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C. W. Nibler

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June
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Nebraska
COOPERATIVE EXTENSION WORK
IN AGRICULTURE AND HOME ECONOMICS
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Factors Influencing Breeding Efficiency In Artificial Breeding Of Dairy Cattle

C. W. Nibler, Extension Dairyman

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Introduction

Reproduction in dairy cattle is complicated mainly because the internal functions of the reproductive organs cannot be observed. When females are bred naturally or when the male runs with the herd, records are generally not accurately maintained as to the number of services required per conception. Now that thousands of females are bred artificially and accurate breeding records are maintained, more and better information is available. In artificial breeding of dairy cattle, two definite problems are evident: First, there is the individual cow in the herd that is difficult to settle; and second, there is the entire herd that is difficult to settle. There are many factors which influence breeding efficiency, some of which can be corrected after there is a good understanding of the science of reproduction. In addition, close cooperation is necessary between the herd owners, technicians, and bull studs which produce semen.

Herd Owner's Cooperation

A herd owner, who becomes a member of a cooperative breeding association or requests artificial breeding service, assumes certain definite responsibilities. For best results, he needs to cooperate whole-heartedly with the technician. The owner needs to know definitely when animals are in heat, approximately when they show the first signs of heat, and how long the cow remains in heat. Reports must be made accurately to the technician. When convenient, the herd owner should be present when the technician breeds the animal -- because at this time they can discuss mutual problems. At the time purebred cows are bred the inseminator must be furnished the certificate of registry.

The female should be confined in a stall that prevents her from moving sideways. It is best to construct a special stall for breeding purposes in one end of the barn. The animals should be placed in the barn or special stall before the technician arrives and should be kept there approximately 6 hours after being bred.

An unsatisfactory conception rate is sometimes due to the fact that cows are not noticed in heat. To prevent this condition, a breeding record should be maintained in the barn and all calving and breeding dates promptly recorded. By watching these dates, one can anticipate or determine approximately when heat will occur. Signs of heat are nervous actions, the mounting of other cows, sometimes a discharge of clear, watery mucus from the vulva, and a drop in milk production the evening or morning preceding heat. The signs of heat are generally more noticeable in heifers than older cows, and more pronounced in the summer than in the winter. A cow in heat will stand, while others are lying down. Her tailhead may be elevated, while the hips and small of the back are lowered. The vulva may be slightly reddened and swollen. A few cows have a quiet heat, and for them heat is hard to accurately detect. Yearling steers are of value as heat detectors when running in the herd.

Herd Owner's Experience

Other factors being equal, breeding efficiency seems to increase as the owner gains knowledge about his cows and understands the principles of artificial breeding. Owners can assist technicians and improve conception rates by doing the following:

1. Eliminate diseased and sterile cows from herd.
2. Determine definitely the approximate time that cows first show signs of heat, and the length of time the cows remain in heat.
3. Maintain an accurate record which shows dates when cows freshen, are turned dry, come into heat, and are bred.
4. Inform technicians about unusual conditions with the cows or herd like heat periods, retained placentas or other factors that might affect reproduction or conception.
5. Wait 60 days after a cow calves before she is re-bred.
6. Realize that cows on a high plane of production may be more difficult to settle than lower-producing cows.

Technician's Cooperation

After a technician starts breeding cows, he assumes definite responsibilities. His personality, ability, sincerity, cleanliness in personal habits, and cooperative attitude are factors that influence the success of the association and secure more cows to artificially breed. Technicians should explain to the owners what is required for best results, and how artificial breeding is different from natural breeding. Particularly should new members of an association be given helpful information. A diagram of the female's reproductive organs shown and explained to the owners assists in the educational program. Technicians need to be constantly on the lookout for methods that will improve their work. Animals should be treated gently and with consideration. Technicians should contact prospective milk cow owners and offer them service. Technicians should ear-tag or tattoo offspring from artificial breeding for identification purposes.

Technician's Experience

Most technicians improve with experience. Becoming acquainted with the owners and their animals makes it possible to do better work. Generally, the first three or four months' results will not be as satisfactory as when the technicians have worked nine to twelve months. Non-return rates are highest when females are inseminated towards the end of the heat period. Technicians that route themselves to inseminate females toward the end of the heat period secure the highest non-return rates.

Information About Reproduction in the Cow

Estrous Cycle - The normal estrous cycle is 21 days, but may vary from 17 to 26 days in non-pregnant cows. With a small percentage of females, the estrous cycle may be less than 17 days or longer than 26 days. Cows bred following an estrous cycle less than 17 days or longer than 33 days will have a lower conception rate than cows bred following a cycle of about 3 weeks. This is due to the fact that eggs are probably more normal after a regular cycle of 21 days than after a short or long estrous cycle. Competent veterinarians sometimes treat cows with abnormal estrous cycles and cause them to come into heat about every three weeks.

Period of Heat - The length of the heat period varies from 4 to 28 hours, and the average is 18 hours. Probably 70 to 75 per cent of females show signs of heat in the forenoon, and 25 to 30 per cent in the afternoon. The most reliable indications of heat are restlessness, and a tendency to mount and be mounted by other cows. A slight swelling of the vulva and a flow of mucus are also signs. When the cow is in the barn in a stanchion, heat is more difficult to detect than when she is running with others in the field.

Cows may be brought in heat out of their normal routine if a veterinarian inserts his hand in the cow's rectum and squeezes the corpus luteum out of the ovary. The cow then comes into heat in 2 to 5 days. The operation requires a delicate and practiced touch and should not be attempted by any except a qualified veterinarian. Some cows, and more frequently heifers, bleed from the vulva about 2 days after the beginning of heat. This bleeding has no bearing on whether or not the cow is pregnant, but can be used as a landmark for observation of the following heat period in about 20 days.

Ovulation and Fertilization - Ten to twelve hours after the animal no longer shows signs of heat, the follicle on one of the two ovaries erupts (that is, ovulation occurs), and the ovum or egg is washed from the follicle into the Fallopian tube. The egg ($1/130$ inch in diameter) travels downward and lives approximately 6 hours after being shed. The sperm introduced by the male or the technician, travels toward the egg and lives 24 to 30 hours after being placed in the female. Generally it requires the sperm some time to reach the egg after being introduced. When the sperm reaches the egg, generally in the Fallopian tube or oviduct, fertilization is complete.

Afterwards the fertilized egg passes into the horn of the uterus. Here it develops and grows for about 35 days without being attached to the uterus. During this period, the fertilized egg receives nourishment from the fluids in the uterus. If the cow's uterus is diseased or if the cow is not properly fed, the uterine fluid may be deficient, death of the developing embryo results, and the cow returns to heat after an indefinite time. If the embryo develops normally, then after this initial period of about 35 days it is surrounded by a placenta that is attached to the walls of the uterus by buttons cotyledons through which nourishment is received from the mother's blood.

The corpus luteum (yellow body) which forms in place of the follicle after pregnancy keeps the cow from coming into heat during pregnancy and produces hormones which are necessary to maintain the life of the embryo. Sometimes a retained corpus luteum will keep a cow from coming into heat when she

is not pregnant. At other times, with a small percentage of cows, it is found that they come into heat one or more times following pregnancy. Because this is an abnormal condition, cows at this time should be carefully watched for an abortion which may follow.

The time during the heat period when cows are bred is very important. Our information about ovulation and fertilization definitely indicates that for best results, cows should be inseminated towards the end of the heat period. Most cows noticed in heat in the forenoon should be bred late in the afternoon. Most cows showing signs of heat in the afternoon should be bred the next morning. This is a general statement and below is shown variation among cows as to length of heat period and variation in time required for ovulation following heat period.

Variation in Length of Heat Periods

	Hours	Hours	Hours
Length of Heat Periods	3.5	18	28
Time Required for Ovulation After Heat Period	2.5	10	18
Per cent of Cows in Different Groups	5-10%	80-90%	5-10%

If cows in the herd are known to have short heat periods, it is important to have these cows bred sooner after the termination of heat than cows whose heat periods are known to be long. Cows with extremely short or long heat periods may require many services before conceiving, unless length of heat period can be established.

Conception might not occur because: First, the egg is not successfully washed from the follicle; second, the egg does not reach the Fallopian tube; third, the sperm does not contact the egg; and fourth, not all eggs develop successfully after fertilization.

Listed in this circular are many different factors that influence results in artificial breeding of dairy cattle by trained technicians.

Age and Maturity of Dairy Heifers

Different breeds of dairy animals reach maturity at different ages. Probably individuals within the breeds mature at different ages. Feed, management and heredity influence the time of maturity.

Satisfactory Ages and Sizes for Breeding Heifers

Breed	Age (Months)	Weight (Pounds)	Heart Girth (Inches)
Brown Swiss	18 - 19	800	65
Guernsey	16 - 17	700	62
Holsteins	17 - 18	875	67
Jersey	15 - 16	600	59

Puberty has been reached when the heifers show definite signs of heat. Most heifers will come into heat before they should be bred. Either age, weight or heart girth measurement, as shown above, can be used as good guides to determine when heifers should be bred.

Feeds and Feeding - Proper feeding of milk cows is necessary for profitable production. If cows are fed adequately and efficiently for maximum milk production, they then should be properly fed for the best breeding results. Good feeding practices include liberal feeding of high-quality roughages, providing nutritious pasture forages from properly fertilized fields, and feeding a balanced grain ration according to milk production. For more details on "Feeding Milk Cows," secure Extension Circular 627 from your county agricultural agent.

Diseases

Reproduction is affected by diseases, physiological abnormalities, and retained placentas (afterbirths). Placentas improperly removed may cause females not to conceive at following heat periods. In females with brucellosis (contagious abortion), the placenta is more likely to be retained than in healthy females.

Brucellosis - There seems to be a variation as to how brucellosis affects the conception rate in animals. Indications are that brucellosis accounts for many shy-breeding cows. It is estimated that one out of every five cows which abort eventually become sterile. Service records on herds infected with brucellosis indicate that more services are required to get a cow settled than in a healthy herd.

Trichomoniasis - This is a disease characterized by difficulties in breeding, early abortions, temporary sterility and pyometra (accumulation of pus in the uterus). As a result of infection, one of several things may happen. (1) The animal may fail to conceive; (2) conception may take place and be followed by abortion; (3) the fetus may die within the uterus, which then becomes filled with a characteristic thin, grayish-white, almost odorless fluid; or (4) a normal birth may occur in spite of infection. The breeding troubles mentioned very often follow the introduction into the herd of a new cow or bull.

Vaginitis - This is a controversial subject. Considerable variation in opinion exists regarding its influence upon the reproducing ability of the cow and heifer. The cause of this disease is not exactly known.

Vaginitis causes a chronic infection of the vulva and vagina. It becomes especially harmful when the infection spreads into the uterus or cervix. The infection results in inflammation and the formation of numerous small pimples and nodules in the vulva and vagina, and in severe cases, pus is present. Severe inflammation and infection will run its course in a few weeks and cows recover without treatment.

Vibrio Fetus - sometimes causes abortion. Pregnancies are most frequently terminated 4 to 6 months after breeding, but they may end during the seventh month or in the early stages of the gestation period. Not all of the facts about transmission and treatment are known. There may be no actual abortion, but cows

may be shy-breeders.

Leptospirosis - is a recently discussed disease upon which definite and complete information is lacking. The severe type causes jaundice, extreme sickness and death, while the passage of bloody urine and decreased milk production for a few days may be the only signs of a mild attack. Many affected cows abort their calves. Vaccines and methods of vaccination against this disease are being developed. If this disease is suspected, a veterinarian should be consulted.

Retained Placentas - Placentas that are not expelled naturally or that adhere to the uterus may cause troubles in reproduction. Pus in the uterus sometimes caused by retained placentas can kill good sperm before fertilization. There is less danger of spreading diseases when cows are artificially bred than when bred naturally. After cows calve normally, the placentas should be destroyed or buried.

Failure to reproduce may be due to conditions not already mentioned. Most animals have the ability to reproduce, but there are always isolated cases of cows and heifers which do not reproduce because of one of many factors. A few of them are briefly mentioned below. Only about one heifer in ten born twin to a bull can reproduce. This heifer, known as a free martin, should be carefully examined before she is eliminated from the herd, because there is a difference in the appearance of the udder and genitalia of the free martin compared with the normal heifer.

Abnormal conditions like plugged Fallopian tubes, cystic ovaries, retained corpus luteum, cervicitis, and metritis may interfere with reproduction.

Sometimes the ovum is fertilized and then reabsorbed or dies before it is ninety days old. In this case, a female thought to be pregnant will again show signs of heat.

Inheritance

Studies show that the ability of females to reproduce is influenced by inheritance. A study in Oregon indicates that cows which are poor reproducers will have offspring that are poor reproducers. Experimental work at other stations indicates that some cow families are better reproducers than others. The inheritance of reproducing ability has been difficult to accurately determine.

Fertility of Semen

Every effort is made by bull studs to supply good viable semen to the technicians. Semen is examined under the microscope from each bull before being forwarded to technicians. Therefore, a better check is made on bulls artificially used than when used naturally.

After semen is diluted, it must be very carefully handled. It should be maintained at a temperature of 34 to 38 degrees. During extremely hot or cold days, semen should not be exposed to outside temperatures very long. In the field, the extreme temperatures have the tendency to be most bothersome.

Research studies indicate that the older the semen, the poorer the conception rates.

Frozen Semen

Semen can be frozen with the addition of glycerol to the diluters to -110° F. (or -79 C.) and when maintained at that temperature, it can be kept for months. The freezing agent is dry ice, and the same agent must be used in the field to keep the semen at a low temperature. Frozen semen offers advantages to the dairy industry, but it also has limitations. It may provide for (1) fuller utilization of the best bulls; (2) using such bulls over a longer period of time; and (3) enabling members of a breeding association to have their cows bred to preferred bulls. Limitations are that only bulls can be used that produce semen that is viable enough for freezing; (2) accurate and painstaking care must be used in the preparation and use of frozen semen; and (3) the agent to keep semen at low temperatures may be too costly or difficult to secure in some rural areas.

The Purebred Dairy Cattle Association has adopted the following regulations concerning the use of frozen semen:

- No. 1 - When frozen semen is used, the letters "FS" are to be written in the lower right-hand corner of the breeding receipt.
- No. 2 - Semen-producing businesses freezing semen must keep an inventory of present semen on hand, and this inventory is to be available to representatives of the Purebred Dairy Cattle Association at all times as are the other records.
- No. 3 - Upon the disposition of a sire, either by death or by sale, the semen-producing businesses must report to the breed registry organization involved, the number of ampules of frozen semen from that sire on hand.
- No. 4 - Semen-producing businesses, in performing the service of freezing semen of sires not owned by the semen-producing business, must report monthly the number of ampules frozen, giving the name and registration number of the sire and the name and address of the owner.

These regulations govern the use of frozen semen by semen-producing businesses and their employees which are under contract to the Purebred Dairy Cattle Association.

Summary

Reproduction is a complicated function, and the method of breeding (naturally or artificially) does not alter the fact that it is complicated. Owners of animals (where artificial breeding has been done) are now securing more accurate records--and as a result, are taking more interest in reproduction problems. Because of artificial insemination, the human element has become important in the reproduction of dairy cattle.

Factors which influence breeding efficiency are as follows:

1. Herd owners need to cooperate whole-heartedly with technicians. There needs to be a good understanding of the science of reproduction, the estrous cycle, and the heat period.
2. Technicians need to cooperate with herd owners and the Board of Directors. Technicians should consult with members about their herds.
3. Technicians become more efficient with experience.
4. Breeding efficiency increases when sterile, shy-breeding and diseased cows are marketed.
5. Heifers should not be bred until they reach the proper size or age.
6. Reproduction is affected by diseases such as brucellosis, trichomoniasis, vaginitis, vibrio fetus, and leptospirosis. Other conditions which might cause cows not to reproduce are -- retained placentas, plugged Fallopian tubes, cystic ovaries, cervicitis, or reabsorbed ovum.
7. The ability to reproduce in females is influenced to a certain degree by inheritance.
8. Semen needs to be carefully handled in the field. Studies indicate the older the semen, the poorer the conception rate. This does not apply to frozen semen.
9. The purpose of artificial breeding is to improve the dairy cattle by breeding better bulls to more females. Therefore, the best feeding and management practices are as essential as the best breeding, if improvements are to be consistently secured.

Explanation of Diagram on Page 11.

The diagram of the reproductive organs shows the different parts and their relative position in a non-pregnant cow. For clarification, the following explanation is offered as to the functions of the parts.

Vulva - The external opening of the reproductive tract.

Clitoris - The female sensory and erectile organ.

Vestibule and Vagina - These two are generally considered only as the vagina. They are separated by an imaginary line, where are found the rudiments of a sphincter muscle. The length of the vagina and vestibule varies with the size and age of the animal. However, the total length is generally 12 to 16 inches.

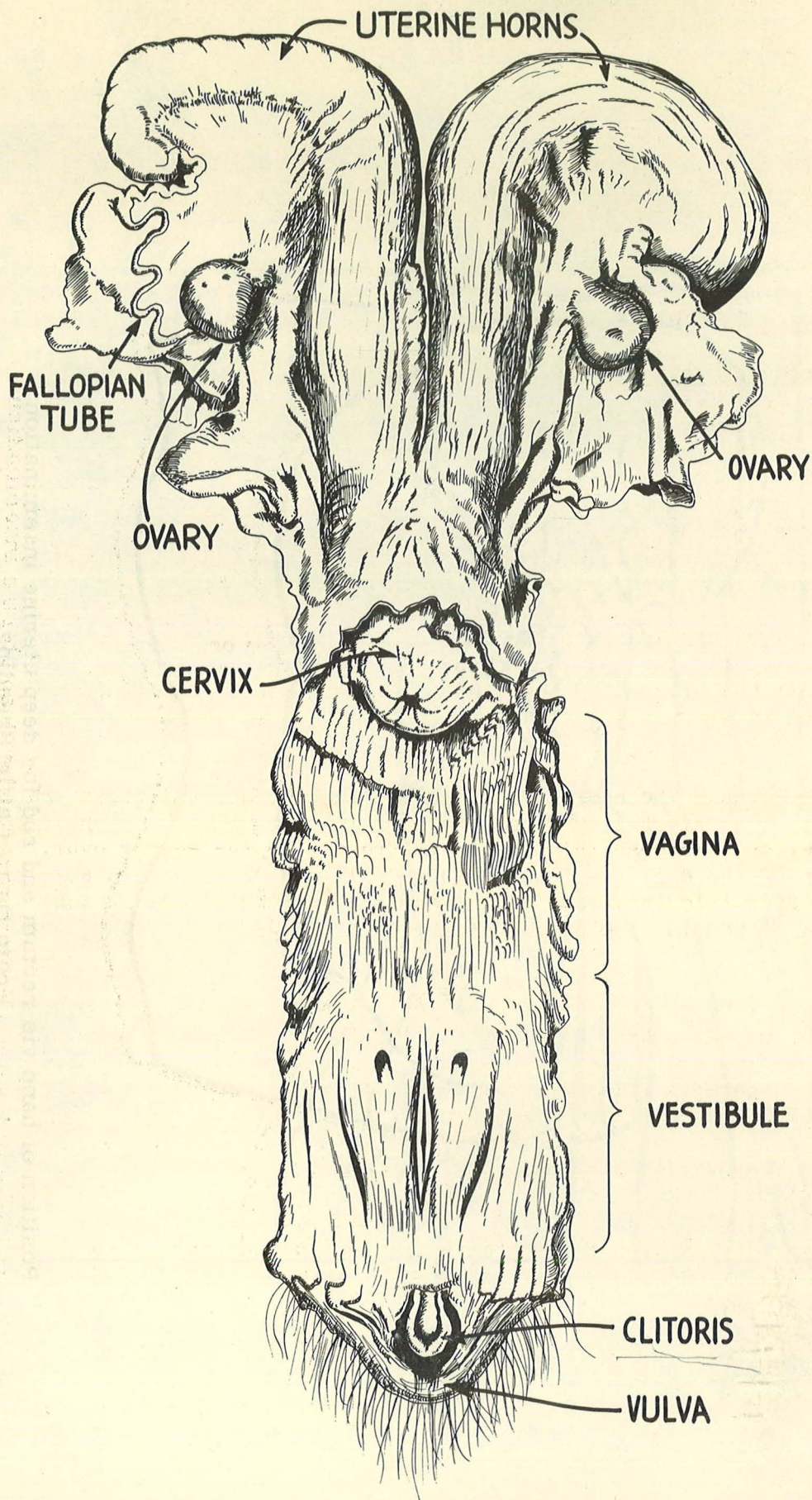
In natural mating, semen is deposited in the upper end of the vagina at the entrance to the cervix. When deposited by an inseminator, it is generally distributed in the cervix and the front end of the uterus.

Cervix - The opening into the body of the uterus. In the normal cow the cervix opens slightly during heat so that the inseminating tube can be passed through it into the uterus. Between heat periods the opening of the cervix contracts, and if pregnancy follows breeding it becomes sealed by a gelatinous plug.

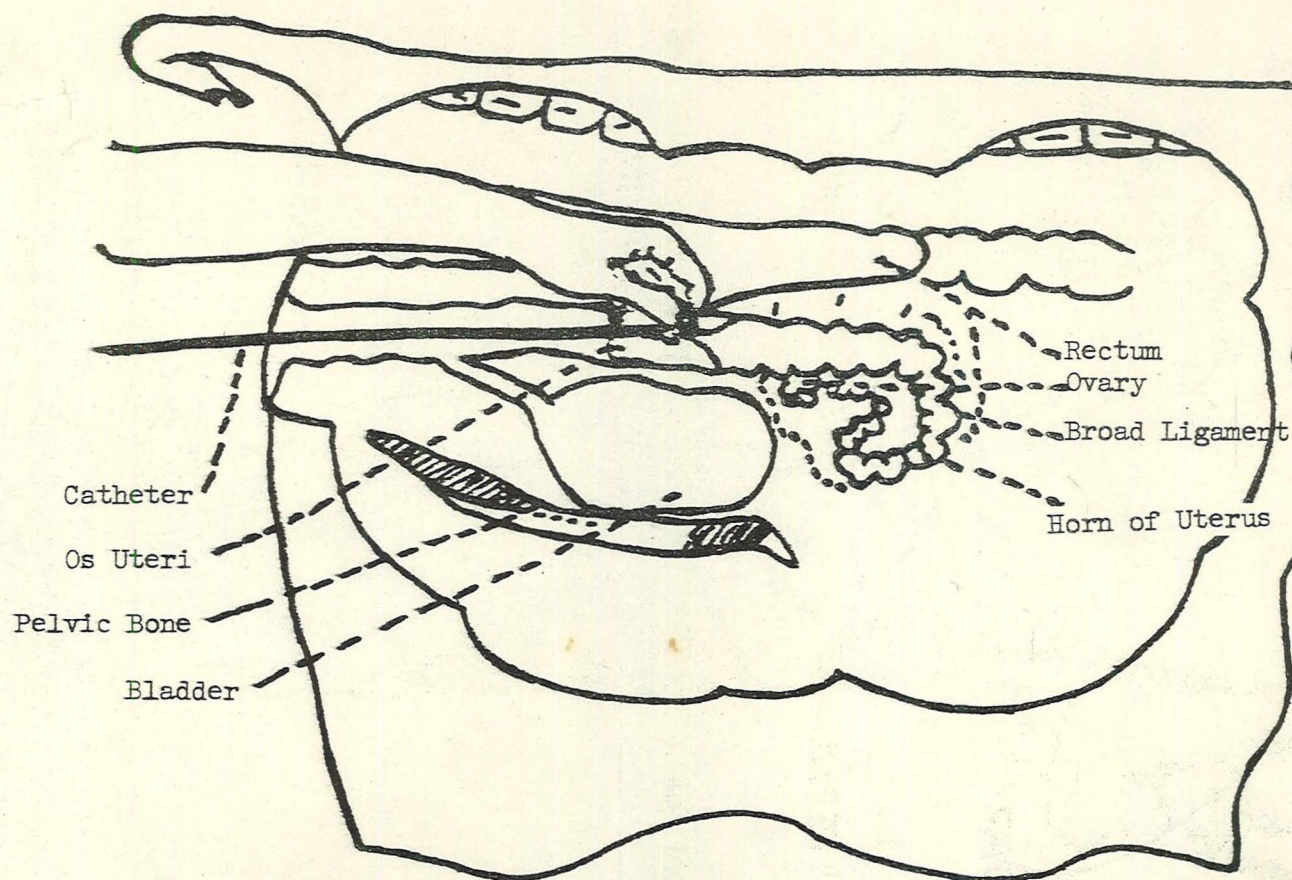
Uterine Horns - The uterus consists of its body and the right and left uterine horns. The internal surfaces are supplied with glands which produce a fluid secretion. Through this the sperm travels to the egg or ovum. After fertilization of the egg, the fetus (unborn calf) develops within some part of the uterus. By cotyledons, the fetal membranes (placenta) are attached to the uterus. This attachment provides nourishment from the cow for the developing young.

Fallopian Tube - There are two Fallopian tubes, also called oviducts, through which the egg passes from the ovaries to the uterine horns. The ends nearest the ovaries are funnel-shaped and, at the time of ovulation, surround the ovaries. Generally the sperm reaches the egg and unites with it in the Fallopian tube. The fertilized egg then passes into the uterus.

Ovary - Two ovaries are connected to the back of the female inside the main body cavity. Normally every 17 to 26 days the follicle, which develops within the ovary, erupts and the egg drops into the funnel-shaped opening of the Fallopian tube. During pregnancy, a corpus luteum develops in place of the follicle in the ovary and prevents occurrence of normal heat.



**REPRODUCTIVE ORGANS OF A COW-
SHOWING CUTAWAY VIEW OF THE VAGINA
AND VESTIBULE.**



Position of hand via rectum and rod for deep uterine insemination
From Dairy Cattle Breeding.