Artificial breeding of dairy cattle in Iowa

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ARTIFICIAL BREEDING OF DAIRY CATTLE IN IOWA

Porter and Raps: Artificial breeding of dairy cattle in Iowa

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Artificial Breeding of Dairy Cattle

What is it?
Breeding cows without having the bull present. (Page 295)

What does it cost?
Approximately $6 per cow, plus any association expenses. (Page 296)

What are the advantages?
The use of better than average sires and elimination of cost and danger of maintaining a herd sire. (Pages 296-297)

What are the limitations?
The herdsman is responsible for detecting cows in heat and notifying the inseminator. Sometimes difficult to do close line breeding. (Pages 297-298)

To what extent is it used in Iowa?
Approximately 90,000 cows were artificially bred in 1947. See map. (Page 299)

Where are the bulls kept?
Two general types of bull studs have developed in Iowa. (Page 301)

How is it done?
The collection of semen and insemination of a cow are described on pages 303-304, 309.

How is semen shipped?
By train, bus or special carrier in refrigerated containers. (Page 306)

How can an association be organized?
1,000 to 1,200 cows needed before service is started in area of approximately 15-mile radius. (Pages 311-314)

Can purebred calves be registered?
Yes, if the rules of the Purebred Dairy Cattle Association are followed. (Page 314)
Artificial Breeding of Dairy Cattle in Iowa

By Arthur R. Porter and Greg Raps

DEFINITION OF TERMS

Of all the scientific terms now associated with general farming practices probably no other one has been more misunderstood than artificial insemination. By definition the term denotes “The deposition of spermatozoa into the female reproductive system by other than natural service.” Thus the word artificial is being used to signify a method “relative” or “in comparison” to natural service and in no wise is it to be understood as a “synthetic” or “unreal” procedure. The use of the word “artificial” to many people automatically suggests an inferior substitute and consequently when used in connection with breeding immediately places a barrier to its acceptance.

The term artificial breeding has often been used synonymous with artificial insemination. However, the former term appears more applicable to the whole program which would include all the procedures necessary to procure and prepare the semen for the actual insemination.

PURPOSE

The purpose or goal of a program for the artificial insemination of dairy cattle in a community, county or state is herd improvement. This objective can be reached only by the use of the best bulls possible to improve the cows’ inheritance for milk and butterfat production. Good feeding methods, good herd management, disease prevention and the use of production records to measure results and point the way for further progress can be actively encouraged in connection with an artificial breeding program.

WHAT CAN BE EXPECTED

With carefully selected bulls we may get in each generation an average production increase of 1 to 3 pounds of butterfat per
year. If this genetic improvement is coupled with improvement through better feeding and management, real progress in the way of increased production can be made over a period of years. In individual herds improvement may be more rapid. Any improvements in the inherited producing ability of cows through the use of better sires can be expressed fully only when the environmental conditions are good enough that they are not the limiting factors.

Conception rates with artificial insemination can be as good as with natural service. The herd owner should not expect them to be better.

**COSTS TO THE HERD OWNER**

The usual service fee is $6 paid at the time of the first service of a cow. Second and third services are allowed without charge if the cow does not conceive. Fourth and additional services usually are charged for at the rate of $1 or $2.

Membership fees in artificial breeding associations vary from $5 to $20. These are for lifetime membership. Assessments for costs of the central bull stud may be made at the rate of $1 to $3 per cow at the time of the first sign-up. If the herd increases in size, the additional assessment may be collected as extra cows are bred.

**ADVANTAGES**

Probably the biggest advantage that artificial insemination may have is the wide use of superior sires. The artificial breeding associations in this country have approximately one bull for each 1000 cows. A well-proved Holstein sire owned by the Eastern Iowa Artificial Breeding Association has sired over 5000 calves.

Artificial insemination provides an opportunity for small herd owners to mate their cows to better bulls than they could afford to own. Where there is more than one breed in a herd, artificial insemination may make it possible to avoid crossbreeding without keeping extra bulls.

The cost, danger and trouble of keeping a herd sire on the farm with the cows can be eliminated by the use of artificial insemination. An extra cow or two could be kept in place of a bull.
Fig. 1. A group of bulls together in the pasture at the Eastern Iowa Artificial Breeding Association Farm.

If properly practiced, artificial insemination can reduce the spread of genital diseases. Regular examination of the semen may detect bulls of low fertility soon enough to prevent their use.

Some indirect advantages from the use of artificial insemination are seen frequently. Breeding and calving records are kept more completely and accurately by the inseminator than most farmers have kept them. Knowing when cows were bred and when they are due to freshen may result in better care previous to calving. The use of good sires through artificial insemination may arouse interest in better feeding and management. Calves by the association bulls may be given more care than that previously given calves on the farm.

LIMITATIONS

Artificial breeding has been "oversold." If a farmer expects too much he will be disappointed. The cost of artificial insemination compared to the cost of keeping a bull depends upon the size of the herd and the additional value that the calves from better sires may have.
An artificial breeding program will not relieve the herd owner of all responsibilities in connection with getting his cows bred. He must know when the cow is in heat. That will take more observation and time than if he had a bull on the farm. He must keep the cow stanchioned or tied until the inseminator arrives. That will take additional time for the owner or herdsman. The dairyman must telephone the inseminator before he starts on the road for the day to ask him to stop at his farm. That means that he must have a telephone, or access to one, and be able to get the phone call through. The road to the farm must be passable for the technician’s car. Service for some cows may be skipped because the owner did not know they were in heat. Service may be skipped if roads are too muddy or blocked by snow and if telephone service is bad.

Bulls usually are used in rotation. Service from all bulls is not available every day. A breeder cannot select a certain sire and be sure of getting service from him.

Enough good proved bulls are not available for artificial breeding. About three-fourths of the bulls used in artificial breeding associations in the United States are not proved.

DEVELOPMENT OF ARTIFICIAL BREEDING

The principles of artificial insemination are thought to have been recognized in Arabian antiquity. It was not until the late Renaissance (1622) that the work was reported on a scientific basis and then with but little more than a novelty interest.

Early in the twentieth century, the Russian physiologist, Professor E. I. Ivanoff, became interested in the problem and developed the artificial vagina. This development allowed the procurement of semen upon demand and with a uniform high quality. Only then were practical fields of the new science opened.

Some time later, the Russian investigators discovered that by holding semen at low temperatures it could be kept viable for several days. Slowly were the economic possibilities of this field unfolding. About 1933 the first reports of the field use of artificial breeding were made.

In 1936 Professor Sorenson instituted the practice in Denmark and within a decade it was being used on more than 33 percent of dairy cattle in that country. England began the practice in 1935 and from a recent report, bred about 60,000 cows during
Fig. 2. The approximate percentage of the total cows in each state which was bred artificially in 1947. The unmarked states were not reported.

1946. Norway, Sweden and the Low Countries are known to have active programs. New Zealand and Australia have both accepted the procedures for their dairy stock.

DEVELOPMENT OF ARTIFICIAL INSEMINATION IN THE UNITED STATES

In 1938 Dr. K. A. Larsen of Denmark was invited to New Jersey by Professor Perry of Rutgers University to train men in this country in the methods of artificial breeding. That same year saw the establishment of the first cooperative breeding organization in the United States.

The intervening 10 years have seen a phenomenal spreading and growth of the work. Figures for 1947 given by the USDA show artificial breeding programs active in 42 states (fig. 2). The report lists approximately 1,743,000 cows participating and about 1,745 bulls being used in the semen producing centers.

In Iowa

Artificial breeding was introduced almost simultaneously in
Fig. 3. Areas in Iowa with artificial insemination service, the types of organizations and sources of semen (1948).

two areas in 1942. The Linn County Cooperative Artificial Breeding Association at Cedar Rapids and the North Iowa Breeders' Cooperative at Kanawha were the first organizations. The growth in the succeeding 5 years is best illustrated by these figures:

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Associations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1942</td>
<td>2</td>
</tr>
<tr>
<td>1943</td>
<td>4</td>
</tr>
<tr>
<td>1944</td>
<td>8</td>
</tr>
<tr>
<td>1945</td>
<td>19</td>
</tr>
<tr>
<td>1946</td>
<td>36</td>
</tr>
<tr>
<td>1947</td>
<td>47</td>
</tr>
</tbody>
</table>

A report in June, 1948, shows 95 of Iowa's 99 counties with artificial insemination service. Of the 95 counties, 47 had cooperative breeding associations. The remaining 38 had service through technicians of private organizations and individual veterinarians.
TYPES OF BULL STUDS

Two types of bull studs have developed in Iowa.

1. Cooperative federation.

A group of local cooperative associations joined together to form a federation. The federation owns the bulls and produces the semen for the local cooperatives. The local cooperatives hire their own "technician-managers" to inseminate cows. The board of directors of the federation which conducts the business is made up of representatives from the local associations.

The federation is the semen producing unit and the locals are the insemination centers. Service is at cost. Good businesslike management and a large volume of business are needed to provide satisfactory service at reasonable cost.

2. Privately owned bull stud providing service for (a) cooperative associations (b) individual insemination units.

(a) Under this set-up the bulls are owned by a corporation which makes agreements with local cooperatives to furnish semen, assist in the training and supervision of technicians and assist with the organization and operation of the associations.

(b) Semen is sold to veterinarians and others who inseminate cows on call. The bull stud may also hire technicians and provide service on call with no membership in an organization required.

Artificial insemination in Iowa is done principally with semen produced and shipped from three bull studs:
- Dairy Genetics, Inc., Des Moines, Iowa
- Eastern Iowa Artificial Breeding Association, Cedar Rapids, Iowa
- Northwest Iowa Federated Breeders' Cooperative, Sheldon, Iowa.

PHYSIOLOGY OF REPRODUCTION

Some of the most pertinent facts in the anatomy and physiology of the male and female reproductive organs are included in this publication. The inseminator's ability is largely dependent upon his knowledge of the reproductive organs. This ability will be more evident to the farmer by his familiarity and use of the proper names of the organs. He will gain confidence in himself
for knowing that he is correct, and others will respect him for his ability to express himself accurately and in the proper terminology.

Reproduction is a split function, one which receives contributions from both the male and female of the species. Since sperm must first be obtained if the egg is to be fertilized, let us consider its origin and development.

The two testes, the primary reproductive organs of the male, are ovoid, semi-flattened structures composed of a mass of innumerable fine tubes (seminiferous tubules), the cells of which are the source of the sperm. The sperms develop with the division of these lining cells and when completed in physical form are transported through the various collecting ducts until a common duct is reached, the duct of the epididymis. This very long tube is coiled in a mass called the epididymis, adjacent to the testes, and is thought to act as a storage space for the young sperm. Here they undergo internal changes until becoming mature, when they pass on into the ductus deferens leading to the copulatory organs. Upon ejaculation small portions of the sperm leave the ductus deferens, are added to the fluids of the accessory glands, to furnish nutrient for the sperm and give volume to semen, and the admixture is then released as the male’s contribution to the continuance of the species.

Two of the terms which have been used in the preceding paragraph should probably be more completely defined—namely sperm and semen. The sperm (spermatozoon) is the actual male germ cell, an exceedingly small unit whose total length (head and tail) is approximately 1/2540 of an inch. The semen (sperm plus the accessory fluids of the prostate, bulbo-urethral and seminal vesicles) is the fluid mixture received upon ejaculation. The concentration of sperms within this fluid is enormous, approximately 100 million to the drop. A bull ejaculating 5 to 10 milliliters (1½-2 teaspoonfuls) of semen is releasing sperms in a number truly astronomical, possibly 200 billion.

The ejaculate when observed with the unaided eye appears as a greyish white, creamy fluid with an irregular coloration (like curdled milk). Semen of excellent quality upon close examination will show actual movement in the tube as the sperms move about in great masses.

The female reproductive system, as diagramed in fig. 7, con-
ists of the vulva, vagina, cervix, uterus (body and right and left horns), Fallopian tubes and the ovaries. Each structure has a definite, important part to play in procreation.

The egg (ovum) originates from the ovary. As the cow goes out of heat the follicle containing the ovum bursts, releasing the egg to be caught by the funnel-shaped end of the Fallopian tube. As this occurs some hours after the cow has been inseminated, the sperms have already traversed the entire length of the genital tract and are awaiting the egg. Union of the ovum and sperm (fertilization) usually takes place high in the tube, usually in the upper (nearest the ovary) third.

The fertilized egg (1/125 inch diameter) which can be seen by the unaided eye continues its travel down the tube to reach the uterus in about 9 days. Here it stops to become attached and continue its growth. The cervix, which was open at the time of heat, is now effectively sealed until the termination of pregnancy when it again opens during delivery of the calf.

TECHNIQUES INVOLVED IN ARTIFICIAL BREEDING

BULL STUD

Semen Collection

The artificial vagina as illustrated (fig. 4) is available through most veterinary or breeders' supply houses. The procedure for use is as follows:

a. The artificial vagina is filled with hot water until a temperature of 40-45°C (104-112°F) within the liner can be maintained. The liner is lubricated either with sterile petrolatum or a water-soluble lubricant. Most often the liner is coated for only a short

Fig. 4. External view of artificial vagina.
distance in from the open end, as deep lubrication appears unnecessary for good ejaculation.

b. The bull is “conditioned” or teased before the actual collection by allowing him up to the animal to be mounted (cow, dummy, or another bull) but restraining him from jumping.

c. After noticeable dripping has occurred from the sheath and the now erected penis, the bull is allowed to mount. The collector grasps the sheath just behind the opening (so as not to touch the penis) but so he can still control the direction of the penis. The artificial vagina is held against the hindquarters of the cow in such a position that the penis can be directed into it without changing the direction of the thrust which occurs as soon as the penis contacts the warm lubricated liner.

The ejaculation, occurring at the end of the penile thrust, places the semen either in the director cone or the collecting tube. The artificial vagina is tilted with the open end down to prevent contamination of the tube contents from the walls of the instrument and is taken to the laboratory where the collecting tube is removed.

Sometimes two collections are taken in succession with only a few minutes between. The ability and vigor of the bull primarily control the amount which he can be used. In the Scandinavian countries, bulls are used regularly on alternate days.
In this country the use will vary with from 4-day to 10-day in­
tervals.

Semen Examination

The evaluation of the semen begins with naked eye observa­
tion of it in the collecting tube, noting the volume (av. 4-6 ml.),
color and consistency. A small drop is placed on a clean micro­
scope slide and examined under low power (with or without
cover slip depending on depth of smear) for the motility of the
sperms. A rating is given it by either classing it as percent motile
or on a graded scale 0 to 5 in which 0 indicates no motility and
5 is 85-100 percent motile.

The concentration of the sperms may be obtained by counting
in a Newbauer red blood cell chamber or by estimation, using a
calibrated colorimeter or graded opacity tubes.

The use of the methylene blue reduction test has been advo-
cated as an adjunct for determining the quality of semen and is carried on as follows:

a. Take 1 ml. diluted semen (.2 ml. raw semen, + .8 ml. egg yolk-citrate buffer).

b. Add .1 ml. methylene blue solution (solution contains 3.7 grams of Na₃C₆H₅O₇ • 2H₂O, 50 mg. methylene blue powder and 100 ml. distilled H₂O).

c. Mix semen and methylene blue solution in small test tube (15 mm. x 75 mm.) and cover to depth of ½ inch with mineral oil and place in water bath at 46°C (114°F).

d. Record time from placing in water bath to return of original egg yolk color (except green color next to mineral oil). High quality semen usually will produce the change in not more than 10 minutes.

Occasionally bulls will be found exhibiting a satisfactory methylene blue reduction time simultaneously with a poor fertility record. Such a condition should not deter one in his use of the test but only fix its relative value more firmly in its proper level as an aid in estimating quality rather than as the sole source of information.

Semen Processing and Shipping

A number of factors must be considered in the production of quality semen, of which not the least important is the handling of the sperms from time of collection to their actual use in insemination.

Many investigators have explored this phase extensively, and the gist of their reports is that temperature constancy and slow temperature reduction are extremely important in maintenance of motility.

The processing of semen thus consists first of buffering it shortly after collection, using Philips' buffer or E.Y.C. (egg yolk-citrate—equal parts of egg yolk and of a solution containing 3.2 to 3.9 grams of Na₃C₆H₅O₇ • 2H₂O per 100 ml. distilled H₂O). These dilutors may be added to the semen as high as 1 part semen to 200 parts dilutor without affecting the subsequent conception rate. A thorough mix is made, and the buffered semen is placed in vials for distribution and slowly cooled, not to exceed 5°C (9°F) every 20 minutes, to holding temperatures of 2-5°C (35.5-40°F).
Shipments are made in small vials identified by colored tabs or marked corks for each breed and bearing labels containing the bull’s identification and date of collection. The vials contain sufficient semen for 5 to 10 inseminations.

The shipping containers are of varied design but are essentially a well-insulated box which holds the carton containing the semen vials and the ice can (prepared by sealing a No. 2 or No. 3 tin can almost full of water and freezing the contained water). Such containers will maintain constant temperatures for 12-24 hours, which gives sufficient safety margin for all intra-state shipments.

Transportation by bus, train and special carriers has been satisfactory in Iowa. Some states have resorted to air transport and are parachuting the packaged semen as a regular means of delivery.

INSEMINATION CENTER

Technician

The technician, inseminator or technician-manager is the next very important link in determining the success of an association. He is the one who talks with those using the service and takes the blame for failure or gets credits for success.

The good technician is honest, conscientious, hard working, pays close attention to details, is skilled in his work and anxious to improve his technique.

Immediately upon receipt of the shipment, the technician removes the semen vials to a refrigerator where they are kept at a constant low storage temperature (35-40°F) until use. It is becoming common practice to ship the semen from individual bulls in more than one vial so that the vial used on the first day is discarded and a fresh vial (which had remained in the refrigerator) used the second day.

The technician is notified by phone, during the morning, of the cows to be bred that day. The farmer’s name or farm number, the breed desired and the approximate time heat was first noticed are recorded in the call book. The animals designated as “P. M. cows” are those noticed in heat the previous afternoon and the “A. M. cows” are those seen in heat that morning.

When the calls have been completed (usually by 10 a.m.) the
Fig. 7. Illustrating the deep cervical method of insemination. 1. Rectum. 2. Cervix. 3. Horn of the uterus. 4. Vagina.
technician arranges his day's itinerary to breed most of the "P. M.'s" on the first part of his route. The available data show cows to be normally in heat from 8 to 30 hours and that they may be bred anytime within 25 hours from the first notice of heat without affecting the conception rate.

Following a careful microscopic examination of the semen to be used during the day and an inspection of his equipment kit for adequate supplies, the technician is ready to take to the road. During the day's work, the semen is carried in a small, ice-cooled insulated box which is open only when a sample of semen is removed.

Upon arrival at the farm, the technician must first identify the cow. The grade cows are identified by ear tags and the registered animals by either color markings or tattoo numbers checked against their registry papers. Needless to say, she should be recognized as the cow actually in heat. The signs of that will vary greatly between cows as some show unmistakable evidences while others pass over a heat period with little visible activity.

**Methods of Insemination**

Two techniques have been used quite successfully in Iowa. These have been designated as (a) the speculum and (b) the deep cervical method.

(a) The speculum method involves the insertion of a glass speculum (a tube 1¾" diameter, 16" long) through the vulva of the cow into the vagina. Illumination either by a penlight or headlight allows visual observation of the cervix. An insemination pipette is then inserted through the speculum and placed with its tip in the cervix where the semen is ejected.

(b) The deep cervical technique requires more training and familiarity with the anatomy of the reproductive tract. In this method the female genitalia are grasped by one hand in the rectum. The inseminator manipulates the reproductive organs to permit passing the insemination pipette, inserted into the vulva and vagina, more deeply into the cervix or into the uterus if desired.

The advantages and disadvantages of the two methods have been compared and are listed on the following page.
Advantages

Speculum
1. Simpler—less instruction necessary.
2. Visual examination for cervicitis.
3. Only sterile instruments contact each animal.

Deep Cervical
1. Less equipment.
2. Permits manual examination of whole reproductive system. Pregnancy may be found.
3. Faster—more cows bred per day.

Disadvantages

Speculum
1. Large volume of air in vagina.
2. More equipment necessary.
3. Higher equipment breakage.

Deep Cervical
1. Danger of abortion with pregnant cow.
2. Contamination of uterus with foreign material.
3. Poorly trained technician may injure animal.

In either method very small volumes of semen are used for insemination. At the present time, from $\frac{1}{3}$ to $\frac{1}{2}$ ml. of the buffered semen is used per cow. Some organizations are using as little as $\frac{1}{4}$ ml. (approximately 5 drops), as it is their opinion that the less foreign matter (egg yolk buffer) introduced into the genital tract, the higher the subsequent conception rate.

At the present time, the deep cervical technique is preferred in the United States and is used almost exclusively in Iowa.

The technician completes his work at the farm by filling in the breeding receipt, the breeding record in the barn, and collecting the service fee.

From the technician’s standpoint, the care of his equipment is as important as his ability to inseminate the cow. The most rigid sanitation and cleanliness must be enforced if he is to maintain a high efficiency in his work and impress his patrons with his thoroughness and caution.

To carry a clean, completely equipped case is the best aid to efficient work. The use of two copper containers, one for the sterile and one for used insemination tubes, greatly facilitates handling the pipettes and keeping the kit neat. After use, the pipette is flushed with cold water before being placed in the used container.
Following a day’s inseminations, the washing of glassware is done as follows:

a. Rinse with water at room temperature.

b. Force warm detergent solution through several times. (Dreft, Sutho or equivalent)

c. Rinse numerous times (eight or more) with tap water.

d. Final rinse (two times) in water distilled over glass.

e. Bake dry and sterilize (260°F or 126°C for 1 hour) in the clean copper tube container.

The day’s work is completed by tabulating the services, accounting for the funds handled and filling out the necessary report forms for the association, bull stud, breed registry offices and Iowa State College.

ORGANIZATION OF COOPERATIVE ASSOCIATIONS

EDUCATIONAL GROUNDWORK

Before any attempt is made to organize, the dairymen of an area should be genuinely interested in improving their cattle and fully understand the limitations as well as the possible advantages of artificial breeding. If enough dairymen are interested, discussion meetings should be held and information provided on the possible advantages and disadvantages. Associations which develop from a desire for artificial breeding service which grows out of educational work are likely to result in greater success than if organized by aggressive promotion. Artificial breeding has suffered from ill-advised promotion. The experience of the past should be considered carefully before hasty organization occurs.

PRELIMINARY SURVEY

A committee may be chosen to conduct further surveys of interest, investigate the possibilities of purchasing semen and determine the prevailing interest with respect to the types of services desired. The preliminary survey should obtain the names, locations, kinds of roads, telephone exchanges, number of cows to be bred and breeds of cattle of those who would use artificial insemination service if available.
INDIVIDUAL PROBLEMS

Each county or area has different situations and needs to be studied individually. Specific services performed by artificial breeding organizations of different types include: (a) ownership of bulls, production of semen and breeding cows owned by members, (b) hiring and supervision of technician-manager but purchasing semen from another agency, (c) purchase of semen and management service from other agency.

A minimum of 8,000 cows bred annually would be needed before contemplating purchasing and maintaining a group of bulls of more than one breed. Little need exists for additional bull studs in Iowa.

Each source of semen should be visited and carefully considered as to (a) number of bulls (five or more of each breed are recommended), (b) quality of bulls, (c) laboratory conditions as to cleanliness and trained personnel, (d) shipping arrangements, (e) breeds available, (f) the cost in relation to the service obtained.

Fig. 8. Bulls on electric exerciser or “merry-go-round” at the Northwest Iowa Federated Breeders’ Cooperative.
BUDGET

Figure membership fees and assessments to cover:

a. Cost of equipment, such as refrigerator, microscope, sterilizing oven, glassware, field kit, eartags and pliers.
b. Office, such as desk, filing cabinet, record books, forms.
c. Expense of incorporation.
d. Investment in bulls, barns and central laboratory in the case of associations owning a share in the bulls.

Figure operating income from service fees to cover:

a. Technician's salary or commission.
b. Cost of semen, including shipping costs.
c. Replacement or depreciation on equipment.
d. Miscellaneous, such as stationery, postage, telephone, electricity, water, rent, annual meeting expense, etc.
e. Insurance of employees and employees' cars.

MEMBERSHIP SIGN-UP

A minimum of 1000 to 1200 cows bred annually in an area of approximately 15 miles from a central point is recommended for successful operation. If the preliminary survey and study of problems indicates a good chance for enough business to meet the budget, one of the following steps can be taken:

a. A tentative sign-up of members and collection of fees to determine if enough will back an organization.
b. The committee may proceed with incorporation and then sign members on a permanent basis.

In neither case should service start until the minimum number of cows decided upon has been reached. The committee should recognize that the sign-up of cows must exceed the numbers to be bred within the first 12 months' operation. The experience of many organizations has been that 1200 to 1400 cows must be signed up to have a minimum of 1000 actually bred the first year.

INCORPORATION

Incorporation under the cooperative laws of the state will indicate an intention and implement a method for carrying on a program of herd improvement to supplement the use of good bulls. Each member will have a voice and a responsibility in the success of the organization.

The articles of incorporation need include only the broad
fundamental principles. Rules and regulations governing the operation of the association may be included in the by-laws.

**APPROVAL FROM PUREBRED DAIRY CATTLE ASSOCIATION**

If purebred calves resulting from artificial insemination are to be registered, the rules of the Purebred Dairy Cattle Association must be followed. As soon as the association is organized and before service starts, the association secretary should apply for permission to practice artificial insemination. Application blanks and information on requirements for approval can be obtained from the Dairy Husbandry Section, Agricultural Extension Service, Iowa State College. The applications and other required information must be sent to that office.

Each technician should be approved and a card with his signature should be on file in the breed registry office of each breed which he is inseminating. The blank cards and blanks for supplying other required information can be obtained from the Iowa Dairy Husbandry Extension office and returned to it for approval.

Following the approval of the association and the technicians, a standard approved receipt form can be used. These receipts are made up in pads to be filled out in triplicate after the insemination of each purebred cow. The technician must identify the cow by comparison of color markings or tattoos with those shown on the registration certificate. Registration certificates should be made available by the owner at the time of insemination of the cow. An indelible pencil must be used in filling out the forms. The full name and registration number of the cow and of the bull, the date, the name of the owner and his address, the name of the organization and the signature of the technician are required. The original copy of the receipt is left with the owner of the cow to be signed and sent in by him when applying for registration of the resulting calf.

If the association and the technician are not approved, a special combination certificate for “between-herd” inseminations is required. These forms consist of a certificate of semen collection and a certificate of insemination. Copies of the combination certificate may be obtained directly from the breed registry organization. The certificate is to be sent in by the owner of the cow when applying for registration of her calf.
The rules of the Purebred Dairy Cattle Association may be revised occasionally. The artificial insemination organization is responsible for keeping acquainted with the rules and complying with them.

**ASSOCIATION RECORDS**

A good bookkeeping system should be set up when the organization is started. Books should be audited annually and the membership kept fully informed about its affairs.

**RECORDS AND THEIR PURPOSE**

Thorough and accurate records are essential for all artificial breeding organizations. Records provide the basis for studying results and analyzing the business to discover the weak points which need improvement. In the cooperative associations records are necessary so that each member may know and better understand the problems of the organization. Among the important records which should be kept are:

A. At the bull stud
   1. Records of all semen collection with identification, date, volume, concentration, rate of dilution and any tests made.
   2. Records of all semen shipments and sales.
   3. Copies or summaries of individual herd breeding and financial records.
   4. Compilation of conception estimates by sires, by associations and by technicians. Conception (actually non-return to service) usually is estimated as the percent of cows for which no repeat calls are received within 60 to 90 days of their first services.

B. At the insemination center
   1. Records of all semen receipts.
   2. Records of telephone calls for service.
   3. Copies of insemination receipts filled out completely.
   4. Copies of individual herd breeding and financial records.
   5. A financial ledger showing all transactions.
   6. Copies of all membership agreements and a roll members and their addresses.
7. Copies of articles of incorporation and by-laws and minutes of all board meetings and other association meetings.
9. Complete file of the bulls by pedigree. This should include all bulls that have ever been in service and the ones now actively in use.