the surrounding discus proligerous. Cells from the discus proligerous surrounding the zona pellucida, becoming modified, form the corona radiata. The protoplasm of the ovum (vitellus) is enclosed by the vitelline membrane, which lines the zona pellucida. The germinal vesicle corresponds to the nucleus of the ovum, and contains the germinal spot or nucleolus. As a usual thing, a Graafian follicle contains but one ovum.

The Graafian follicle continues to grow until it projects from the surface of the ovary and finally ruptures, liberating the ovum which is taken up by the Fallopian tube. After the follicle bursts, its walls collapse leaving a wound on the surface of the ovary. As in all wounds to vascular organs, hemorrhage takes place, and the collapsed follicle becomes filled with a blood clot. Cells grow in from the ruptured wall, and the clot becoming organized, the structure is now known as a corpus luteum or "yellow body." What becomes of the corpus luteum depends upon whether or not conception occurs. If conception does not occur, there is retrogression and disappearance of the cells, and the entire mass becomes shrunken and cicatricial in character. If conception takes place, the body remains during the entire duration of pregnancy. There is, therefore, a distinction between the corpus luteum of oestrus and the corpus luteum of pregnancy. There is no apparent variation in the two, and they cannot be differentiated clinically without taking into consideration signs of pregnancy. The difference is that one remains for a comparatively short time, while the other remains during pregnancy. The

assumption that the presence of a large yellow body always indicates pregnancy is not well founded, since they have been observed occasionally in the ovaries of virgins.

ENDOCRINOLOGY OF THE OVARY.

Interstitial cells of the ovary

In certain animals, cells have been found in the ovarian stroma, that appear to be different from the ordinary connective tissue cells of this structure. They are known as the interstitial cells of the ovary. As the Graafian follicles develop, large epithelium-like cells may be found in the theca folliculi. They have been named theca cells, and are derived from the stroma, and possibly from the interstitial cells just mentioned. The cells of the corpora lutea are derived from these theca cells. When the corpora lutea disappear, the theca cells become lost in the substance of the ovarian stroma.

Corpora Lutea

As the Graafian follicle becomes larger and more distended by fluid, it finally bursts at its thinnest point, and the liquor folliculi, the ovum, and the discus proligerous escape. The epithelial cells of the membrana granulosa may become separated from the theca, and undergo disintegration. As already stated, the cavity is filled with blood from the ruptured capillaries of the wall. The theca cells in the wall of the cavity grow into the clot, and on account of the yellowish color due to the fat-like material they contain, the name corpus luteum (yellow body) has been given to the structure. The cells are now known as the luteal cells. Blood-vessels develop from the wall, and in combination with the luteal cells form a vascular gland-like structure much larger than the former Graafian follicle.

It will be noted that the corpus luteum is developed entirely from the theca cells of the ruptured follicle, and that

these theca cells are descendants of the connective tissue cells of the ovarian stroma, therefore it is evident that the epithelium of the follicle has nothing to do with the production of the corpus luteum. On the other hand, some authorities believe that the epithelium of the follicle is not lost when the structure ruptures, but become transformed into luteal cells. The luteal cells first line the wall of the follicle, and later form thick folds which converge toward the center.

Effects produced by removing and reimplanting ovaries.

When both ovaries are removed in young animals, it is probable that male characteristics will be assumed to a certain extent. The uterus does not develop, and oestrus is not established. If the operation is delayed until after the animal has attained puberty, the changes are not as pronounced. Oestral periods are permanently abolished. In rabbits, the mammary glands, uterus, and oviducts usually become more or less atrophied (Carmichael and Marshall). The animal may show a tendency to increased formation of fat.

No doubt the effects which are brought about by the ovaries in determining the secondary sexual characters are due to an internal secretion produced by these organs. It seems probable that the changes are due to a secretion from some form of cells, like the interstitial cells, and not from the generative epithelium. Oestral periods probably are not due to either secretions from the Graafian follicles, or the corpora lutea. This is proved by the fact that oestrus persists in animals in which the corpora lutea are destroyed, or where none can be demonstrated in the ovaries. Further, it has been shown that the changes brought about by excision of the ovaries can be prevented by grafts of ovarian tissue in which corpora lutea, and even Graafian follicles - these having undergone degeneration - are absent. It has been demonstrated (Marshall

and Jolly) that ovarian grafts, regardless of the lack of Graafian follicles, can be depended upon to prevent atrophy of the uterus in animals that have been spayed.

Effects produced by ovarian extracts

It has been shown (Itagaki) that ovarian extracts may either stimulate, or inhibit, uterine contractions, depending upon what portion of the ovary is employed in the production of the extract. When extracts prepared from corpus luteum are injected intravenously, there is increase in tone of the uterine muscle and augmentation of the normal rhythmic movements, without affecting blood-pressure. On the other hand, extract of ovarian hilum (interstitial cells) has the opposite effect on the uterine muscles, and blood pressure is lowered. When pieces of uterine muscle are placed in extracts of follicular tissue, or liquor folliculi, the tone and rhythmic contractions of the muscle is increased. The opposite effect is produced when the muscle is placed in extract of hilum. It would seem that extracts of follicular tissue and corpus luteum act as hormones, and stimulate the uterine muscles to increased activity, while extracts of hilum act as chalone, and inhibit contractions.

Extract of corpus luteum injected intravenously into lactating animals increases the flow of milk (Ott and Scott). This effect probably is due to stimulation of muscle fibres in the mammary alveolar walls, and is not produced by ovarian extract in which corpus lutea is not present (Mackenzie).

Effect of corpus luteum on metabolism

It has been demonstrated (Sack) that corpus luteum fed to female white rats will cause them to lay on flesh, but no such effect is apparent in males. Experiments have been made (Ancel and Bouin) which indicate that corpora lutea are concerned in the development of the mammary glands during pregnancy. If a Graafin

follicle is ruptured in a virgin rabbit - with the production of a corpus luteum - the mammary glands undergo development, but if the corpus luteum is not present, no development is apparent. Development of the mammary glands has been produced (Ott and Scott) in virgin rabbits by subcutaneous injections of extract of corpus luteum at frequent intervals. It is stated (Ancel and Bouin) that destruction of all of the corpora lutea in a pregnant rabbit will prevent the development of the mammary glands, which would indicate that the secretion of the corpora lutea is essential to mammary development. It has been reported (Fraenkel) that when corpora lutea are destroyed in rabbits soon after conception, the embryo fails to become attached to the uterine mucosa and development of the embryo is arrested.

ENDOCRINOLOGY OF THE UTERUS.

In bitches and cats, hysterio-*o*phorectomy perhaps is more generally practiced as a spaying procedure than *o*phorectomy alone, and in view of this fact, the endocrinology of the uterus should be considered.

Some investigators (Bell and Bond) hold that estrum and ovulation depend upon an internal secretion of the uterus, and further, that this secretion stimulates the growth of corpora lutea. Others (Carmichael and Marshall) dispute this by showing that development of the ovaries, accompanied by the formation of Graafian follicles and corpora lutea takes place in young animals after hysterectomy. Another authority (Mackenzie) has advanced the theory that a hormone is secreted by the uterus during the latter part of the gestation period, which acts as a galactagogue.

THE MARE.

The ovaries of the mare are ovoid or bean shaped. They are about three inches long and one inch in thickness, and weigh from 2½ to 3 ounces each. They are situated in the sublumbar region, and lie three or four inches behind the kidneys. Each ovary shows a notch or depression, the ovulation fossa, which is situated at the free border. They are enveloped in the anterior end of the broad ligament of the uterus - the mesovaria - by which they are suspended from the sublumbar region. Their other attachments are to the ovarian ligaments which connect with the extremities of the cornua of the uterus, and the fimbriated extremities of the Fallopian tubes. They are further supported by their blood-vessels and nerves.

The Fallopian tubes, or oviducts, are canals which carry the ova from the ovaries to the uterus. They are two flexuous tubes extending from each uterine horn to the ovary. Each is enclosed in a peritoneal fold derived from the external layer of the broad ligament, termed the mesosalpinx. The tube begins at the horn of the uterus by a very minute opening, the ostium uterinum, and terminates in a trumpet shaped stricture in the center of which is a small opening, the ostium abdominals. The edges of the trumpet shaped free extremity possess fimbriae which are arranged around the ostium abdominale. The fimbriae embrace the ovary in such a manner that the extruded ova pass into the tube and are conveyed to the uterus. The walls of the tubes possess three coats; a serous, a muscular, and a mucous, which is continuous with that of the uterus. Ciliated epithelium lines the tubes, and inner surface of the fimbriae. Each tube is from ten to twelve inches in length.

The uterus consists of a body and two cornua. It is situa-

ted in the sublumbar region, and the pelvic cavity; lying between the rectum above, and the bladder and intestinal convolutions below. The body is cylindrical and somewhat flattened. The anterior extremity, or fundus, communicates with the cornua. The posterior extremity which constitutes the neck, or cervix, is continuous with the vagina. The cornua, or horns, diverge forward and upward with a free concave ventral border, and a convex dorsal one, to which is attached the suspensory, or broad ligament. The uterus has three coats; an external serous, a middle muscular, and an internal mucous, provided with ciliated epithelium. The broad ligaments are reflections of the peritoneum, and pass from the uterus to the bladder, rectum, vagina, and walls of the pelvic cavity. Two fibrous cords, the round ligaments, pass from the uterus to the internal inguinal rings and enter the inguinal canals. The uterus has three openings, one at the end of each horn- the ostium uterinum- which is the beginning of the Fallopian tube, and one at the anterior extremity of the cervix- the ostium internum.

The vagina is a cylindrical canal running from the vulva to the uterus. It is from six to eight inches in length, and when dilated, its lateral dimensions are limited only by the pelvic walls. With the exception of the anterior two inches, the vagina is retroperitoneal, and consists of a muscular and a mucous coat. It has no glands. Its anterior end is occupied by the intravaginal part of the cervix, so that the cavity is reduced to an annular recess called the fornix vaginae. The posterior part is continuous with the vulva.

The vulva is the terminal part of the genito-urinary tract, and is about five inches in length. The external urethral orifice opens on the floor of the vulva about four inches anterior to the

external opening. The clitoris is found in a depression, the fossa navicularis, situated on the floor of the vulva just in front of the inferior commissure of the vulvar cleft.

Indications for removal of the ovaries

Operations for the removal of the ovaries in the mare may be divided into two classes: (1) Ovariectomy in those individuals suffering from degenerative processes in the ovaries causing nymphomania, and (2) Oöphorectomy in animals possessing normal ovaries.

Ovariectomy - Charlier, a distinguished French veterinarian, was the first to perform vaginal ovariectomy in the mare in 1850, and in his honor the procedure is now referred to as the "Charlier Method." Prior to this time ovariectomy had been practiced to a limited extent through the flank, but with very poor results.

The symptoms of nymphomania are those that would be expected to follow an irritable condition of the genitalia. Merrillat divides the individuals suffering from this condition into two principal classes, with intermediate forms between the two extremes. The mild form of the disease is that in which the animal switches the tail slightly while being driven, and may at times lean against some solid object. The intense form is that in which the animal appears to be in a state of chronic oestrus, behaving in a most indecent and repulsive manner manifested by squealing, stretching the hind legs widely apart, and ejecting frequent jets of urine. The clitoris is erect and protruded, and in the stable or in harness, the animal exhibits an uncontrollable desire to kick on the slightest provocation. The animal may lean against the sides of the stall, shafts, pole, or team mate; in the meantime squealing and urinating. Some may become actually vicious, and will kick, stamp, bite, and strike their caretakers. Many of these animals are "rein grippers." Some of them

appear to be quieter during their actual periods of oestrus. It is said that the ovaries are not abnormal in all of these cases.

Simpler and less dangerous operations than ovariectomy - such as clitoridectomy, and myectomy of certain caudal muscles to prevent switching the tail and gripping the reins - have been suggested and employed with more or less success when the condition is not due to ovarian disease. Palliative procedures are of no real benefit when the seat of the difficulty is in the ovaries, and as Lacroix states, "The condition of nymphomania still continues in spite of clitoridectomy, or caudal myectomy." The cause of the trouble must be removed to secure favorable results. Absence or presence of ovarian disease may be determined by rectal examination.

Oöphorectomy - Removal of the normal ovaries has been practiced to a limited extent in race and hunting mares. Hobday reports six cases operated in his practice. One of them was a trotting mare three were runners, and two were hunters. He states that the operation causes the patient to become more even tempered, and therefore more reliable as a racing tool. The spayed mare is not upset by periods of oestrus, and will race away from her competitors if possessed of the necessary speed, rather than hang back alongside the other contestants.

Preparation of the Patient

A mild purgative should be given the animal two or three days prior to the date of operation. If the bowels are comparatively empty, matters are greatly facilitated by reason of lessened intra-abdominal pressure, as well as affording greater freedom of movement for the hand in the peritoneal cavity, on account of the space occupied by the pelvic flexure of the colon, the caecum, and the floating colon, being reduced to a minimum. Probably oil is the best purgative to give in these cases. Irritating, or even

stimulating purges, are contra-indicated. The diet should be restricted for several days.

Restraint

The intravaginal operation, performed in the standing position, is the only one that is worthy of consideration, and while some good authorities refer to operating in the recumbent position, it is not recommended. It is impossible to "balloon" the vagina properly except in the standing position, and when this most important step cannot be carried out, the operation becomes much more difficult for the surgeon, and much more dangerous to the patient.

The operation is best performed in stocks, but may be carried out in a strong single stall so arranged that an extra side-piece of heavy timber, or pole, can be fastened temporarily, but securely, to the manger at one end, and to a strong temporary upright at the other end. This upright should be securely spiked to the floor below, and to the stringer above. The horizontal timber or pole, should be about four feet from the floor, and is used for the express purpose of making the stall just wide enough for the patient and leave no room for lateral movements on her part. It is advisable to have the animal brought into the stall before the temporary timbers are finally secured. The patient then may be crowded over against the stall partition by the horizontal timber or pole - which comes about half-way up her side - and the upright timber fastened at the proper places above and below. Some sort of temporary girth or sling, should be securely attached to the side of the stall - about four feet from the floor - so that it can be passed under the mare's belly and strapped, or otherwise fastened to the horizontal timber, to prevent her from lying down. A strong cross-bar should be fastened in front of the mare's breast to prevent her from crowding ahead against the manger. Her hind pasterns should be hobbled,

or properly secured by side-lines. A rope, or heavy strap, should be passed over her loins and fastened to each side of the stall to prevent arching of the back, and straining. Never proceed with the operation until absolutely certain that the method of restraint adopted is all that it should be (see report of Case No. 2).

Anaesthesia

One or two capsules (depending upon the size of the patient) each containing an ounce of chloral hydrate should be given about one hour before the time set for the operation. A twitch may be necessary to keep the animal's head raised to the proper height.

Preoperative Procedures and Technic of the Operation.

The tail is bandaged from its base to the region of the last vertebra, and is either tied to one side, or stretched upwards and secured to an overhead beam, joist, or other appropriate object. It is important before proceeding further, that the patient be catheterized and an enema given - to insure absolute emptiness of the bladder and rectum. The depression under the base of the tail, the anus, the perineum, and the vulva, should be washed thoroughly with soap and warm water. This washing may extend for some distance each side of the median line. The clitoris and its prepuce should be carefully cleansed and rinsed off, and all of the parts mentioned are then to undergo a second washing with a 1-1000 solution of mercuric chloride. Some surgeons irrigate the vagina with antiseptic solutions at this stage of the procedure. Merrillat recommends solutions of lysol, phenol, or mercuric chloride for this purpose at a temperature a little above that of body heat. Lacroix advises a one half of one per cent lysol solution. Hobday recommends filling the vagina "with warm antiseptic solution - creolin (1-50), or chinosol (1-500) - and this allowed to come in direct contact with the interior of the vagina for at least ten minutes. The hand is

then introduced and moved to thoroughly agitate the fluid, which is now aided to escape. Afterwards, with sterilized cotton wool and fresh chinosol solution, the vagina is swabbed out and dried. The patient is now quite ready for operation." Dollar warns against the introduction of irritating fluids into the vagina, and says that "mercuric chloride solution 1-1000 if warm, may irritate the vagina and cause straining." The only solution mentioned by William (W. L.) for irrigating the vagina contains 0.5% sodium bicarbonate, and is used at a tepid temperature.

Williams makes the following very interesting and instructive observations: "The vulvo-vaginal canal of the mare is unique in its physiological behavior. Under venereal excitement or the introduction of the operator's hand or of tepid water, the organ has the power of ballooning or dilating to a degree not seen so far as we know in other animals; the walls become erected, hard, and stand apart from each other, filling the pelvic cavity, the vaginal walls resting firmly against the pelvic bones at every part except at the points where the bladder and rectum intervene and these organs are pressed out flat and occupy a minimum space. In the quiescent state the vaginal walls are in contact and from the perinaeum forward to within about 10 cm. of the uterine os, the vulva and vagina are connected above with the rectum by the pelvic connective tissue, while anterior to this point the vagina is covered by peritoneum, and it is in this area that the incision needs be made in the operation. The ballooning of the vagina profoundly alters the relation of this operative area, and changes it from the horizontal in the quiescent organ, to the perpendicular in the ballooned condition."

The technic of equine ovariectomy performed in the standing position as recommended by Williams, has been followed in all of the operations described later, with the exception of a few modifications.

The only instruments required for this operation are (1) a Colin's scalpel, and (2) either a special spaying (Chassaignac) ecraseur, or a spaying emasculator. Whichever one of the last mentioned instruments is selected, should be about two feet in length. The author prefers the emasculator for the reason that it is more easily sterilized and seems to be a safer instrument than the ecraseur. The term "safer" is used in the sense that the space between the "hook" of the emasculator, and the boxing through which it is drawn by the screw, may be so gauged as to admit only the mesovarium and its vessels, leaving no room for an intestinal loop, or portion of the mesentery, to be forced between the hook and the boxing during possible straining on the part of the patient. On the other hand, there is more or less danger of engaging some other structure along with the ovarian attachments, when the loop of the ecraseur chain is passed over the ovary. When the bulk of the tissues to be divided is too great to be encompassed by the emasculator - due to adhesions involving the ovary, mesovarium and tube - the ecraseur must be employed.

The instruments should be sterilized in boiling water for at least ten minutes. The surgeon's hands and arms should be thoroughly scrubbed with soap and warm water, paying particular attention to the nails. The hands and arms should then be washed in a 1-1000 mercuric chloride solution. Iodine may be applied to the hand and wrist that is to penetrate the peritoneal cavity, first being sure to wash off all traces of the mercuric chloride solution with sterile water.

The sodium bicarbonate solution is injected into the vaginal canal, forcing its walls apart, and the hand grasping the Colin's scalpel is now passed into the already dilating cavity of the vagina. As soon as "ballooning" has taken place, the guard of the

scalpel is pulled back by the thumb, and holding the instrument in a horizontal position cutting edge downward (Williams recommends a vertical position), with the point of the blade about an inch above the cervix and a little to the right of the median line to avoid a longitudinal fold of the mucosa which passes from the vaginal wall to the superior surface of the cervix, a forward thrust is made, passing through the mucosa, muscle and peritoneum. The guard should be pushed forward before the blade is withdrawn to avoid wounding any other structure. As a precaution against losing the scalpel by reason of its slipping forward out of the fingers and dropping into the peritoneal cavity, it is well to attach a cord to its handle, the end of which should hang out of the vulva. The scalpel may be left in the vagina after making the incision, or it may be withdrawn to the outside by traction on the cord. This procedure does not require the withdrawal of the operating hand. The forefinger is first passed through the incision, then the second and third fingers, and finally, holding all the fingers and the thumb in the form of a cone, the entire hand is passed into the peritoneal cavity. As the vaginal wall above the cervix is comparatively thin - little more than an eighth of an inch in thickness - when ballooned, the incision is easily enlarged by the gradual introduction of the fingers as described. The body of the uterus will be found just below the perforation in the vaginal wall. In animals of average size the body of the uterus is from three to four inches in diameter (see anatomic description). Tracing the body forward to the horns, and then along them at almost right angles to the fundus, the ovaries are encountered suspended by their mesovaria and vessels. The emasculator is then inserted into the vulvo-vaginal canal by the free hand, and its end passed along the palm of the operating hand, which is drawn backward into the opening while the

instrument is "eased" through the perforation parallel to the arm. It is well to give the ovary one or two complete turns in order to twist the mesovarium and its vessels into a more definite and compact mass before it is slipped between the crushing parts of the emasculator. After engaging the tissues mentioned, the ovary is held in the palm of the hand. The handle of the emasculator is then turned by the operator's free hand, or by an assistant. This should be done as rapidly as possible, so as not to prolong the operation unduly. After removal, the ovary should be drawn through the operative opening and deposited on the vaginal floor. The opposite ovary is removed in a like manner. It is impossible to pass directly across from one ovary to the other without encountering the colic (lesser) mesentery which supports the floating (small) colon, and forms a longitudinal partition at this point. When the operation is completed the ovaries and the emasculator are withdrawn through the vulva at the same time.

The after treatment consists of keeping the animal in the standing position for a day or two, laxative diet, and rest for at least a week. If colic develops, the patient should be treated.

The principal modifications to the Williams technic practiced by the author are, (1) catheterization, (2) enema, (3) emasculator employed in preference to an ecraseur, (4) Colin's scalpel held in horizontal position, (5) immediate sheathing of scalpel after the incision is made, and (6) cord attached to handle of scalpel as a safeguard, also for use in withdrawing the same from the vulvo-vaginal canal after the incision is made.

The following cases are selected as representative:

No. 1 - Chestnut, 8 years old, weight 1050 lbs. Exhibited symptoms of nymphomania. Anaesthesia and technic (except re-

straint) as described. Against the best judgment of the writer, the operation was performed with the animal fastened to a Kyle operating table by means of two canvas girths and the usual foot hobbles. The table was left in the vertical position in order that the patient might remain standing. This procedure was resorted to for the reason that neither stocks, nor other suitable means of restraint in the standing position were available. The operation was a success, followed by an uneventful recovery, and good results.

No. 2 - Bay, 10 years old, weight 1000 lbs. Same owner as in the preceding case. The patient was nervous and ugly. Anaesthesia and technic of operation the same as in the preceding case. As the restraint adopted for controlling the first mare had proved fairly satisfactory, and after all, seemed to be safe enough, the same measures were resorted to in this case. One ovary had been removed, and the ovarian attachments of the opposite side were partially severed by the spaying emasculator, when the mare started to squeal and struggle, and finally, after she had "knuckled down" on her hind pasterns, and thereby had thrown the weight of her posterior parts on the rear girth, the canvas tore out of its metal fastening, and allowed the hind part of the animal to fall to the floor. The results of this accident were disastrous. That portion of the ovarian attachment not already severed by the emasculator, was entirely torn apart; the pelvic flexure of the colon was ruptured with consequent escape of feces: and the opening in the vagina above the cervix was badly torn by the shaft of the emasculator. It was necessary to destroy the mare.

The history of this case illustrates the folly of resorting to any "makeshift" in the way of restraint - even though urged so to do by the assistants and the owner - when the judgment of the

operator is not in accord with the proposed method. Never substitute an untried procedure for one that has been tried repeatedly and found reliable. Postpone the operation until such time as will permit of its being carried out in a safe and surgical manner. This applies not only to restraint, but to anesthesia, instruments, and antiseptic precautions.

No. 3 - Gray, 12 years old, weight 1100 lbs. Anaesthesia and technic (including restraint in stocks) as described. A large cystic ovary was removed, which was drawn through the operative opening in the vagina with considerable difficulty. Uneventful recovery, with good results.

THE COW.

The ovaries are smaller than those of the mare, being from one to one and a half inches in length, and one inch in thickness at their greatest diameter. Although they are oval in shape, they are somewhat pointed at their uterine ends. They have no ovulation fossae. Follicles and corpora lutea are often found projecting from their surfaces.

The Fallopian tubes are long, but not as flexuous as in the mare, and the fimbriae surrounding the ostia abdominale are not as extensive.

The uterus lies almost entirely within the abdominal cavity. The body is much shorter than in the mare, and the cornua diverge downward, forward, outward, and finally upward. The cervix is four or five inches long, and its wall is dense and thick. Its lumen is flexuous, and possesses three cartilaginous rings. The mucous membrane lining the body and horns of the uterus is characteristic on account of the uterine cotyledons. These are vascular rounded prominences, and their function is for placental attachment. They are about one hundred in number. The broad ligaments are not attached to the sublumbar region as in the mare, but to the upper flank region.

The vagina is longer, and its walls are thicker than in the mare. The recto-genital pouch of the peritoneum extends backward about five inches on the dorsal surface, while ventrally the serous coat extends backward about two inches.

The vulva lies about two inches behind, and the same distance below the ischial arch. The glans clitoridis is small. The external urethral orifice is about five inches from the inferior commis-

sure. Behind it is a blind pouch, the suburethral diverticulum, which is about one inch in length, and readily admits the end of a finger.

Indications for removal of the ovaries

In the cow, excision of the ovaries is practiced for the purpose of increasing the fattening qualities. Oöphorectomy is the operation performed.

Occasionally, ovariectomy is performed for the cure of nymphomania. Confirmed "bullers" usually are nymphomaniacs, and if incurably sterile, should be spayed and fattened for market.

Among the reasons advanced for the utility of oöphorectomy in heifers are, (1) that the animals grow faster, (2) fatten much more easily, (3) have a better quality of beef, (4) bring a higher price on the market - at least as high as steers, and (5) may be turned in pastures, feed lots, or yards with steers, with greater profit to both sexes. Referring to the first reason, there is some evidence to show that the operation may produce an opposite effect to the one desired in animals less than one year old. In a questionnaire sent to owners relative to the outcome of former operations, the following question was included: "How did the spayed heifers compare with those not spayed, at three years of age?" One reply was, "Fatter but not as large," another, that "The heifers that were spayed at one year old remained on the more dwarfy order - did not grow to any size. The others did well, and after being fattened sold within one cent a pound of the steers. I think it is a profitable practice in heifers past one and a half years old." On the other hand, still another owner replied that "These heifers weighed at three years old two hundred and fifty pounds more than those not spayed. They also sold for \$1.50 a hundred more than those not spayed." These heifers were spayed as yearlings, as

were many others at that age, with very favorable results. Undisputed points are, that spayed animals certainly fatten more readily than unspayed ones, with the production of a better quality of beef at a higher market price.

Ovariectomy and Oöphorectomy (Cow)

The preparation of the patient, the restraint, the anaesthesia (if considered necessary), the preoperative procedures, and the technic of the vaginal operation, are about the same as in the mare, with the addition of the necessary employment of a vaginal dilator or speculum for tensing the vaginal wall. It is impossible to "balloon" the vagina of the cow by the introduction of irrigating fluids or the hand.

The flank operation in cows is performed on those individuals that are too small to be operated through the vagina. This procedure is described under operations on the heifer.

Oöphorectomy (Heifer)

The flank operation will be described first, and is the one advised for animals older than yearlings.

Preparation of the Patient.

It is advisable that intra-abdominal pressure be reduced to a minimum. Therefore, the diet should be restricted for several days, so that at the time of operation the animal - or animals - will be well "gaunted."

Restraint

A dehorning chute in the field - in lieu of hospital stocks - may be so arranged that it will answer the purpose very nicely as a means of restraint in the standing position. As the operation is performed preferably through the left flank, it is necessary to rebuild the left side of the chute accordingly. This is done by removing all horizontal slats or bars that would interfere with free

access to the region of the left flank. Provision must be made for the introduction of a cross-bar, which is passed from side to side, just in front of the animal's stifles and is to prevent her from lying down. A crow-bar does very well for this purpose. The head should be securely controlled, and the hind feet hobbled and held back to prevent picking up either foot and standing on the cross-bar.

In so-called "range" countries, the animals are "foot-roped" from saddle horses, and "stretched." That is, one rider "ropes" the front feet of a heifer, another "ropes" the hind feet, and with the ends of the lariats fastened to the saddle horns and the horses headed in opposite directions, the heifer is stretched prostrate on the ground. The operation is performed in this position.

Anaesthesia

None.

Preoperative Procedures and Technic of the Operation

The hair is clipped at the seat of the incision, and all loose hair is brushed away. The operative area is first thoroughly scrubbed with soap and water, then with a solution of some reliable coal-tar antiseptic. Mercuric chloride solution is recommended only for the initial disinfection of the surgeon's hands and arms, and not for use on the operative area as it is toxic for some individuals. Two pails are necessary; one containing the water with which the first washing is done, the other containing the antiseptic solution.

The instruments preferred by the writer are a Miles' castrating knife - with a hook blade which has been ground so that the cutting edge is at an angle of about 45 degrees to the shank - a spaying emasculator, a pair of heavy artery forceps, and a large

spaying needle. A spaying ecraseur, or spaying shears may be substituted for the spaying emasculator.

The instruments are boiled, and the surgeon's arms and hands thoroughly disinfected in the same manner as described under spaying the mare.

An incision three to four inches in length is made, beginning an inch or two below the transverse lumbar processes, and midway between the last rib and the point of the hip. This incision is either vertical, or downward and forward, extending through the skin and subcutaneous tissues to the external oblique muscle. With the end of the closed artery forceps a puncture is made in the muscle, equidistant from the commissures of the skin incision. The forefinger is inserted in the puncture, and the muscle fibres gradually spread apart until the internal oblique comes into view. Repeat the procedure on this muscle, and finally, after separating the fibres of the transversalis in a like manner, the peritoneum is reached. This is picked up by the artery forceps, punctured by the knife, and the opening enlarged by the introduction of the forefinger and gradually the entire hand. Some prefer to cut the muscles, instead of separating their fibres. The uterus is located, and the right horn traced to its ovary. This is removed by the emasculator, which has been introduced into the peritoneal cavity parallel to the arm. Holding the right ovary in the palm of the hand, the left ovary is then located and removed. Both ovaries, as well as the emasculator, are brought to the outside at the same time. The nature of the opening through the several muscle layers favors its early closure, making suturing unnecessary. The skin incision is closed by linen sutures, which may be interrupted or uninterrupted. Undiluted creolin, or lysol, may be smeared over the closed incision and boric acid dusted into this, which together

with the slight amount of blood present, forms a protective crust.

The median line operation is advised for yearlings. With the exception of the restraint, the steps leading up to the operation are practically the same as the foregoing.

Restraint

This is carried out in a barn or shed high enough for a triple tackle block outfit to be used to advantage. At least two good strong assistants are necessary - three would be better. A number of yearlings are driven into a pen or box stall, and each in turn is caught and led or dragged to the point where the tackle is firmly secured to an overhead beam or rafter. The quieter and tamer the animal, the easier the work will be. Leather hobbles about eight inches in length, with two inch rings in one end, and one and a half inch rings in the other, are passed around the animal's pasterns and the smaller rings passed through the larger ones. A "singletree" is hooked into the smaller rings and the large ring in the middle of the "singletree" is hooked into the "bucket" (hook) on the lower, or single block. This must be done dexterously, and the animal raised off the ground by means of the tackle, as quickly as possible. The animal is then lowered so that while the head and shoulders are resting on the ground, the hind parts are suspended at a height that will bring the site of the incision about three feet from the ground. This position produces a somewhat concaved condition of the abdominal wall very advantageous to the operation. A rope is looped around the front feet, and is either tied to some nearby post, or held by one of the assistants. The site of the laparotomy incision is in the median line, and begins about two inches anterior to the two front teats. Like the flank incision, it is just long enough for the passage of the hand. The hair at the site of the incision is clipped and further treated as in the

flank operation. The instruments - which are the same as those used in the flank operation - are boiled, and the surgeon's arms and hands are disinfected.

The incision is carried through the skin, linea alba and rectus muscle. The peritoneum is brought out through the opening with artery forceps, first "nicked" with the knife, and the opening then enlarged for the passage of the entire hand. The ovaries are located readily, and can be drawn outside the abdominal cavity very easily. However, it is better to remove them intra-abdominally by means of the spaying emasculator. The laparotomy incision is closed by heavy linen sutures passing through the skin, muscles, and peritoneum. The sutures may be either interrupted or uninterrupted as best suits the operator. The sutured incision is dressed in the manner described in the flank operation.

The advantage of the median line, over the flank operation for yearlings is that it seems to be less severe. The somewhat tedious "boring" through the muscular flank region is not borne as well as the median line procedure in animals of this age.

The following cases are selected as representative:

No. 1 - Black Grade Aberdeen Angus, 3 years old, weight about 1150 lbs. Technic as described under "flank operation." Recovery with good results.

No. 2 - Red and white Grade Hereford, 2 years old, weight about 950 lbs. Technic as described under "flank operation." Recovery. Animal weighed 200 lbs. more at 3 years of age than those unspayed of the same age.

No. 3 - Red Grade Shorthorn, 2 years old, weight about 900 lbs. Technic as described under "flank operation." Recovery. Ani-

mal weighed 200 lbs. more at 3 years of age than unspayed heifers of same weight and quality at the time of operation.

No. 4 - Black Grade Aberdeen Angus, 15 months old, weight about 700 lbs. Technic as described under "median line operation." Recovery and good results.

No. 5 - Red and white Grade Hereford, 15 months old, weight about 750 lbs. Technic as described under "median line operation." Recovery, with very marked increase in weight, in comparison with heifers not spayed of the same weight at the time of operation.

No. 6 - Red and white Grade Hereford, 12 months old, weight about 600 lbs. Technic as described under "median line operation." Recovery with very favorable results. When marketed as a 3 year old, this heifer weighed 250 lbs. more than the unspayed heifers of the same age.

THE EWE

There is a scarcity of literature on the anatomy of the Sheep. Chauveau, in referring to the uterus says, "In the Sheep the arrangement is the same as in the Cow except that the cotyledons are hollowed like a cup in the center, and deserve their name. The cornua are longer and more pendulant than in the Cow." The same author states that "they (canals of Gaertner) are not present in the Sheep. In the Sheep, the labia of the vulva have several folds externally, and the inferior commissure terminates in a point." Ellenberger, in his "Leisering's Atlas of the Anatomy of Domestic Animals," referring to the cotyledons of the ewe, says, "they are hollowed out like cups, and on this account are called uterine cups." Sisson makes no reference to the anatomy of the Sheep, and Strangeways refers in a general way to the comparative anatomy of Ruminantia, making no reference to the anatomy of the Sheep in particular.

Indications for removal of the ovaries

Under date of February 4, 1920, Dr. E. T. Baker, Moscow, Idaho writes as follows: "In reply to your query in regard to spaying of ewes, will say that it is not practiced to my knowledge." Dr. Baker is considered the leading authority on sheep practice in the United States.

Dollar makes the following statements: "Female lambs are seldom castrated. Obich operated on ten-weeks-old animals from the left flank. The incision was sufficiently large to admit the index and middle fingers into the abdomen. The ovaries were drawn towards the opening and were snipped off with scissors. In twelve cases healing was uninterrupted, but in one lamb an abscess occur-

red at the point of operation. Hering castrated six two-year-old sheep for the purpose of discovering whether the yield of wool would prove greater after operation. In two, only the left ovary could be reached. The operation was well borne, though it failed in its object. The animals fattened earlier than their fellows."

Rushworth makes the following statements: "This is the removal of the ovaries of the female, a counterpart of the operation of castrating the male, and while it is rarely performed on ewes, owing to the fact that their breeding qualities are more to be valued than the slight improvement in the mutton and facility to fatten which this operation is supposed to confer, still as it is a common operation on other classes of she stock, notably swine and cattle, and as beyond a doubt a spayed female will take on flesh quicker, and do better as a feeder than one which is entire, which would be an advantage in fitting ewes for exhibition in the fat stock class, we shall briefly describe here the modus operandi of the operation. Place the ewe on its back on an inclined plank, having assistants to hold the subject securely in position; make an incision directly back of the umbilicus (navel) extending backwards towards the mammae about two inches in length, cutting directly through the skin and subcutaneous structures, exposing the lining of the abdominal cavity (peritoneum); pierce this by inserting the knife at right angles to the body of the subject, and widen the opening sufficiently to permit the insertion of the first two fingers of the hand. By reaching backwards, and slightly to one side the horn of the uterus will be felt. This can be traced forwards until the ovary manifests itself, situated at the extremity of the cornua. Bring the ovary to the surface and hold it with one hand, employing the fingers of the other to trace and secure the other

ovary, the possession of the first materially assisting in finding its fellow. The ovaries are twisted off to prevent hemorrhage which would be liable to occur if the parts were directly cut with the knife. The horns of the uterus are then returned to the abdominal cavity, and the lips of the incision brought together by sutures. It is well to take one deep suture through the skin, abdominal walls, and peritoneum, and two superficial ones through the skin, just bringing the edge of the cuticle in apposition. The sutures should not bring the edges of the wound tightly together, as the inflammation which always results would tend to tear out the stitches, which would be followed by serious if not fatal results. The after-treatment consists in dressing the seat of operation with pine tar, or some such agent to keep the wound in an aseptic condition and prevent attacks of the fly."

THE SOW

The ovaries are enveloped in a fold of the mesosalpinx, and each has a well marked hilus. Their surfaces show rounded prominences giving them a mulberry-like appearance.

The Fallopian tubes are long and less flexuous than in the mare. The fimbriated extremities have large abdominal openings.

The uterus is peculiar on account of its short body, and extremely long and flexuous horns. The cervix is remarkably long, and is continuous with the vagina, without forming a projecting intravaginal portion.

The vagina is about four inches in length. It has thick muscular walls, and is small in calibre.

The vulva is long, as is also the clitoris.

Indications for removal of the ovaries.

The operation is not extensively practiced at the present time for the reason that swine attain their growth at a comparatively early age, and often are fattened and sent to market before they are one year old. Oöphorectomy hardly would be worth while under these conditions, as it would take longer for the desired effects of the operation to manifest themselves, than could be expected in the few months interval between the date of the operation and the marketable age.

Dollar says, "The castration of the sow is gradually being discontinued. The improved races of swine exhibit sexual appetite to a less degree than the old breeds. They remain in heat for a shorter time, and their fattening suffers little in consequence, so that castration has become more or less superfluous."

After reciting some of the reasons why the spaying of sows is seldom practiced at the present time Merillat says, "Nevertheless, it being a fact that veterinarians are occasionally called upon to perform this operation, its performance should not become a lost art."

Oöphorectomy

This is the operation which usually is performed, and preferably at about three months of age.

Preparation of the Patient

The diet should be restricted for twenty-four hours.

Restraint

Assistants hold the subject on a table or bench, left side uppermost.

Anaesthesia

None.

Preoperative Procedures and Technic of the Operation

The hair is clipped or shaved from the region of the left flank, and this area scrubbed with soap and water. The parts are then washed with a disinfectant, or painted with iodine. The instruments consist of a Miles' castrating knife, two pairs of artery forceps, and a spaying needle. These are boiled, and the surgeon's hands disinfected. An incision is made in the skin about two inches in length. This is carried through the muscles down to the peritoneum, which is picked up by the forceps and incised. The first and second fingers of one hand are inserted into the peritoneal cavity, and passing above the bladder, the uterus is located and brought out through the incision. Traction on each horn in turn brings its ovary through the incision. The ovaries are removed by torsion with the artery forceps, and the uterus is re-

turned to the abdominal cavity. The incision is closed by one or two linen sutures, and the operative area is smeared with creolin or lysol, and dusted with boric acid.

The after-treatment consists in keeping the animals quiet in clean comfortable quarters, or at pasture if the weather is suitable.

The following cases are selected as representative:

No. 1 - Black, Grade Poland China, 4 months old, weight about 100 lbs. Technic as described. Recovery.

No. 2 - Black, Grade Poland China, 6 months old, weight about 150 lbs. Technic as described. Recovery.

No. 3. Black, Grade Poland China, 6 months old, weight about 150 lbs. Technic as described. Recovery.

THE BITCH

The ovaries are small, oval and flattened, and are situated just behind the corresponding kidney. Each ovary is covered by a peritoneal pouch called the bursa ovarii, which is continued to the cornu of the uterus, thus forming the mesosalpinx and ovarian ligament.

The Fallopian tubes are almost straight. Their fimbriated extremities have large openings.

The uterus has a short body and long cornua. The cornua are nearly straight, and lie within the abdominal cavity. The cervix is short, and has a thick muscular coat. The round ligaments are long, and extend through the inguinal canals.

The vagina is comparatively long. The muscular coat consists chiefly of circular fibres, and the mucous membrane forms longitudinal folds.

The vulva has thick labia. There is a depression on each side of the urethral orifice. The clitoris is small with a pointed glans.

Indications for removal of the ovaries

The bitch is more commonly spayed than any other animal, and it behooves veterinarians, especially those engaged in city practice, to become skillful in performing this operation - to try to do the very best operation possible.

As already intimated, the principal indication for oöphorectomy in the bitch is to prevent the disgusting manœuvres peculiar to their kind while "in heat." Many good authorities contend that all bitches which have no breeding value should be spayed, and thus limit the production of enormous numbers of undesirable canines. From

a humanitarian standpoint the argument is that the operation would eliminate the suffering incident to parturition, and prevent the precarious existence of unwelcome - as well as unlicensed - puppies, which, when finally discovered by the authorities, must necessarily be destroyed.

An unsexed bitch is more dependable as a hunting or stock dog, than one that is entire, for the reason that she is more even tempered, and - as mentioned in connection with the mare - is not upset by oestral excitement. In animals which are kept merely as pets, it is unnecessary to mention the advantages conferred by this operation.

Another reason in favor of spaying the bitch is that in many parts of the country the license fee on a spayed bitch is the same as for the male animal; while the annual license fee for an unspayed bitch may be as high as \$10.00, or in some communities even higher.

Possibly the most important reason of all for performing this operation is, that the congregating of large numbers of male dogs of all sorts and conditions in the vicinity of the home of a bitch "in heat" - regardless of whether she be at large, or confined within doors - is not only a disgrace to the neighborhood, but may be the means of disseminating almost any infectious disease to which the species is subject. To those who have witnessed the familiar spring-time scene of ten or fifteen snarling, fighting dogs skirmishing on the lawn or on the school-grounds, this argument should appeal with full force.

The advantages of operating during the period of puppyhood cannot be overestimated. This applies to the results, as well as to the operation itself. If spayed at an early age, there seems to be no tendency for the patient to lay on an increased amount of

fat, which occasionally ensues when following the operation on a matured animal. Further, if operated before the first oestral period, it is almost certain that the patient never will exhibit the slightest symptoms of being "in heat," and will remain as active and alert - possibly more so - than if she had not been unsexed.

Hystero-Oöphorectomy (Puppy Operation)

In carrying on this work, we have sought to perfect a procedure of hystero-oöphorectomy in the young female dog without inserting the finger through the laparotomy incision, and in which the uterus could be brought outside the abdominal cavity through a very small incision by means of instrumentation.

The operation should be limited to puppies from two to six months of age, as anatomical changes such as growth in the diameter and length of the structures involved, with relative shortening of their attachments, as well as certain changes in their relative positions within the abdominal cavity, render the operation impossible in the mature animal.

Preparation of the Patient

The diet should be restricted for twenty-four hours, and just prior to the operation catheterization may be practiced if considered necessary.

Restraint

The animal should not be confined as usually is done by attaching cords to each leg, and then stretching until the abdominal muscles, vagina, uterus, horns, and tubes are taut. Relaxation is imperative. After the animal has reached the proper stage of anaesthesia, she should be placed on her back unfettered in an ordinary operating trough, so that she will lie exactly in the position of dorsal decubitus. The sloping sides of the trough materially

assist in maintaining this position, which, by the way, is absolutely necessary if one is successfully to locate the incision precisely in the median line.

Anaesthesia

This operation should not be carried out except under ether anaesthesia, as the animal must be relaxed as well as unconscious.

Preoperative Procedures and Technic of the Operation

The abdominal region is shaved, thoroughly washed with soap and water, dried, and painted with iodine. The instruments are sterilized by boiling, and the operator's hands properly disinfected. The technic of the operation is as follows:

The exact location of the laparotomy incision is first determined. An ordinary human uterine sound, the distal two inches of which has been bent to resemble the shape of a "sled runner," is passed into the vagina until it contacts the cervix, exerting just enough forward pressure on the sound to "take up the slack" in the vagina (Fig. 1). The handle of the sound acting as a lever of the first class is then depressed, the superior commissure of the vulva being used as a fulcrum. This brings the floor of the vagina just posterior to the intravaginal part of the cervix in contact with the abdominal wall, and produces an elevation easily felt, and more or less apparent (Figs. 1 and 2). This is the place for the incision. The sound is then removed, and holding a narrow bladed scalpel as one would hold a pen, an incision a quarter of an inch in length is made with the point of the knife held at right angles to the skin, and extending through the skin and muscle to the peritoneum. At this time the scalpel with its cutting edge uppermost - to avoid possible injury to the bladder - is held in such a manner that while its point is directed forward, it is in contact with the peri-

toneum, and the end of its handle is raised about two inches from the abdominal wall in the median line posterior to the incision. This gives the scalpel a forward, and slightly downward direction with the back of the blade toward the bladder (Fig. 3). It is now cautiously pushed through the peritoneum, and a grooved director slipped along the side of the blade into the peritoneal cavity. This is a very important point to remember because unless the director, or some similar instrument, is inserted before the knife is withdrawn, the chances are that the incision through the peritoneum will be "lost." With the director in the abdominal incision, the opening may be slightly enlarged so that it corresponds to the length of the skin and muscle incision. While this opening is being made the sound always should be removed from the vagina, and in no event should an attempt be made to cut down onto the elevation already mentioned (Figs. 1 and 2).

After the incision is completed, the spring dilator should be inserted. The jaws are first placed so that the incision is stretched longitudinally. The dilator is then carefully swung around until its pressure is exerted laterally (Fig. 4). The opening into the peritoneal cavity must be clear, clean-cut and unobstructed by omentum. The sound is now introduced into the vagina for the second time, and that part of the vagina already described as surrounding the cervix is carefully pushed up through the dilated incision by the proper manipulation of the sound, and grasped by forceps just below, and in front of the part covering the rounded end of the instrument. Should omentum persist in covering those portions of the vagina and the uterus which are pushed up through the incision, the parts must be returned to the abdominal cavity and another trial - or even several trials - made until the clean

uncovered structures are brought up through the opening. Attempts to grasp the region surrounding the cervix by forceps, through a fold of omentum are almost sure to prove disastrous, and are likely to terminate in rupture of the vaginal wall, with consequent protrusion of the sound. When the forceps are properly adjusted as shown in Figure 4, both the sound and the dilator are removed, and gentle traction on the forceps brings into view the remarkably short body of the uterus as far forward as its bifurcation. One of the horns is grasped between the thumb and forefinger, and by steady traction the ovary is brought outside of the abdominal cavity, and secured as shown in Figure 5. Occasionally, difficulty may be experienced in securing the ovaries - especially the right one. In this event an assistant should raise the hind parts of the animal by placing the hand under the hips, at the same time pushing forward, thereby flexing the vertebral column, and further relaxing the structures involved. A ligature may be placed back of the forceps (Fig. 5), or, if ligation is unnecessary, it is a very good plan to adjust another pair of forceps either above or below the first pair, and by carefully rotating the uppermost pair, rupture the tissues. The other ^{ovary} _^ is removed in a like manner, and a curved Ferguson angiotribe applied to the body of the uterus just posterior to the bifurcation (Fig. 6). Again as in the case of the ovarian attachments, ligation may be done at this point, or the uterus may be grasped with forceps close up against the concave side of the Ferguson, and removed by torsion. The uterine stump is released from the Ferguson, and allowed to slip back into the abdominal cavity.

In following the different steps of this operation it will be noted that no structure to be replaced within the abdominal cavity is touched by the fingers, which fact should reduce the dangers

of infection to a minimum.

Unless the laparotomy incision exceeds a quarter of an inch in length, a suture is superfluous. However, as some may prefer to use a suture, the method of placing it will be described.

Before starting to place the suture, the spring dilator is again adjusted in the incision so that the jaws will stretch it longitudinally (Figs. 7 and 8). This is done so that the skin, muscle, and peritoneal incisions will be exactly in the same vertical plane, thereby making it possible to place the suture equidistant from the wound commissures in all three layers. The method of placing the suture is shown in Figures 7 and 8.

The suture should be removed in eighteen hours. If it has been too tight, thereby causing inversion of the margins of the wound, and preventing apposition of the cut edges, the skin incision may "gape" slightly after removal of the suture. This is of no consequence, as the skin wound will heal readily by granulation, and no apprehension need be felt in regard to the deeper layers. If the tension of the suture has been just right, and the margins of the wound have been in apposition from the time the suture was placed until its removal at the end of eighteen hours, it will be found that adhesion of the margins of the wound is well advanced, and unless the wound becomes infected, there will be very little evidence after a few days to show that an operation has been performed. Figure 10 shows a case in which a suture was used. Figure 11 shows a case in which no suture was used.

In about 200 cases operated on in this manner, the uterine horn was ruptured in three cases in attempting to draw the right ovary outside of the abdominal cavity, and in four cases the sound was pushed through the vaginal wall.

The advantages of operating early in life, as bearing on the subsequent mental and physical condition of the patient, have been mentioned. The advantages of the operation itself are: (1) the age at which it can be performed - insuring a minimum of shock, (2) the small amount of cutting, and handling of tissues, (3) keeping the fingers out of the abdominal cavity, (4) suturing of the laparotomy incision usually unnecessary, and (5) an operation pleasing to the client, therefore, one that will gain prestige for the surgeon.

Attention will now be drawn to some accidents which may occur, and certain difficulties which may be encountered, in performing this operation. All of these must be guarded against through the good judgment, and individual ingenuity of the operator.

The descriptions of the various steps must be gone over thoroughly, and the cuts carefully studied, before the operation is attempted. If approached before the details are thoroughly understood and firmly fixed in the surgeon's mind, failure may result from any of the following causes: (1) Inserting the sound in the bladder instead of in the anterior end of the vagina. This accident is almost impossible. (2) Improper location of the laparotomy incision (Figs. 1 and 2). (3) Injury to the bladder, or intestines while making the laparotomy incision (Fig. 3). (4) Improper placing of the retractor, with insufficient dilatation of the laparotomy incision (Fig. 4). (5) Puncture of the vaginal floor with the end of the sound, due to excessive pressure exerted by the instrument while pushing the tissues through the laparotomy incision (Fig. 4). (6) Difficulty in grasping with forceps the posterior part of the uterine wall, on account of its being enveloped either by omentum, or by the peritoneal fold surrounding the urachus (Fig. 4). (7) Rupture of the uterine horn while attempting to draw the ovary

outside the laparotomy incision. It would seem that further comment is necessary only as regards two of the possibilities mentioned.

Injuries to the urinary bladder and the intestines will be considered first. It is advisable to empty the bladder by means of digital manipulations made through the abdominal wall, preliminary to the operation. Usually this can be accomplished with little difficulty after the animal is anaesthetized and relaxed. By referring to Figure 3, it will be noted that the point of the knife, with its cutting edge uppermost, enters the peritoneal cavity just far enough to produce such an opening in the peritoneum as will admit of the introduction of the point of a grooved director. The point of the directors - its grooved side against the flat of the blade and handle, and in the same plane - is pushed into the peritoneal cavity. The knife is then withdrawn. With the director in the opening, its point turned backward, the peritoneal incision is then sufficiently enlarged. If the bladder has been emptied, and the incision cautiously made as described, there is no danger of injuring that organ. If the diet has been restricted, as usually is the case preceding this operation, there is little danger of intestinal puncture.

The other condition to which reference will be made, is the one occasionally encountered in which it seems almost impossible so to manipulate the sound that neither omentum, nor the serous fold surrounding the urachus will be brought out through the incision along with, and covering, the posterior portion of the uterus. If, after repeated trials, this condition persists, it may be necessary to have an assistant hold the handle of the sound with the posterior uterine region pushed out through the incision, while the opera-

tor with small artery forceps clears away the tissues mentioned, so that a firm hold of the uterine wall may be secured by the very tips of the jaws of the instrument (Fig. 4). As already intimated, puncture of the vaginal floor may be a result of too much manipulation during this stage of the procedure.

This is not a difficult operation, but is one in which the details must be followed very closely in order to insure a perfect result. If things go wrong, the operator is very likely to give up in disgust, and become prejudiced against the entire procedure.

Oöphorectomy and Hystero-Oöphorectomy (In more mature subjects)

The ovaries alone, or the ovaries and the uterine horns - or even the body of the uterus - are excised according to the judgment of the operator. Unless the horns, or their ligaments, are injured by traction in the process of being used as guides to their respective ovaries, there is no occasion for removing them, and a simple oöphorectomy is indicated.

Preparation of the Patient, Restraint, and Anaesthesia

Practically the same as described under the "Puppy Operation," with the exception that morphine and atropine in combination, or morphine alone, may be given in place of the other, as complete relaxation is not imperative in the operation to be described.

Preoperative Procedures and Technic of the Operation

The abdominal region is shaved, thoroughly washed with soap and water, dried, and painted with iodine. The instruments are sterilized by boiling, and the operator's hands properly disinfected.

Since the location of the laparotomy incision is a very important point, it is worthy of some discussion. Five different text-books on canine surgery have as many different suggestions for

the location of the laparotomy incision. They are as follows:

- (1) "An incision made in the linea alba at the umbilicus, with a sharp-pointed bistoury, cutting toward the diaphragm."
- (2) "The incision extends across the umbilicus."
- (3) "The incision should be made slightly to either side of the linea alba, and immediately posterior to the umbilicus."
- (4) "An incision is made in the median line, midway between the umbilicus and the pubis."
- (5) "The incision is made immediately in front of the pubis, and extends forward."

Therefore, according to these authorities, the operator is offered a wide range in the selection of the site for incision. In addition to the three intermediate possibilities offered, he may begin as far forward as just anterior to the umbilicus, or as far backward as just anterior to the pubis. The length of the incision recommended varies from one "just large enough to freely admit the index-finger," to one "two inches in length, or longer if necessary."

Each of the locations mentioned as desirable for the laparotomy incision has its advantages, as well as its disadvantages. When the ovaries are once located, it is much easier to draw them out through an incision that is made well forward. On the other hand, the farther forward the incision, the more difficult it is to locate the uterine horns. For this reason, operators who rely upon first picking up the uterine horns as guides, and then following them forward to the ovaries, do not recommend an incision anterior to the umbilicus. The other extreme - an incision just in front of the pubis - renders the location of the uterus and its horns comparatively easy, but in a mature animal, especially if long-bodied, great difficulty is likely to be encountered in drawing the ovaries back through an incision located so far posteriorly.

The only means of correcting this difficulty is either to extend the incision far enough forward, so that the ovaries can be brought outside the abdominal cavity - in order that suitable hemostasis may be applied to their attachments - or, to assume the risk of rupturing these attachments by inserting the index-finger far forward into the peritoneal cavity, and then, by scraping the tissues with the finger nail, effect a separation. Neither of these procedures may be considered good surgery: In the one, too long an incision is necessary to secure the ovaries and provide for appropriate hemostasis - in the other, no adequate method is provided for controlling the hemorrhage that is very apt to follow the intra-abdominal method of rupturing the ovarian attachments, especially in adult animals.

A location approximating a "happy medium" seems to be preferred by most operators. An incision three quarters of an inch to an inch in length, beginning at a point one third of the distance from the umbilicus to the pubis, and in the median line, will be found very satisfactory. Little difficulty is experienced in locating the horns at this point, and the ovaries may be drawn out through the opening, and appropriate hemostasis applied to their attachments, without undue tension on the horns. If the incision is well dilated, the intestines comparatively empty, and a good light obtainable, it often is possible to pick up and draw out the horns with forceps, thereby making it unnecessary to insert the finger through the laparotomy incision.

In mature animals it is best to ligate the ovarian attachments (mesovaria), including all vessels. Silk or catgut may be used for this purpose. If the ovaries alone are to be excised, other ligatures are passed around the Fallopian tubes, the ovarian ligaments, and their accompanying vessels. The ovaries are removed

by torsion with artery-forceps.

If for any reason, it seems advisable to remove the horns, the ligations are made proximal to the points where the amputations are to be made, and great care should be taken to include all blood-vessels within the ligatures.

The laparotomy incision should be closed by two silk or linen sutures, passing through the skin, muscle and peritoneum. One of these sutures - preferably the one that is causing the most irritation - may be removed in two days. The other, a day or two later.

The following points will now be considered: (1) whether or not the use of a sound for the purpose of facilitating the location of the uterus is permissible; (2) whether in the majority of cases the sound is passed into the uterus or goes no farther than the anterior extremity of the vagina; and (3) whether or not there is great danger of passing it into the bladder.

Some authorities deprecate the use of a sound, and refer to its employment as "unwarranted," "practiced only by the novice," and "bunglesome." The following quotations are taken from textbooks on canine surgery: (1) "Some operators believe the uterus may be more easily distinguished by first introducing a probe, catheter, or sound into the fundus of the organ by way of the vagina. This is an amateurish method and hinders rather than expedites the operation." (2) "Some operators introduce a sound into the uterus previous to the operation, but this as a rule is unnecessary, as familiarity with anatomy will easily detect the difference between the intestine and the fallopian tubes." Commenting on the second quotation, which is from a prominent authority (Glass), it would seem that there could be no possibility of mistaking the intestine for a Fallopian tube, since the diameter of the small intestine by actual

measurement in the same individual is from sixteen to twenty times as great as that of the Fallopian tube in a normal condition. No doubt the author intended to refer to the uterine horns, and not to the Fallopian tubes. Unless it can be shown that damage is done to the parts through the introduction of the sound, there can be no valid objection to the practice. Any procedure that will facilitate and make positive the absolute location of an organ, or part, should not be discouraged, and may well be practiced as a routine measure even by the most skilled operators.

In the beginning of this work the writer was of the opinion that a sound passed into the vagina, could proceed through the cervical canal into the uterus. Text-books referred to "introducing a sound into the uterus" (see preceding paragraph) and without giving the matter much serious thought, or studying the anatomy of the parts, the statement was accepted without question. More recently, while making a study of the parts, attempts have been made to pass a straight sound, with a rounded head three millimeters in diameter (about the size of a match-head), through the services of several hundred bitches, both living and dead. Except in the cases of a very few large mature animals, the procedure has been uniformly unsuccessful, and in spite of the most careful manipulations, the end of the sound has come to a stop at the anterior extremity of the vaginal canal.

Whenever the occasion presented itself, the following experiment has been made on bitches that have died from various causes in the laboratory of experimental surgery: First, the abdominal viscera have been exposed by an incision made through the linea alba, extending from the xiphoid cartilage to the pubis. The sound mentioned has been introduced into the vulvo-vaginal until it came

in contact with the cervix. With the fingers of the left hand, the uterus and vagina have been brought up into the field, and while the sound - directed by the right hand - has been gently pushed and rotated against the opening of the cervical canal, manipulation of the vaginal wall surrounding the head of the sound has been made with the fingers of the left hand, in an attempt to work the end of the instrument into the external os. Usually the attempt has been unsuccessful.

As may be noted in the diagram reproduced from Sisson's "Text-Book of Veterinary Anatomy," shown herewith, the intravaginal part of the cervix in the bitch is well marked, and projects backward into the vagina not unlike the cervix of the mare, except that dorsally it is continuous with the roof of the vagina, which produces a break in what otherwise would constitute an annular space surrounding the structure. Few practitioners would think of attempting to pass a sound of any size into the vulva-vaginal canal of a mare, and expect it to proceed unaided through the cervical canal into the uterus. It would not be reasonable to suppose that a sound with a shaft, say, one-half inch in diameter and possessing a head the size of a hen egg, would enter the cervix of a mare, unless the hand was first inserted in the vagina, the cervix dilated, and the end of the sound carefully guided into the external os by the fingers. By simply inserting the sound in the vulva, and then pushing it forward, it would be expected that the end of the instrument would pass to the side of the cervix, instead of into the cervical canal, and come to a stop in the annular space - the fornix vaginae - surrounding the base of the structure. This is exactly what does happen in the majority of cases when a like procedure is attempted in the bitch, as is easily demonstrable on the dead sub-

ject. The fact that the sound usually does not enter the uterus, but stops in the anterior vaginal region, renders the procedure no less useful as an aid in locating the uterus.

There is little danger of passing the sound into the external urethral orifice in the bitch. This orifice is so situated on the pelvic floor, just anterior to the ischial arch, that unless the sound is bent to a certain angle, it is almost impossible to effect an entrance into the bladder. In experimental laboratories where it is necessary to practice catheterization extensively, a vaginal speculum is first introduced, and then so manipulated that the external urethral orifice is drawn backward and downward over the edge of the ischial arch, where it can be seen, and the catheter inserted.

The following cases are selected as representative:

No. 1 - Black mongrel, 4 months old, weight 10 lbs. Anaesthesia and technic as described under "Puppy Operation" (Hystero-oöphorectomy). Laparotomy incision one half inch in length, was closed by one silk suture, which was removed in eighteen hours. Healing of wound by first intention. Uneventful recovery.

No. 2 - White poodle, 3 (?) years old, weight 18 lbs. Morphine anaesthesia. One half grain of the drug was administered hypodermically 30 minutes before the operation, followed by another half grain 20 minutes later. Digital examination made through the laparotomy incision showed the patient to be pregant. The foeti were about one inch in length, and one half inch in diameter. Hystero-oöphorectomy was performed. The mesovaria including the ovarian vessels, and the fundus of the uterus including its vessels, were ligated with silk, and all structures between the ligated points were removed en masse through a laparotomy incision one

inch in length. The incision was closed by two interrupted linen sutures passing through the skin, muscles, and peritoneum. One suture was removed the second day after the operation, the other, the third day after the operation. Healing by first intention. Uneventful recovery.

No. 3 - Black mongrel, 10 months old, weight 22 lbs. Morphine anaesthesia as described in the preceding case. Laparotomy incision $3/4$ of an inch in length. Hystero-ophorectomy was performed. A Ferguson angiotribe was placed upon the mesovaria and the ovarian vessels, leaving room between the angiotribe and the ovary for the attachment of a pair of artery forceps, manipulation of which produced torsion and separation of the structures between the two instruments. The laparotomy incision was closed by two interrupted linen sutures which were removed on the third day. Healing by first intention. Uneventful recovery.

No. 4 - Brindle bull terrier, 9 months old. Brought by owner to be spayed, but on account of suffering from bronchitis, the operation had been postponed for several days. On February 5th the temperature was 102 at 12 M. On February 6th 101.8 at 9 A.M., and 102 at 4 P.M. On February 7th 101.8 at 9 A.M. Operation was decided upon at noon February 7th. As ether was contra-indicated on account of pulmonary complications, morphine was administered as in Case No. 2. Usual technic preceding a laparotomy was employed. Laparotomy incision $3/4$ of an inch in length was attempted in one half hour after the first administration of the morphine. Patient was not insensible to pain, and whined and struggled violently. After completing the laparotomy incision which was accomplished with difficulty, it seemed advisable to finish

the anaesthesia with ether, even though its administration might be attended with more or less danger to the patient. Although a considerable quantity of ether was given, the patient continued to strain, struggle, and twist about so violently, that several attempts were made before the left uterine horn could be brought up through the incision by the finger. The straining was so intense at one time that a loop of the small intestine was forced through the incision. After the cornua were finally brought outside, a simple oöphorectomy was performed. The mesovaria and accompanying vessels, and the Fallopian tubes and their vessels just anterior to the extremities of the horns were ligated with silk, a Ferguson angiotribe adjusted between the ligations and the ovaries, and the latter removed by torsion with artery forceps. The laparotomy incision was closed by two sutures of braided silk (No. 5) extending through skin, muscles, and peritoneum. As the operation had lasted over half an hour, it was feared that the results of extensive and prolonged intra-abdominal manipulations, combined with the bad effects of ether anaesthesia in her condition might prove disastrous. A careful record kept for several days subsequent to the operation showed that the patient's temperature did not rise more than one degree, at no time did she appear to be sick, nor was her cough aggravated in the least. There was considerable infection present at the site of the laparotomy incision, and it seemed advisable to remove the sutures after about 48 hours, to liberate the pus. This permitted the skin incision to "gape open" slightly. Patient was discharged February 12, 1920 and made an uneventful recovery. This case was interesting on account of the peculiar pathological and surgical complications attending it.

No. 5 - Black and white fox terrier, 5 years old, weight 21 lbs. Had produced several litters of puppies. Very fat. Ether anaesthesia. Laparotomy incision one inch in length. Operation consisted of oöphorectomy, and removal of the uterine cornua one half inch anterior to the bifurcation. Mesovaria and their vessels, and the cornua and their vessels were ligated with silk. Laparotomy incision closed by two interrupted braided silk (No. 5) sutures. Sutures removed on third day. Uneventful recovery.

No. 6 - Black and white mongrel, 9 months old, weight 25 lbs. Ether anaesthesia. Laparotomy incision $3/4$ of an inch in length. Operation same as No. 5. Left mesovarium and its vessels ligated with catgut. Right mesovarium was ruptured through tension in drawing the ovary out through the incision, rendering ligation impossible. The uterine cornua and their vessels were ligated with catgut. There was no apparent hemorrhage. Laparotomy incision closed by two interrupted catgut sutures, which were removed on the third day. Uneventful recovery.

No. 7 - Brindle bull terrier, 4 months old, weight $11\frac{1}{2}$ lbs. Anaesthesia and technic as described under "Puppy Operation" (Hystero-oöphorectomy) with exceptions as noted later. The laparotomy incision was only one quarter of an inch in length, and after the body of the uterus had been removed by torsion (see Fig. 6) the angiotribe was released before the next step of passing the end of the grooved director into the abdominal cavity was carried out. This permitted the stump of the uterus to retract into the abdominal cavity, and the laparotomy incision through the muscles and peritoneum could not be found. The opening was hopelessly lost. As it was impossible to place the usual single suture under

these conditions, it was omitted. The skin incision healed by first intention, and recovery was uneventful. Probably this is the first time that a bitch has been spayed under similar conditions, i.e., through as short an incision - one quarter of an inch in length - and requiring no suture. (See photograph.)

No. 8 - Yellow and white collie, 3 months old, weight 7 1/2 lbs. Anaesthesia and technic as described under "Puppy Operation" (Hystero- δ phorectomy) with omission of suture. Healing of wound by first intention. Uneventful recovery.

No. 9 - Yellow and white collie, 3 months old, weight 5 3/4 lbs. Anaesthesia and technic as described under "Puppy Operation" (Hystero- δ phorectomy) with omission of suture. Healing of wound by first intention. Uneventful recovery.

No. 10 - Black and white collie, 3 1/2 months old, weight 9 1/4 lbs. Anaesthesia and technic as described under "Puppy Operation" (Hystero- δ phorectomy) with omission of suture. As the diet of this puppy had not been restricted, considerable intra-abdominal pressure was present. After the left ovary had been excised, and while exerting traction on the right uterine horn in the attempt to draw its ovary through the small laparotomy incision (one-quarter of an inch in length), the horn was ruptured at its anterior extremity. No doubt this accident was due to the fact that omentum had pushed up into the opening, and becoming "wedged" there, interfered with the free passage of the ovary. Nothing further was done at this time to secure the right ovary.

As this puppy had an enlargement at the umbilicus, it was thought best to operate upon it while she was anaesthetized. The enlargement, which was about the size of an acorn and very firm,

was shaved and painted with iodine. A median line incision was made down upon it, and it was found that the contents of the sac consisted of omentum and fat. The opening through the muscle and peritoneum was barely large enough to pass the end of a grooved director, and through this opening extended the "neck" of the omental mass. The omentum was dissected away, and the hernial opening through the muscles and peritoneum enlarged until it was about one half inch in length. The margins of the opening were carefully trimmed, and then closed by two interrupted silk sutures extending through the muscles and peritoneum. Three interrupted silk sutures were taken in the skin incision, and were removed on the third day. Healing of the laparotomy, and hernia, skin incisions by first intention.

On the fifth day following these operations, the puppy was operated for removal of the right ovary. The region of the right flank was clipped, thoroughly washed with soap and water, shaved, dried, and painted with iodine. The patient was anaesthetized with ether, and a vertical incision three-quarters of an inch long was made, high up in the flank, and about half an inch posterior to the last rib. After controlling all hemorrhage from the skin and muscle incision, the peritoneum was drawn up into the opening with forceps, and carefully incised. The index-finger was passed into the peritoneal cavity and the ovary located with very little difficulty, near the point of the incision. It was brought outside of the abdominal cavity and removed by torsion. One catgut suture was placed in the muscle-peritoneal incision. The skin incision was closed by three linen sutures, and painted with iodine. The lower skin suture was removed the next day - the remaining two, on the second day.

THE CAT

No mention is made of the female genital organs of the cat, in any of the standard text-books on the anatomy of the domestic animals. Slight reference is made to these organs in certain works on surgery. Williams (W. L.) says, "The uterus and ovaries of the cat are naked, and far more easily distinguished than in the bitch, there being no extra deposit of fat in the broad ligament." Lacroix states that "The principal structural differences in the parts directly concerned for the operation of spaying, between the cat and the dog, are that the cat possesses a very thin abdominal wall, longer uterine horns, and smaller ovaries. The oviducts and ovaries of the cat are not dissimilar to those of the sow."

Indications for removal of the ovaries

The same as in the bitch, although as a usual thing the behavior of the feline species during oestrus, is much less obscene than that of the canine.

Hystero-osthorectomy (Through the flank)

This is the operation usually performed. The median line incision through the linea alba is not recommended in cats for the reason that herniae may follow laparotomy incisions in this location due to thinness of the abdominal wall. Stitch abscesses, accompanied by burrowing of pus between the abdominal muscles, and necrosis are also very likely to occur. It is probable that necrosis is due to the tension which is brought to bear upon the sutures in this location, which, in cutting off the circulation, lowers the vitality of the parts. Another difficulty is that cats do not take kindly to skin stitches, and are bound to keep up a constant licking and biting of the sutured parts after the first day or two following

the operation, which, of course, is before the stitches can be removed with safety.

Preparation of the Patient

The diet should be restricted for twenty-four hours just prior to the operation.

Restraint

The patient should be wrapped in a coat or blanket, to prevent scratching while being anaesthetized. After reaching the stage of surgical anaesthesia, no further restraint is necessary.

Anaesthesia

Ether.

Preoperative Procedures and Technic of the Operation

The hair in the region of the left flank is clipped, but not shaved, for the reason that cats will not lick a clipped area with the same readiness that they will a shaved surface. All loose hairs are brushed from the operative area, which is then thoroughly washed with soap and water, dried, and painted with iodine. The instruments should be sterilized by boiling, and the surgeon's hands properly disinfected.

The anaesthetized animal is laid on a table, left side uppermost, and held by an assistant who should keep the body of the patient moderately well stretched while the location of the incision is being determined. The skin incision is vertical, and begins just below the transverse lumbar processes and extends downwards far enough to admit the finger. It is made between the last rib and the point of the hip, but a little nearer the rib. After incising the skin, the incision is drawn backward for about half an inch, and a muscle incision of the same length is made down to the peritoneum which is picked up with forceps, drawn up into the

incision, "nicked", and the opening carefully enlarged. The finger is inserted, and the left uterine cornu is drawn through the opening, followed by its ovary. The ovarian attachment may be ligated, or separated by torsion. Traction on the left horn will bring the bifurcation of the uterus through the opening, so that the right horn may be secured and its ovary brought outside the incision. The right ovary is removed in the same manner as the left. As the uterine horns have been subjected to considerable traction, and possibly some mutilation, it is best to remove them just anterior to the bifurcation, applying ligatures, or torsion to each horn.

A single catgut suture is placed in the incision through the muscles and peritoneum. This is done in the following manner: With a pair of fine pointed forceps, one wound margin - including only the muscles and peritoneum - is grasped equidistant from its commissures. The margin is everted by means of the forceps, and the needle passed through the tissues close to the point engaged by the forceps. The same procedure is repeated on the opposite side, and the suture tied. By this method, the peritoneum is sure to be included in the suture, and the tissues are held so firmly by the forceps, that the needle penetrates them much more easily than when attempting to place the suture in any other manner. The skin and muscle incisions do not approximate after the catgut suture has been placed and the skin released. The skin incision draws forward into position, and the tissues assume their normal relations to each other. The sutured muscle-peritoneal incision may be felt through the intact skin, about one half an inch posterior to the skin incision. The skin incision may be left unsutured, or two fine silk sutures may be placed in the upper half of the incision, leaving the lower half open for drainage (see reports of cases).

The site of the incision is again painted with iodine. The skin sutures are removed on the second day, and usually there is healing by first intention of the upper, or sutured, end of the incision.

The after-treatment is very important. The wound should be inspected daily for symptoms of infection, and at the first signs of suppuration, the parts should be so treated as to afford free drainage, and thereby prevent burrowing of pus between the skin and muscles. The diet should be restricted to milk, soup, or other liquid food for at least a week, and special efforts made to prevent constipation, which is likely to ensue from disinclination to endure the pain produced when the abdominal muscles are brought into play in the act of defecation.

Many veterinarians appear to dread the operation of oöphorectomy in the cat. The sensitive nervous temperament peculiar to the species, as well as marked susceptibility to infection and gastroenteritis, renders the operation much more serious than similar procedures in the bitch.

The following cases are selected as representative:

No. 1 - Gray, 5 months old, weight 5 1/2 lbs. Anaesthesia and technic as described. Small abscess developed between the skin and the underlying tissues at the upper, or sutured end of the skin incision. When the two skin sutures were removed at the expiration of 48 hours, the edges of the incision parted, and about 30 c.c. of pus escaped from the wound. Otherwise, recovery uneventful.

No. 2 - Gray, 8 months old, weight 8 lbs. Anaesthesia and technic as described. Healing of sutured end of skin incision by first intention. Uneventful recovery.

No. 3 - Black, 6 months old, weight 7 lbs. Anaesthesia and technic as described. Healing of sutured end of skin incision by first intention. Uneventful recovery.

SUMMARY

1. Ovariectomy is indicated in mares suffering from nymphomania, providing that the cause of the trouble is in the ovaries. The various modifications to the usual operative technic, as summarized on page 19, should be carried out so that the dangers attending the operation will be reduced to the minimum.

2. Oöphorectomy is indicated in cows and heifers of little, or no breeding value that are to be marketed for beef. At least one year should elapse between the time of the operation, and the date of slaughter, in order that the desired effects of the operation may become manifest. In the case of a valuable breeding animal suffering from one diseased ovary, unilateral ovariectomy is advised.

3. Oöphorectomy is not indicated in ewes.

4. Oöphorectomy may be indicated in young sows of little breeding value, if performed between two and three months of age, providing that they are not marketed until they are at least fifteen months old. This permits a year to elapse between the date of operation and the date of slaughter, thus giving time for the desired results to manifest themselves.

5. Oöphorectomy, or hysterio-oöphorectomy is indicated and should be practiced on all bitches that are of no breeding value, thereby limiting the production of worthless dogs. When possible, the operation should be performed at three or four months of age

so that the operation described as indicated for the puppy may be performed.

6. Oöphorectomy, or hysterio-oöphorectomy is indicated in cats which are to be kept for pets and not for breeding purposes, and whose owners object to their behavior during oestral periods. The flank operation is the one recommended.

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DESCRIPTION OF PLATES

Plate No. 1. Instruments used in spaying the Mare.

Plate No. 2. Instruments used in spaying the Cow.

Plates No. 3 and No. 4. Illustrating various steps in spaying the Puppy.

Fig. 1. Diagrammatic sagittal section of parts, showing how point of incision is determined.

Fig. 2. Elevation on abdominal wall due to pressure exerted by curved sound in vagina.

Fig. 3. Method of entering peritoneal cavity. (Diagrammatic.)

Fig. 4. Incision dilated laterally, with vagina pushed through, and region covering cervix grasped by forceps.

Fig. 5. Ovary drawn out through incision and held by forceps immediately behind it.

Fig. 6. Body of uterus, horns, tubes and ovaries lying on abdominal wall with Ferguson angiotribe placed on uterus just posterior to bifurcation.

Fig. 7. (At top) Method of placing suture. (Left side).

Fig. 8. (Center) Method of placing suture. (Right side).

Fig. 9. (At bottom) Incision closed by one suture.

Fig. 10. Wound forty-eight hours after operation. Suture was removed eighteen hours after operation.

Plate No. 5. Genital organs of Bitch.

Plate No. 6. Photograph of Case No. 7 (Bitch) taken four days after the operation.

PLATE I

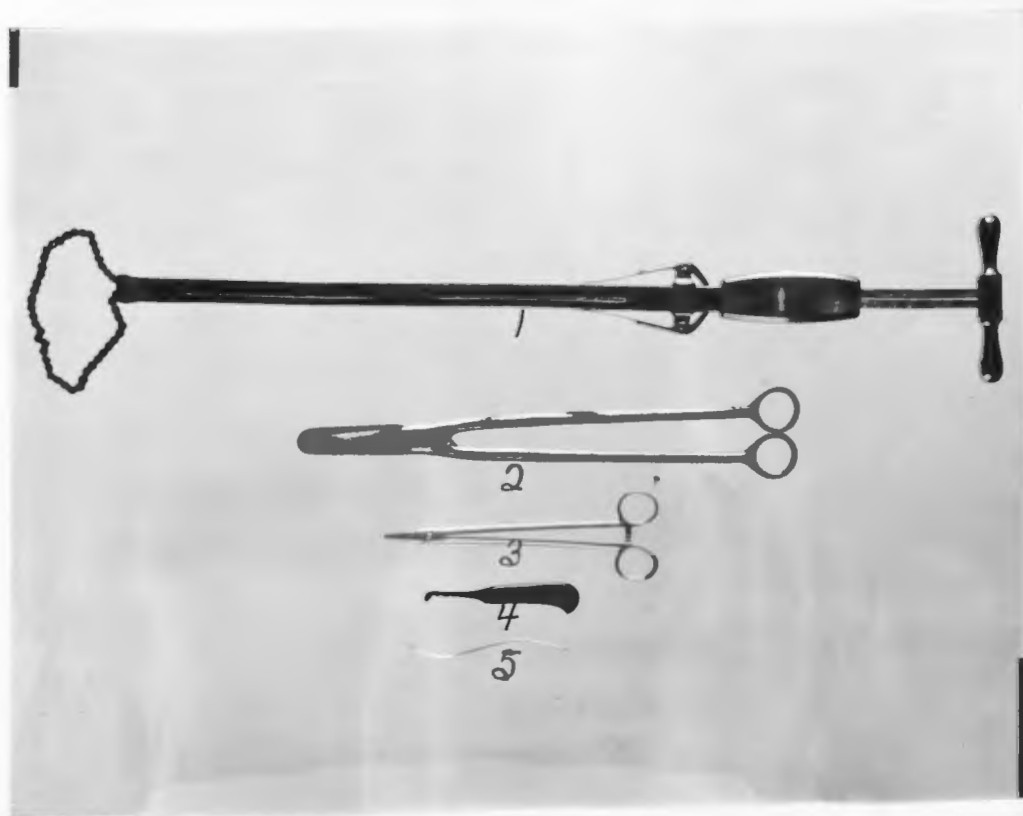


Instruments used in spaying the Mare.

1. Spaying Emasculator

2. Colin's Scalpel

PLATE II



Instruments used in spaying the Cow.

1. Spaying Ecraseur
2. Spaying Shears
3. Forceps
4. Miles' Castrating Knife
5. Spaying Needle

Note - It is sometimes necessary to use the Ecraseur in spaying the mare, when the bulk of the tissues to be divided will not permit the use of the Emasculator.

PLATE III

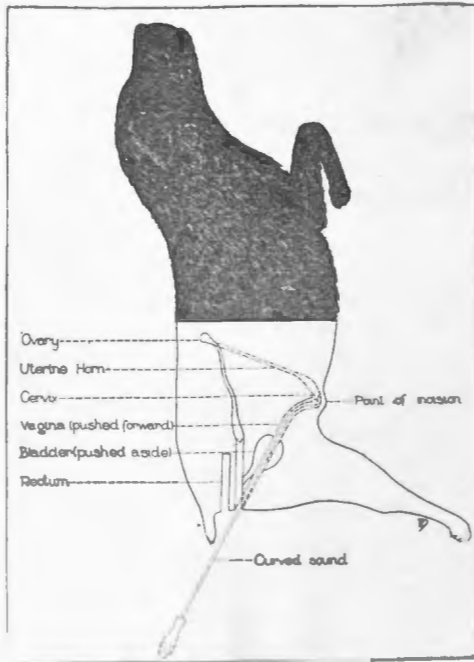


Fig. 1

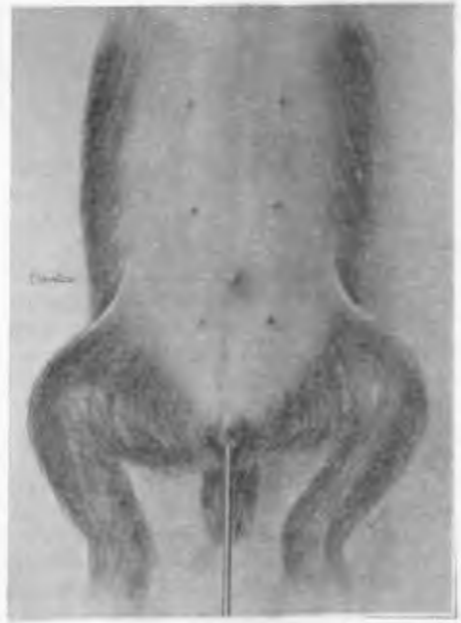


Fig. 2

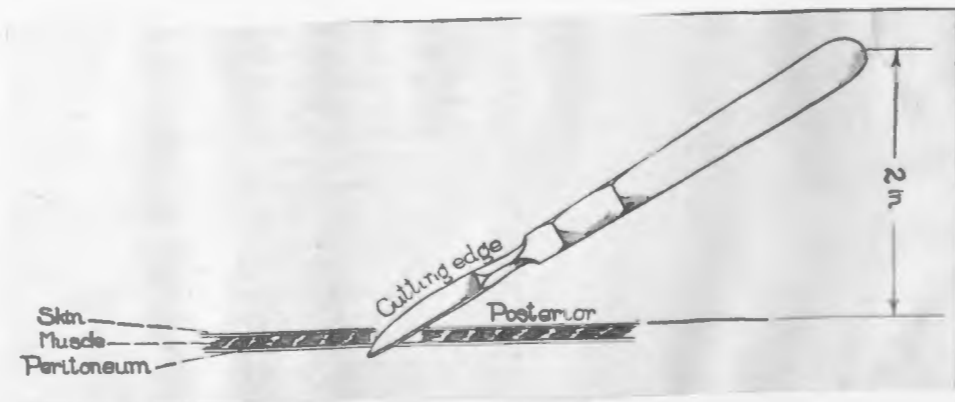


Fig. 3

PLATE IV

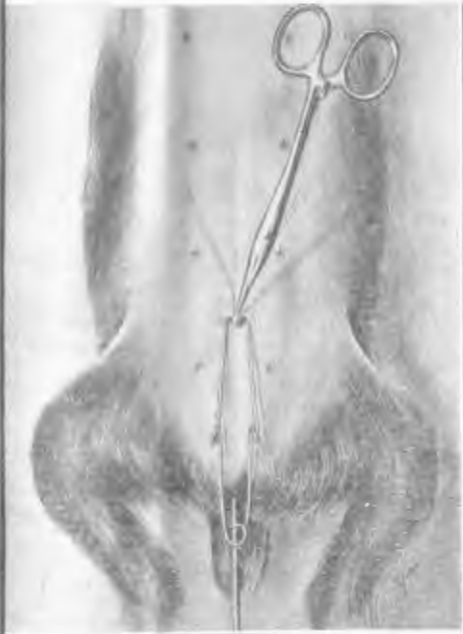


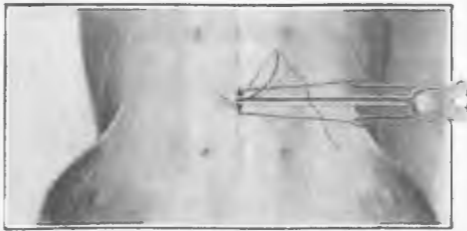
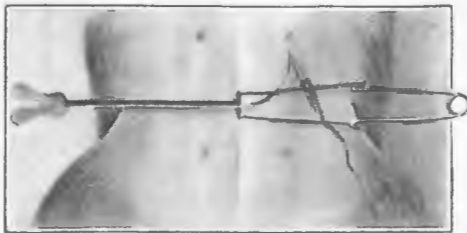
Fig. 4



Fig. 5



Fig. 6

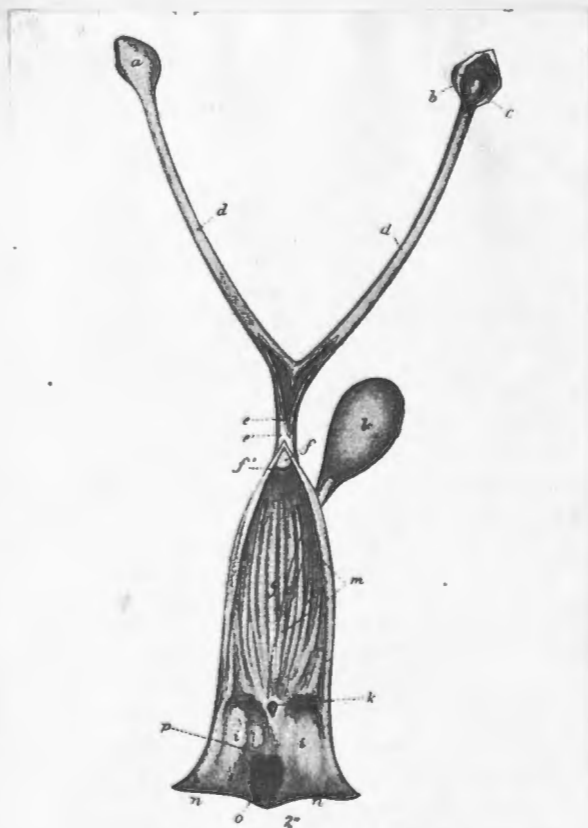


Figs. 7, 8 & 9



Fig. 10

PLATE V



GENITAL ORGANS OF BITCH.

Vulva, vagina, and uterus (in part) are slit open. *a.* ovarian bursa; *b.* Same opened to show the right ovary. *c, d, d.* Horn of uterus. *e, e.* Body of uterus. *f.* Neck of uterus. *g.* Vagina. *h.* Hymen. *i.* Vulva. *k.* External urethra orifice. *l.* Urinary bladder. *m.* Urethra. *n, n.* Labia Vulvae. *o.* Fossa clitoridis. *p.* Central projection of fold of mucous membrane which conceals the clitoris. (After Ellenberger, in Leisering's Atlas.)—*Sisson's Anatomy.*

PLATE VI



Photograph of Case No. 7, taken
four days after the operation.

(Bitch)