Summary of reports...

Ninth Annual

Beef Cattle Day

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Summary of reports...

Ninth Annual Beef Cattle Day

Contents

Mineral Deficiencies in Ruminants .................................................. 3
Fluid and Electrolyte Therapy ......................................................... 6
Production Testing of Ranges and Pasture Land .............................. 9
Factors Affecting Reproduction in Beef Cattle .............................. 14
Progress Reports ................................................................................ 20
  Management of the Adair Beef Herd .............................................. 20
  Forage Preferences of Grazing Animals on Western Oregon Improved Pastures ................................................. 22
  Beef Cattle Breeding Research ..................................................... 23

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The Western Oregon Livestock Association
The Oregon Cattlemen’s Association
Mineral Deficiencies in Ruminants

D. C. CHURCH

The verbal presentation of this report at Beef Cattle Day was primarily a pictorial description of practical mineral deficiencies in ruminants. However, for the benefit of those who wish to have a written report, a brief description of problems caused by mineral deficiencies is presented here.

In the case of the major minerals (calcium, chlorine, magnesium, phosphorus, potassium, sodium, and sulfur), phosphorus and sodium generally are considered to be the most limiting in ruminant rations.

Phosphorus

Phosphorus (P) is widely distributed in plant and animal tissues and is quite versatile with respect to the functions performed in the animal body. Deficiency of P appears to be a widespread problem throughout the world. Most of the forage that ruminants consume is little more than adequate in P at best, and weathered, leached forage is nearly always borderline or deficient. In the young animal, a deficiency of P and/or vitamin D will result in rickets, which is evidenced by thickening and swelling of the joints. The front legs may be bent forward or sideways or both. The joints, particularly the knee and hock, become swollen and stiff and the back is humped. In advanced cases, the gait will be stiff and dragging of the hind feet will occur. The animals may be irritable and may have convulsions. Labored breathing may occur, and the animal usually will refuse food, except for something like milk.

In older animals, symptoms of P deficiency are less clear-cut. A dry, unkempt coat of hair will be evident, but this is probably just a reflection of the fact that the animal is no longer licking itself. Weight gains will be reduced, as will other types of production. Animals usually have an abnormal or depraved appetite termed "pica," in which case they will consume "foreign" articles, such as rocks and bones, in an apparent effort to get P. The P content of blood, bones, and other tissues will be reduced. Fertility of both males and females will be impaired, and bone breakage may be more common than in adequately nourished animals.

Calcium

A deficiency of calcium (Ca) does not appear to be as detrimental to ruminants as deficiencies of some other mineral elements. Some cases of low-Ca rickets have been reported, but this condition is not believed to be common. In older animals, particularly dairy animals, a chronic deficiency will result in reduced Ca in the bones; the bones may become thin and brittle, and fractures may be a problem. Productivity of growing animals will be reduced when animals are fed deficient rations. Milk fever is a special case of a temporary deficiency, but it is not believed to be caused by a dietary deficiency as such.

Magnesium

As in the case of Ca and P, most of the magnesium (Mg) in the body is found in the skeleton. An outright de-
ficiency of Mg in ruminants is not considered to be very common. A deficiency can be produced in young calves that are confined to a diet of whole milk. Such calves develop skin lesions, become irritable, and may have convulsions. Kidney lesions may be observed, and some tissues may be calcified (deposition of excess minerals). Jaundice may develop; liver and kidney damage also have been reported. Grass tetany is a special case in which Mg seems to be involved. In tetany, one or more factors appear to interfere with Mg utilization by the animal, although a deficiency of the element is not indicated.

**Sodium**

In contrast to the three elements discussed above, sodium (Na) is found primarily in the soft tissues (non-bony tissues). Large amounts of Na are found in saliva, rumen fluid, and various gastric secretions. Appreciable amounts are excreted via the urine; thus the requirements of the ruminant animal are relatively high. The first symptom of salt-deficient animals is an intense craving for salt. Depraved appetites generally develop and may be evidenced by licking of the hands and clothing of the caretaker, consumption of soil soaked with urine or runoff from a manure pile, and licking of barn walls. A decrease in body weight may occur along with a loss of appetite. Sodium-deficient cows assume a gaunt, “tucked-up” appearance; they develop dry, harsh skin (particularly on the neck), unkempt hair, and listlessness. A staggered gait in the hind legs may develop. In long-term cases, some animals may collapse and die, and irregular heart action has been detected. Salt requirements are increased as productivity increases. Sheep, in general, are believed to be more resistant than cattle to a deficiency of salt.

**Other major minerals**

The remaining major mineral elements—chlorine, potassium, and sulfur—do not appear to represent problems. Sulfur deficiencies have been produced in experiments with sheep, but outright deficiencies of chlorine and potassium have not. With respect to sulfur, it is sometimes said that high-urea rations may be borderline in sulfur. This might be a possibility, since a relatively large percentage of the sulfur intake is derived from natural proteins. Consequently, if protein is replaced with urea, sufficient sulfur may be something to keep in mind.

**The trace minerals**

The “trace” minerals include a group of minerals—copper, cobalt, iron, iodine, manganese, molybdenum, selenium, and zinc—required in relatively small quantities. Fluorine and chromium may belong in this group also. Of this group, only copper, cobalt, iodine, and selenium are known to be deficient in ruminant rations under practical conditions.

**Copper.** Copper (Cu) deficiency is relatively common in some areas of the world, including Oregon. Areas of high rainfall and/or muck soils appear to be the primary problem sites. A moderate deficiency of Cu (or an excess of molybdenum) results in a bleaching of the hair in cattle and a bleaching of dark wools and loss of crimp in sheep. More severe deficiencies result in a condition called enzootic ataxia (falling disease, swayback) which is evidenced by a partial posterior paralysis. The animal has difficulty in using its hind legs. This condi-
tion appears to be due to damage to the spinal cord, although why it should affect this portion is an unresolved question. Profuse diarrhea also has been reported in animals on deficient Cu or high Mo intakes.

*Cobalt.* Cobalt is a constituent of vitamin B\textsubscript{12} which is required by the tissues for red-blood cell formation as well as for other processes. Some areas in Australia, Florida, and in other places in the world are known to be deficient in this element. A deficiency results in no particular symptom other than an unthrifty appearance. If cobalt deficiency is the problem, treatment results in a prompt recovery.

*Iodine.* Iodine is a constituent of thyroid hormones produced by the thyroid gland. A deficiency results in simple goiter, an enlargement of the thyroid gland. Presumably, the gland enlarges in an effort to retain as much of the element as possible. Goiter in the young frequently is accompanied by stillborn young. Areas of the world that have been glaciated in the past are apt to be deficient in iodine, presumably because much of the iodine has been leached out of the soil. A small amount of iodine in salt provides an easy remedy for this deficiency problem.

*Selenium.* Selenium (Se) appears to be the primary factor in the prevention of muscular dystrophy or white muscle disease of ruminants. Deficiency occurs primarily in areas derived from volcanic soils. Presumably, the Se was vaporized during volcanic activity, leaving an insufficient amount in the soil in many cases. White muscle disease is characterized by the development of lesions of the skeletal or heart muscle. The lesions are lighter in color than normal muscle and may be highly mineralized. Affected animals have difficulty in moving about and, when the heart is involved, may die suddenly from heart failure. Death loss of the young may be very high. Older animals seldom are affected.

*Other trace minerals.* Although iron deficiency in pigs is a major problem, it does not appear to be one for ruminants. A deficiency can be produced on a milk diet, but iron supplementation of normal young animals does not seem to be beneficial. In fact, veal calves may grow quite well even when they are very deficient in iron.

Evidence that molybdenum is required has been obtained when purified diets have been fed to sheep. The same statement applies to zinc, but there is no evidence that either mineral is apt to be deficient in most practical rations. In the case of manganese, deficiencies in animals fed on purified or practical rations have not been reported.
In order to use fluids and electrolytes effectively on sick animals, these terms should be defined and their functions in the normal animal should be considered.

**Fluid**

When referring to fluids, we are speaking essentially of water, the water inside the animal body. An adult bovine consists of about 60% water; at birth, a calf will consist of over 75% water. Females contain a bit less water than males; this is because they have more adipose tissue compared to muscle tissue. The fact that all body tissues contain water should not be overlooked. This includes bone, which has about 10% water.

Body water can be divided into two classes: (1) intracellular fluid; and (2) extracellular fluid. The extracellular fluid is found in two parts: (a) blood plasma—that fluid portion of the blood in the vascular system; and (b) interstitial fluid—that portion outside the vascular system which surrounds the individual tissue cells. The body fluids are in a state of dynamic equilibrium, and there is a constant exchange of water between the fluid compartments.

Sources of body water are food and liquid intake. Water is excreted by the skin, lungs, kidneys, and intestines. Lactating animals lose a considerable amount of water in milk. Some is lost in tears, saliva, and secretions of the nasal and genital tracts.

Most animals are unable to store large volumes of water. Therefore, the intake must be rather constant. The camel is an exception, and he can go several days without water by burning body fat which yields metabolic water that supplements his conserved outside source. Sheep on succulent pasture can subsist without additional water. Horses require 10 to 12 gallons per day on normal dry feed. An increase in physiological activity increases respiratory losses and losses due to perspiration and in some cases more urine is excreted. Because of these increased losses, an additional source of water is necessary to maintain normal body function.

In addition to the major role of transporting food, oxygen, and waste products, body fluids also play a vital part in temperature regulation and lubrication of various surfaces (joints, eye, mouth, peritoneum, and so forth).

**Electrolytes**

An electrolyte is any substance which when dissolved in water is dissociated into ions and is then capable of conducting an electrical current. The most common example is table salt (NaCl). This compound is necessary in animal diets in relatively large amounts. NaCl changes appearance when dissolved in H₂O, and we no longer recognize it as table salt. It exists in the ionic form of Na⁺ (positive electrical charge) and Cl⁻ (negative electrical charge).

In a similar manner, other electrolytes dissolve and exist in animal bodies in the ionic state. Those cations (positive-charged ions) which exist in readily measurable quantities are

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sodium (Na\textsuperscript{+}), potassium (K\textsuperscript{+}), calcium (Ca\textsuperscript{++}), and magnesium (Mg\textsuperscript{++}). The common anions are chlorine (Cl\textsuperscript{-}), bicarbonate (HCO\textsubscript{3}\textsuperscript{-}), hypophosphate (HPO\textsubscript{4}\textsuperscript{2-}), and sulfate (SO\textsubscript{4}\textsuperscript{2-}). The proteins ionize as acids (anions) and function as negatively charged particles. The large size of protein molecules restricts their passage from the vascular system, so they disperse into diffusible amino acids and regroup in high concentration in the intracellular fluid.

The concentration of electrolytes in the body fluids is variable. We have a high concentration of Na\textsuperscript{+} in the extracellular fluid and a high concentration of K\textsuperscript{+} in the intracellular fluid. Concentration of protein is moderate in blood plasma, practically nonexistent in interstitial fluid, and quite high in intracellular fluid.

Dehydration

With these few basic facts regarding body fluids and electrolytes, let us consider some of the common pathological conditions which upset nature’s balance. Dehydration is an abnormal decrease in body fluids which usually involves both water and electrolytes. It may result from (1) reduced intake; (2) loss through natural channels, as in diarrhea, vomiting, or excess sweating; and (3) unnatural loss, for example, hemorrhage. Probably the most common loss of fluid observed in veterinary practice is due to diarrhea. Here the lining of the lower bowel, which normally resorbs large amounts of water, is irritated and normal resorption does not occur.

Scouring calves are known to excrete as high as 40 times as much water in fecal material as normal calves do. They may lose water at the rate of 100 milliliters per kilogram of body weight in a 12-hour period. This loss of fluid from the body causes less blood volume, so the intracellular fluid leaves the cells and enters the blood plasma in an attempt to maintain blood pressure. In addition to water loss, this scouring causes an extensive loss of electrolytes, especially Na\textsuperscript{+} and K\textsuperscript{+}; some HCO\textsubscript{3}\textsuperscript{-} is also lost. Potassium is withdrawn from intracellular fluid and enters the circulating blood in an attempt to neutralize the acid build-up which was created by decreased urine output and excessive cation loss. This high level of K in circulating blood may cause a shock condition in the calf and also interfere with proper cardiac function.

**Treatment**

If a severely dehydrated scouring calf is down and about to die, what can be done? It is necessary to get water into the calf and to replace some of the electrolytes lost due to the scouring process. Normal electrolyte solutions are excellent, and available commercially. In lieu of these, a mixture of two teaspoons of table salt per quart of water can be made. This solution should be warmed to body temperature before administration. The calf should have up to 4 quarts daily, one half of which may be given orally and the other half should be injected parenterally. The solution may be injected intravenously, subcutaneously, or intraperitoneally.

The oral fluid should be given in small amounts and often (about 2 cups per hour). Intravenous injection should be given slowly in order to minimize the chance of shock. The replacement fluid should not have a concentration of electrolytes greater than that found in normal circulating fluid. This might cause shock and overstimu-
lation of heart muscles by a temporary high level of potassium.

In chronic or prolonged scouring, the parenteral fluid should be supplemented with amino acids and dextrose. Here again the concentration should not be greater than that found in normal blood (5% dextrose is equivalent to normal electrolyte concentration). In addition to fluid therapy, antibiotics and anti-diarrheal compounds should be used to correct abnormalities of the bowel.

Other disease conditions

Many other disease conditions exist where fluid therapy is of vital importance. In prolonged vomiting, not only water but sodium chloride and hydrochloric acid (H Cl) are lost. This loss of acid from the body causes a build-up of alkaline products in the blood (alkalosis). To combat this type of dehydration, bicarbonate should be increased in fluid therapy; this converts to carbonic acid in the bloodstream and assists in combating the alkalosis.

Kidney function is of prime importance in body water and electrolyte balance. Many electrolytes and excessive amounts of water are excreted and then selectively resorbed in order to maintain the proper relationship in blood plasma. Kidney disease can radically upset this intricate balance, and change of treatment can often help animal patients with kidney diseases.

This is a rather superficial exposure to fluid and electrolyte therapy. However, it will serve to point out that this type of treatment is available and can be very beneficial to animal patients when properly applied.
Production Testing of Ranges and Pasture Land

Dillard H. Gates

Production testing of beef cattle has resulted in significant improvements in production on many Oregon farms and ranches. Some of the ideas and philosophies basic to production testing of beef herds are also applicable to forage-producing lands upon which the herd is dependent.

A logical approach to a discussion of production testing of range and pasture lands may be to first review some of the information on production testing of beef cattle. John Landers, animal science specialist, Oregon State University, made the following statements in Fact Sheet 70, June 1964:

1. Production testing is a simple method of obtaining systematic records for selecting and breeding more productive beef cattle. The records can be used to put beef production on a businesslike basis with a minimum of cost and effort.

2. Both commercial and purebred producers who wish to improve their herds may use production testing.

3. Production testing will help the cattleman improve the conformation and increase the weight of his weaners more rapidly. It will identify the poor producers and make it possible to increase the pounds of calf produced per cow by eliminating poor producers.

Few changes need to be made in these statements to help identify problems and opportunities in increasing forage production. For example:

1. Production testing of range and pasture lands is a simple method of obtaining systematic records on production from each pasture or range unit. The records can be used to put livestock production on a businesslike basis with a minimum of cost and effort.

2. All livestock producers who wish to increase livestock production through increased forage production may benefit from production testing of rangelands.

3. Range production testing will help the livestock producer increase salable animal products by helping to identify the relative productivity of each grazing unit, thus providing a basis for improvements or changes in grazing management. It will provide useful information in the development of each grazing unit toward its productive potential.

Production testing of rangelands would merely establish a procedure for gathering production information on each grazing unit. These records would become part of the information upon which the manager would base his decision-making. If as a result of these records it became apparent that a given grazing unit or units was not producing satisfactorily, the manager could begin to examine alternatives for achieving potential productivity.

Records required

As a bare minimum, production testing of rangelands must include records on stocking rate and season of use (see Form 1). Additional information on animal performance (see Form 2) and forage utilization (see Form 3) is also highly desirable and would provide help in evaluating the forage resource. Information on animal performance could be obtained by sample weighing of stock on and off of each grazing

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Form 1. Example of grazing unit evaluation for pasture performance (AUM's)

<table>
<thead>
<tr>
<th>Pasture</th>
<th>Animals in(^1)</th>
<th>Animals out</th>
<th>Animal unit days (AUD) per pasture (No. x days)</th>
<th>AUM per pasture</th>
<th>(AUD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date</td>
<td>No.</td>
<td>Date</td>
<td>No.</td>
<td>Date</td>
</tr>
<tr>
<td>North</td>
<td>1/1</td>
<td>10</td>
<td>2/1</td>
<td>50</td>
<td>4/1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4/15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Animals should be recorded as animal units (AU) based on the following: 1 mature cow with/without calf = 1 AU; 1 long yearling = ¼ AU; 1 weaner calf = ½ AU; 5 sheep = 1 AU.

Form 2. Example of grazing unit evaluation for animal performance

<table>
<thead>
<tr>
<th>Pasture no.</th>
<th>Animal no.</th>
<th>On pasture</th>
<th>Off pasture</th>
<th>On pasture</th>
<th>Weight change</th>
<th>Gain or loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Date</td>
<td>Wt., lbs.</td>
<td>Date</td>
<td>Wt., lbs.</td>
<td>Days</td>
</tr>
<tr>
<td>North</td>
<td>7</td>
<td>5/15</td>
<td>500</td>
<td>7/15</td>
<td>620</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>5/15</td>
<td>510</td>
<td>7/15</td>
<td>605</td>
<td>60</td>
</tr>
</tbody>
</table>
unit. Portable scales are available now through many county livestock associations. In many cases, the cost of owning portable scales could easily be justified by the information they would provide for management. The manager could then pinpoint animal performance on any grazing unit for any season of use (Form 2).

Utilization of forage is affected by many factors. These include, but are not confined to, topography, species composition, relative palatability, season of use, and availability of water and salt. Forage produced but not utilized is of limited value. Proper utilization of the existing forage resource should be given full considera-
tion before making expenditures for other range improvements. Utilization information can be obtained by utilization checks recorded on maps, following the grazing period for any unit. Wide year-to-year fluctuations in forage production occur due to varying weather conditions. Therefore, records accumulated over a period of time would become increasingly valuable and meaningful to a manager. An evaluation of records would identify range units in need of improvements to increase productivity. A complete knowledge of the range resource (soils, plants) is also essential in evaluating present and potential productivity. Otherwise, expenditures for range improvements may be hazardous and results disappointing. An understanding of production potential coupled with information obtained from production testing of rangelands, could form the basis for sound decisions concerning expenditures for range improvements and subsequent increases in animal performance and net income.

**Expected returns from range improvements**

If production testing records show less than satisfactory performance of a grazing unit and production potential has been evaluated correctly, improvement alternatives are available. All improvement alternatives are not applicable to each site or management unit, but they can be utilized where applicable. An evaluation of expected costs and returns from improvements will assist a manager to more fully evaluate production testing records and reach a decision as to which improvement practice, if any, is desirable for his operation.

**Range seedings.** Expected costs and gross returns from seeding 500 acres of rangeland to adapted forage species and managing for full production are shown below. Returns are based on full production following the establishment of the seeded grass.

**Assume present production:**

- **Yearlings**
  - 500 acres
  - April 15-Sept. 15, 5 months
  - 10 A/AUM (500 A ÷ 10 A/AUM = 50 AUM) (50 AUM ÷ 5 mo. = 10 AU)
  - Gain—1\(\frac{1}{2}\) lbs./day/AU = 45 lbs./AUM
  - 45 lbs./AUM x 50 AUM’s = 2,250 lbs. gain
  - 500 A x $1.12/A = $560 gross annual income from 500 A

**Assume potential production** on selected sites seeded to crested wheatgrass and managed for proper utilization:

- **Yearlings**
  - Seed 500 A at $10/A = $5,000
  - Use May 15-July 15
  - 2 A/AUM (500 A ÷ 2 A/AUM = 250 AUM) (250 AUM ÷ 2 mo. = 125 AU)
  - Gain—2 lbs./day/AU = 60 lbs./AUM
  - 60 lbs./AUM x 250 AUM = 15,000 lbs. gain
  - 500 A x $1.12/A = $560 gross annual income from 500 A
Sagebrush control. Expected gross returns from sagebrush control on 500 acres are projected below. Returns are based upon proper site selection and full production following deferment after spraying.

Assume present production:
Cow-calf
500 acres
July 15-October 15, 4 months
8 A/AUM (500 A ÷ 8 A/AUM =
62 AUM's) (62 AUM's ÷ 4 mo. =
16 AU)
Gain—1½ lbs./day = 45 lbs./AUM
45 lbs./AUM x 62 AUM = 2,790 lbs. gain
Gain—5.58 lbs./A
5.58 lbs. x $0.25/lb. = $1.40/A
500 A x $1.40 = $700 gross annual income from 500 A

Assume potential production on selected sites, with controlled sagebrush and properly utilized grass:
Spray 500 A sagebrush at $2.25/A = $1,125
Use July 15-October 15, 4 months
4 A/AUM (500 A ÷ 4 A/AUM =
125 AUM's) (125 AUM's ÷ 4 mo. = 31 AU)
Gain—1½ lbs./day/AU = 45 lbs./AUM
45 lbs./AUM x 125 AUM's = 5,625 lbs. gain
Gain—11.4 lbs./A
11.4 lbs. x $0.25/lb. = $2.85/A
500 A x $2.85 = $1,425 gross annual income from 500 A

Summary
Records providing information on the productivity of each grazing unit could contribute significantly to the decision-making processes of the range livestock operator. Records showing animal performance or actual forage use by grazing animals provide a basis for evaluation of the productivity of each grazing unit. The information, used in conjunction with information concerning potential productivity, could form the basis for a range improvement program or other management changes aimed at increasing efficiency of production.

Records on both livestock and grazing land productivity would contribute toward the ideal of having high-quality feed available at all times for grazing livestock. A good forage management program would help provide an environment in which superior animals could express their full genetic potential.
Factors Affecting Reproduction in Beef Cattle

EARL F. ELLINGTON

Introduction

A fundamental and most fascinating characteristic of all living matter is its ability to reproduce itself. Reproduction, as it occurs in higher animals, such as cattle, is an extremely complicated process involving a series of complex coordinated events in both the male and female. In the female, the principal events include development and release of eggs from the ovaries, sexual desire, copulation, transport of eggs and sperm cells, fertilization, ovum implantation, pregnancy, and parturition. The events occurring in the male are less complicated; they consist of the formation of sperm cells, sexual desire, copulation, and ejaculation.

Alterations in fertility

Because of the many intricate and complex processes involved in making reproduction possible, it is not surprising that numerous types of disturbances can and do cause alterations in fertility, perhaps to the extent that sterility (a complete loss of fertility) is apparent. In some instances, a specific condition or disease may be the cause of a reproductive disturbance, whereas in other cases a variety of factors may be responsible. Still in other cases, no apparent reason for the impaired fertility can be ascertained. However, the causes of most reproductive problems can be found among the following: (1) anatomical defects, (2) mechanical injury, (3) nutritional deficiencies, (4) physiological disturbances, (5) genetic causes, (6) pathological disorders, and (7) managerial and miscellaneous problems. A brief discussion of each of the above categorized causes of reproduction problems in cattle follows.

Anatomical defects

Numerous types of anatomical defects of the genital organs may arise during the prenatal development of a calf. Some defects are so severe as to result in sterility, whereas others may have only a slight effect on fertility.

The most widely discussed congenital abnormality in cattle is the "freemartin," which develops when a heifer is born as a co-twin with a bull. When twins of the opposite sex are produced, approximately 11 out of 12 genetic females have abnormal reproductive organs and are sterile. The degree of abnormality ranges from slight alterations to complete absence of the reproductive system. The external reproductive structures may appear normal, while development of internal female reproduction structures is arrested. The male reproductive system which is intended to be rudimentary in the female may differentiate to some extent.

The most widely accepted explanation for the freemartin condition states that placental membranes of cattle twins often join, resulting in a fusion of blood vessels and in an intermixing of the blood of the two fetuses. If the fetuses are of opposite sex, the hormones produced by the male calf interfere with differentiation of the female reproductive structures and cause de-
development of various portions of the male system in the female. Since only a small percentage of heifers born as co-twins to bulls are fertile, saving them for breeding purposes cannot be recommended.

Other congenital abnormalities of the female reproductive tract (persistent hymens, absence of definite parts, double cervices, underdeveloped parts, and obstructions in different areas) have been reported. The relation of these various conditions to fertility depends on the severity of the condition.

**Abnormalities in the bull**

Anatomical abnormalities in the bull may involve many parts of the reproductive tract. One aberration easily detected is underdevelopment of one or both testicles, which may result in a failure of sperm-cell production, especially if the underdevelopment involves both testicles. Cryptorchidism, the failure of one (unilateral) or both (bilateral) testicles to descend from the body cavity to the scrotum, may occur. Retention of the testicles in the body cavity results in a failure of sperm-cell production, but apparently does not greatly alter the testicular hormone-producing ability. As a result, bilateral cryptorchids are sterile but have masculine characteristics. However, if only one testicle fails to descend as it would in the unilateral condition, the bull may be fertile. Adhesions and malformations of the reproductive system, as well as hernias, are conditions that influence the breeding value of a bull. General anatomical soundness, especially of the feet and legs, should be considered since it may influence the ability of males to serve females.

**Mechanical injury**

Two critical times, as far as injuries are concerned in the female, are at the time of service and at parturition. Service by a large or vigorous bull may result in injury of the female reproductive organs. Complications at calving may result in permanent damage to the reproductive organs, in addition to a possible loss of the calf and dam. Perforations of the uterine and vaginal walls, lacerations of the cervix, prolapse of the reproductive structures to the extent that the uterus may be involved, and prolapse of the rectum may result from complicated births.

The testicles, from an anatomical standpoint, would appear to be vulnerable to injury, but cases of testicular bruising, inflammation, and lacerations are not very common. Occasionally, the penis may become bruised or lacerated during service. The consequences of the various injuries in both males and females vary from a temporary reduction in fertility to complete sterility.

**Nutritional deficiencies**

One of the most common forms of nutritional reproduction problems results from an inadequate supply of energy. Underfeeding seriously delays sexual maturity in heifers and impairs fertility in mature cows. Sexually mature cows that are underfed will show impaired signs of heat, irregular heats, and failure to conceive. An adequate supply of grain will, however, restore normal function to the reproductive organs.

Some controversy exists concerning the association of overfeeding with infertility. There are cases where excessive fat deposits around the ovaries and other reproductive structures appear to cause infertility. On the other hand, feeding heifers in excess of the
recommended energy levels apparently does not cause infertility at the time of first breeding. With such animals, there has been an indication that detrimental fertility effects may become apparent later in life. It may be that the fat, sterile cow is sterile not because she is fat, but is fat because she is sterile. Castration of either sex has a fattening effect, and inactive ovaries possibly could cause the same effect.

Protein deficiencies in cattle are unlikely under most farm conditions unless underfeeding occurs, because of the ability of cattle to synthesize protein in the rumen. The quality of protein fed is not as important as the quantity because organisms in the rumen can synthesize needed types of protein from poorer quality proteins. Under range conditions, especially in overgrazed or drought areas, protein deficiencies are believed to occur and to result in impaired reproduction. It is difficult, however, to rule out the possibility of other nutritional deficiencies under such conditions.

Vitamins

Ruminants, such as the cow, are able to synthesize the needed B vitamins and vitamin K. Reproductive disturbances have been associated with vitamin E deficiency in the case of some small laboratory animals, but not in the case of any farm animals. A deficiency of vitamin D adversely affects reproduction, but it can be easily corrected by periodic exposure of the cows to sunlight or by feeding them sun-cured hay. If vitamin C is required by cattle, it appears to be produced in sufficient quantities in their bodies.

Vitamin A deficiency in cattle results in many reproductive disturbances, perhaps to the point of complete reproductive failure. In the male, this deficiency causes a cessation of sperm-cell production and reduces the sex drive. In the female, the major effects are embryonic death, abortion, and giving birth to dead or weak calves. The detrimental effects of vitamin A deficiency are primarily associated with improper development of membranes in the reproductive organs.

Considerable evidence has accumulated indicating that mineral deficiencies have marked effects on reproduction. Reproduction failures in cattle due to phosphorus deficiency are worldwide. Sexual maturity is retarded, the ovary becomes nonfunctional, and the estrous cycle ceases in response to phosphorus deficiency. Among other minerals, deficiencies of iodine, cobalt, copper, selenium, and manganese have been implicated in reproductive disturbances.

Physiological disturbances

Growth, development, and functional activity of the reproductive systems are primarily under the influence of hormonal secretions. Hormones are chemical substances that are released directly into circulation by glandular structures and typically travel to another part of the body to act. Some are involved indirectly in reproduction in that they maintain the animal in a state of general well-being, whereas others act directly on reproductive structures. The pituitary gland, ovaries, testicles, and placenta are the major sources of the hormones that are directly involved in reproductive processes. Possibilities of hormonal disturbances are endless, and only examples of some of the more common abnormalities will be mentioned.

Failure of reproductive structures to develop (sexual infantilism) may be a cause of irregular or absent heat.
periods in females and lack of sex drive in males. Such animals usually become excessively fat and resemble steers and spayed heifers. This condition presumably is the result of decreased secretion by the pituitary gland of hormones called gonadotropins. Unfortunately, treatment with such hormones is not often successful.

**Ovarian malfunction**

Abnormal function of a structure on the ovary called the corpus luteum can alter fertility. This structure has primary roles in regulating the estrous cycle and in maintaining pregnancy. A new one is formed after each heat and ovulation, but, if the female does not become pregnant, the corpus luteum loses its function before the next heat period. If it should fail to lose its function, the cow will not come into heat nor ovulate, and this is what happens during normal pregnancy. But, if it persists in the nonpregnant female (persistent corpus luteum), she will go into a prolonged period of sexual quiescence (anestrus) and not breed. Some evidence indicates that only a partial persistence of the function of the corpus luteum may result in a condition of ovulation without heat (silent heat or silent ovulation).

Aberrations in corpus luteum function have been implicated as one factor involved in the hard-to-settle animal (repeat breeder). These individuals require two, three, or more services before they conceive. Failure of fertilization and high embryonic mortality have been observed in studies with repeat-breeding cows. Hormones from the corpus luteum, as well as from other structures, are important in both of these areas.

Abnormal function of another ovarian structure, the follicle, can interfere with reproduction. Follicles are the structures that contain the developing eggs and secrete some of the female sex hormones. Occasionally they continue to grow to enormous sizes rather than to rupture and release their eggs (ovulation). The enlarged follicles are called “ovarian cysts,” and in cattle they often cause exaggerated sexual desire (nymphomania). Breeding of such animals does not result in conception unless there is a recovery from this condition and ovulation occurs. The best explanation for the development of ovarian cysts is based on the disturbance of the secretion of gonadotropic hormones by the pituitary gland.

Hormonal disturbances can be at least partly responsible for other alterations in the estrous cycle, as well as for other reproductive problems such as difficult calving. No doubt, problems in the male, such as deficient sexual desire and reduced semen quality, are at times due to hormonal disturbances.

In spite of the important role of hormones in reproduction, it is well to keep in mind that not all, and indeed perhaps very few, reproductive problems are entirely due to hormonal disturbances. A wide variety of hormonal preparations is available, but none should be used except under the direction of a well-informed practitioner.

**Genetic factors**

The development of breeds or lines which differ in prolificacy is evidence that fertility has a genetic basis. Genetic factors may influence reproductive performance by (1) the expression of lethal characteristics, (2) the expression of abnormal anatomical reproductive characteristics, and (3) the regulation of physiological mechanisms responsible for reproduction, such as hormone production and action.
Genetic factors causing the expression of lethal characteristics affect reproductive efficiency by interfering with successful pregnancy. The new offspring dies either during some stage of prenatal development or at birth. The frequent result is that a cow may settle to breeding, but after a few heat periods have been missed she may return to heat.

In some cases, the genetic effect might not be severe enough to cause the death of the offspring, but it might cause the calf to be born with certain abnormalities, such as the anatomical reproductive abnormalities previously discussed. With few exceptions, the anatomical factors of nonpathological origin that cause sterility and lower fertility are believed to be of hereditary origin. Reproductive disorders of a heritable nature should not knowingly be perpetuated.

As stated earlier, reproductive events are directly under the control of physiological mechanisms, such as hormone action. Such physiological mechanisms are in turn under genetic influence, and alterations in the genetic make-up may alter reproduction by involving the hormonal system. For example, cases of inherited thyroid disturbances have been reported in cattle. Because of thyroid involvement in both growth and reproduction, both processes will be greatly retarded.

It is known that fertility in beef cattle is not highly heritable. This is not to imply that genetic factors are not important in fertility, but rather that environmental factors mask the expression of most of the traits that are controlled by quantitative genetic factors.

Pathological disorders

Any disorder, such as a systemic infection which affects the general well-being of an animal, may have either a temporary or permanent effect on fertility. In the male, for example, pneumonia or other diseases that are accompanied by fever may interfere with sperm production.

Nonspecific infections of the genital tract, especially those of the cervix and uterus which may occur following calving, are common causes of reproductive problems. A variety of microorganisms may be involved and the severity of the problem will depend upon the nature and extent to which they have invaded the reproductive tract.

Specific genital diseases which are spread chiefly by sexual contact account for a considerable portion of sterility in cattle. Brucellosis, leptospirosis, trichomoniasis, and vibriosis are some of the most troublesome diseases of this type. The organisms responsible for these diseases interfere with gestation and result in abortion of the fetus. Initiation of estrous cycles is often an indication of early termination of pregnancy, even though an aborted fetus is not evident. Unfortunately, many diseases in this category present rather subtle symptoms and are not recognized until the cow aborts. The technical assistance of the local veterinarian in a health program for the herd should always be included in a beef operation.

Future research

Unfortunately, some of the causes of reproduction problems remain unrecognized or unknown. Our inability to directly observe processes such as the production of sperm cells and eggs, fertilization, and egg implantation severely limits progress in analyzing breeding problems of individual animals.
No doubt other factors, such as temperature, light, humidity, and psychological traits, are significant in influencing fertility. Data from artificial insemination associations show seasonal variation in the conception rate of dairy cattle, with the poorest conception rate in the late summer and winter and the maximum rate in the spring. It is known that ambient temperatures influence fertility in many species. The study of the reproductive behavior of animals as affected by interaction with other animals, by stresses to which they are subjected, and by the environment in which they exist seems to be a most promising area for future research. Additional research concerning mechanisms by which various nutritional, hormonal, and genetic factors alter reproduction is prerequisite to developing effective methods for improving fertility.

**Good management imperative**

Fortunately, many reproduction problems can be corrected by good management. Practices such as avoiding rebreeding too soon after calving, breeding at the proper stage of estrus, avoiding breeding of animals too young, avoiding excessive use of bulls, pregnancy testing, and keeping and using records will do much to improve the fertility of a herd. It should be kept in mind that selection of disease-free breeding stock, isolation of newly purchased animals, and periodic health examinations are more effective than treatment. If disease should strike, however, treatment should be prompt to avoid any unnecessary losses and the spread of disease.
Management of the Adair Beef Herd

A. T. RALSTON

Although the commercial herd of beef cattle produced at the Adair range unit is used for research, its management is on a commercial basis. This means that successful management techniques used with this herd can be used with the same degree of success under similar conditions in western Oregon.

The cow herd is returned to pasture after weaning and remains there until the middle of December or January 1, depending upon range conditions. Two-year-old heifers receive protein block supplements from September until hay is fed. The hays fed are Alta fescue and subterranean clover or perennial ryegrass. Under ad libitum feeding, this will produce a gain of between 0.33 and 0.67 pounds per day.

After calving, the cows and calves are placed on pastures away from the buildings as soon as the calves are able to travel. Dispersal of animals and constant surveillance during the first 60 days of a calf's life are mandatory for disease control. Shade and water are also important to young calves and may add several pounds to their weaning weight.

The breeding season is short (63 days or 3 heat periods). The cows are bred to drop their calves from the last week in February until the first week in May. This timing is important for two critical phases of production. First, calves dropped during the earlier part of the season have enough size to take care of the extra milk supply produced by cows grazing on our lush May pastures, and, second, the lush pastures just prior to and during the major portion of the breeding season improve fertility in both the male and female. Also, from an economic standpoint, less hay is needed per cow under this system.

Heifer replacements are selected from the oldest and largest calves. The record of the dam, as well as the record of the calf, is used in this selection. We save only heifers that have desirable conformation. A 205-day correction is used when comparing calf weights of one year to those of another year but not to compare calf weights within years. Conception at first service is important, and we do not want to downgrade a cow or her calf for early conception.

Replacement heifer calves are fed to gain 1.00 pound per day; this results in heifers weighing from 650 to 700 pounds by the time of the breeding season. At the beginning of bad fall weather, they are fed to gain about 1.00 pound per day until calving. This does not produce an overly fat heifer, but one with enough size to milk well.

The male calves at present are on a hormonal (diethylstilbestrol) experiment until weaning. At weaning, they are castrated and used in the nutritional barn for research. They are marketed at 13 to 15 months of age when they weigh about 1,050 pounds.

The cows are all palpated about 90 days after the bulls are removed. All DR. RALSTON is professor of animal science at Oregon State University.
open cows are sold. An average cow that calves every year will return more money than the best cow in the herd that is dry one or more years.

A summary of the progress of this herd is presented in the table below. The herd has increased in size, average age has been reduced, and weaning weights have been maintained or improved. The conception rate after three years of culling has tended to plateau at around 95%; this includes yearling heifers that usually have a conception rate of about 75%.

Summary of herd age, calf production, and conception rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Avg. age of cow</th>
<th>Calves</th>
<th>Avg. calf wt.</th>
<th>Conception rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Years</td>
<td>No.</td>
<td>Lbs.</td>
<td>%</td>
</tr>
<tr>
<td>1961</td>
<td>6.6</td>
<td>63</td>
<td>445</td>
<td>89</td>
</tr>
<tr>
<td>1962</td>
<td>5.5</td>
<td>86</td>
<td>436</td>
<td>78</td>
</tr>
<tr>
<td>1963</td>
<td>5.4</td>
<td>66</td>
<td>467²</td>
<td>87</td>
</tr>
<tr>
<td>1964</td>
<td>5.3</td>
<td>89</td>
<td>458</td>
<td>94</td>
</tr>
<tr>
<td>1965</td>
<td>4.9</td>
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<td>441</td>
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</tr>
<tr>
<td>1966</td>
<td>5.1</td>
<td>110</td>
<td>457</td>
<td>94</td>
</tr>
</tbody>
</table>

² Corrected to a 205-day weight.

Average calf age in 1963 was only 195 days; when corrected to an age of 205 days, the average weight looks somewhat better than it actually was.
Forage Preferences of Grazing Animals on Western Oregon Improved Pastures

T. E. Bedell

With the objective of investigating grazing animal preferences and the resultant effects on forage, esophageal-fistulated beef cattle and sheep have been grazed separately on tall fescue-subclover and perennial ryegrass-subclover pastures on a season-long basis since 1964 at the Oregon State University Adair tract near Corvallis. Samples of animal diets and of available forage have been assayed for botanical composition, crude-protein content, and estimated dry-matter digestibility.

Cattle diets were grass-dominant in both pasture mixtures, regardless of stocking rate (light or heavy). The only general exception concerned diets of cattle on perennial ryegrass-subclover during the May to early June period of 1966 when subclover composed up to 40% of the diet, especially under light grazing. As the grazing season progressed, preferences for both perennial ryegrass and tall fescue increased until these grasses composed over 75% of the diet.

Crude-protein content of cattle diets declined throughout each grazing season, but, because of selective grazing, it remained at higher levels than that in the available forage. Dietary crude-protein content approached 18% during late April on both pasture mixtures. Heavy cattle grazing resulted in holding forage in a vegetative state later into the grazing season. Consequently, from late May through August, diets on both pasture mixtures under heavy grazing contained more crude protein than they did under light grazing. This difference averaged approximately 3½%.

Although forage crude protein of perennial ryegrass-subclover exceeded that of tall fescue-subclover by about 1½% in 1966 and 4% in 1964 on cattle pastures, animal selectivity narrowed the difference to less than 1% dietary crude protein in favor of ryegrass-clover. With the exception of the summer of 1964 on ryegrass-clover, dietary crude-protein content substantially exceeded forage crude-protein content. The difference in crude protein between diets and forage was greater on fescue-clover pastures.

In estimated dry-matter digestibility, diets of cattle on perennial ryegrass-subclover exceeded those of cattle on tall fescue-clover by about two percentage points. Stocking rate affected cattle dietary digestibility differently on the two pasture mixtures. Diets from lightly grazed ryegrass-subclover were two to three percentage points more digestible than diets from heavily grazed ryegrass subclover and from both lightly and heavily grazed fescue-clover. Dietary estimated digestibility exceeded forage digestibility by a greater extent during the summer period than during the spring period, indicating that animal selectivity played a more important role later in the season.

Dr. Bedell is assistant professor of range management at Oregon State University.
Beef cattle breeding research at Corvallis was originally concerned with the establishment of three lines of Herefords and one of Angus. These four lines were bred as closed populations and selected with equal emphasis for suckling gains, feed-test gain, feed efficiency, and score for conformation. Culling was done for low fertility and inherited defects. Each of the lines showed a positive response followed by a plateau.

It was decided to combine the Hereford lines as a basis for the establishment of subsequent lines and to continue the Angus line, which was started on a wider base and has shown no plateau as yet because of a relatively low level of inbreeding. The three Hereford lines have been combined by a diallel mating plan by making all possible line and line-cross matings. The merit of the line-crosses compared with the inbreds is being evaluated from data on rate and efficiency of gains of bulls and heifers and from carcass data on the bulls. In addition, the calf-producing ability of the heifers is being evaluated by mating them to one and the same Angus bull and getting the weaning weights of their calves.

Line-cross heifers (1 x 2, 1 x 3, and 2 x 3) will be mated to line-cross bulls of our own (1 x 2, 1 x 3, and 2 x 3) to establish one line. Line-cross heifers (1 x 2, 1 x 3, and 2 x 3) will be mated to line-cross bulls (1 x 4, 1 x 10, and 4 x 10) from the United States Range Livestock Station for the establishment of a second line. These two lines will be maintained at 30 breeding cows and 2 bulls in each line.