Farm & Home Science Vol. 21 No. 3, September 1960
Farm and Home SCIENCE

Ground covers for collecting precipitation,
by C. W. Lauritzen ........................................ 66

People in the news ........................................ 68

Arthritis, by J. L. Shupe ................................. 70

Need for drainage, by L. Wilson ....................... 72

Changing effectiveness of antibiotics,
by J. O. Anderson .......................................... 74

Demonstrating the management of poorly drained soils,
by F. W. Keifer, Jr. ......................................... 76

Does range seeding pay?
by C. W. Cook and R. D. Lloyd ....................... 78

Utah's red meat slaughtering and packing industry,
by N. K. Roberts and B. Warnick ..................... 80

Economical water trough and mineral box,
by M. L. Dew and L. E. Harris ....................... 82

Vol. 21, No. 3  September 1960
UTHA STATE UNIVERSITY • LOGAN • AGRICULTURAL EXPERIMENT STATION
Water is a perpetual problem in many semiarid regions. Oftentimes the only source of water for livestock and even culinary use is that collected in small reservoirs constructed in natural drainageways. There is much uncertainty about these reservoirs filling, and the quality of water is frequently poor. Much of the water when collected is lost through percolation and evaporation, and over the greatest portion of most years these reservoirs are often dry. In other areas and at times when the reservoirs are dry, if water is to be had, it must be hauled and frequently from considerable distances. Even though the precipitation in a region is not great, if all that falls could be collected and stored, small areas would provide substantial amounts. As an example, the precipitation on one acre of land in an 8-inch annual rainfall area amounts to 217,248 gallons. This is enough to supply water to more than 200 head of cattle for 100 days.

In some parts of the world rain water has been collected through the use of paved watersheds for a long time. In the Virgin Islands and on Gibraltar the runoff from slopes of exposed rock constitutes an important source of fresh water. In both these areas the slopes have been plastered with concrete to make them less pervious and thereby increase the water yield. In Arizona in one instance, corrugated metal roofing nailed to a wooden framework has been used to collect water for livestock.

The problem is how to collect this water at a price which will make it economically feasible. Usually, the bulk of the precipitation falling in desert areas occurs in light showers, and the water is absorbed by the soil without producing runoff. Even fairly heavy storms frequently occur without producing any runoff because of the high intake of the land surface on which it falls. If a land area is covered with a watertight non-absorbent cover, essentially all the water which falls can be collected under proper conditions.

**The use of ground covers for collecting precipitation**

In the past, materials suitable for intercepting and collecting precipitation have not been available at a cost which made this method of developing water practical. The performance of new materials which have been developed in recent years, however, indicates that in some areas water can be developed by ground covers at a cost which will be competitive with other water sources.

Cooperative studies on the collection of water for livestock between the U. S. Department of Agriculture and the Utah Agricultural Experiment Station were started in 1955. Materials evaluated have included plastic films—vinyl and polyethylene— butyl rubber sheeting, asphalt-coated jute fabrics, and chemical sealants. Of these, butyl sheeting and asphalt-coated jute material look most promising.

Trouble with seam failure due to wind action was encountered with polyethylene film when used as ground covers. Bird damage was also a problem. Ground covers of vinyl film were much less susceptible to wind and bird damage, but after about two years of service the vinyl films began to develop holes due to migration of the plasticizer. Plastic films of 8 mils or thinner were tested, while 25 mil butyl sheeting was used.

Runoff from soil surfaces can be increased by treatment with certain chemicals. Evidence is still lacking, however, to indicate that this is a practical approach. Even with heavy treatments, the soil materials studied absorbed considerable water.

**Promising materials**

We have had only two years' experience with butyl rubber sheeting used as a ground cover. Specimens have been exposed a somewhat longer time to obtain...
In areas of low rainfall, the answer to the problem of water shortage may be

GROUND COVERS FOR COLLECTING PRECIPITATION

A collapsible butyl-coated nylon bag will provide water storage if it is protected. Bag partly filled with water. Bag filled with water — capacity 1600 gallons.

Typical Ground Cover Installation

after ten years as a ditch lining did not show measurable deterioration, except for some mechanical damage from livestock. The extremely good aging properties of butyl seem to make this material admirably suited to ground covers.

The asphalt-coated jute material, while less expensive, will not age as well. Just how long the coated jute fabric will give service is still a matter of conjecture, but we believe that with a small amount of maintenance, ten years' service can be expected. The fabric used in our test installation was given a sprayed application of clay emulsion to improve the aging. A built-in coating, or protective surface, will be a feature of future materials.

As with all asphalt membranes, weed penetration is a problem with the asphalt-coated jute fabrics, and ground sterilization is an essential part of the installation. Effective control can be obtained by spraying the area prepared to receive the ground cover with Karmex W at the rate of two pounds per 1,000 square feet. If the ground cover is to be laid immediately, it may be desirable to supplement this with a light application of polyborchlo- rate to prevent vegetation from penetrating until the Karmex W can become effective. If butyl

(Continued on page 87)
Dr. R. H. Walker

Dr. George T. Blanch

Dr. L. H. Pollard

Dr. W. H. Bennett

PEOPLE IN THE NEWS—

DEAN R. H. WALKER

In July of 1958 Dean R. H. Walker was appointed to head the Utah State University Mission to Iran. He had directed the program as part of his assignment at Utah State since its inception in 1951 and had made a number of earlier trips to Iran to get the program under way. He returned from his last assignment in August with his wife and youngest son, Gordon.

The USU program in Iran has three principal purposes: to assist the Agricultural College of the University of Tehran to improve teaching and research; to carry out an educational program in irrigation throughout the country; and to develop a demonstration farm which will show the benefits of modern farming methods.

During the past two years while Dr. Walker has been in Iran great progress has been made in these programs. In addition to the activities in Iran, a number of students and staff members from the University of Tehran have come to Utah State for further study.

Dean Walker is leaving Utah State University to accept a position at Brigham Young University after serving 22 years on the staff here. He came to Utah State University in 1938 as dean of agriculture and director of the Utah Agricultural Experiment Station. Under the direction of Dean Walker the agricultural programs at USU have grown in both quality and size. He has emphasized the use of modern tools and methods in both research and teaching.

Dr. Walker has made a special contribution in promoting friendly, progressive relations between the Utah Agricultural Experiment Station and the U. S. Department of Agriculture. During the period he was director, the U. S. Department of Agriculture located many of its leading research workers in Utah as cooperators with the Station. Dr. Walker also took the leadership in technical aid to agriculture in foreign countries. He was leader of a U. S. agricultural mission to Thailand and has been in charge of the USU contract for aid in Iran since its beginning.

Dr. Walker served as director of the Agricultural Experiment Station from 1938 until there was a general reorganization in 1955. This was the longest period of service of any Station director. In 1955 he was made dean of the College of Agriculture and director of Agricultural Sciences with general responsibility for coordinating the work of the Agricultural Experiment Station and the Cooperative Extension Service. In the reorganization Dr. Wynne Thorne was appointed director of the Experiment Station and Dr. Carl Frischknecht continued as director of the Cooperative Extension Service. When Dr. Walker recently announced he would not return to USU, Acting Dean William H. Bennett was appointed dean.

We regret that Dr. Walker is not returning to Utah State University. Our associations with him have been pleasant and profitable. He made important contributions for the benefit of the entire state through the stimulation and guidance of research and educational programs. Our best wishes go with him in his new assignment.

DEAN WILLIAM H. BENNETT

UTAH State University, on May 5, 1960, appointed Dr. William H. Bennett dean of the College of Agriculture to succeed Dr. Rudger H. Walker. Dr. Bennett has been acting dean the past two years during Dr. Walker's assignment in Iran.

Dean Bennett is a native of Canada. He obtained his B.S. and M.S. degrees in agronomy at Utah State University and his doctorate degree at the University of Wisconsin. He has served successively as county agent, assistant and associate professor of agronomy, and assistant director of the Cooperative Extension Service.

FARM AND HOME SCIENCE
DR. GEORGE T. BLANCH

In 1958, Dr. George T. Blanch, head of the Department of Agricultural Economics, went to Iran to assist in improving teaching and research at Karadj College. Dr. Blanch was accompanied by his wife and youngest son. In addition to his work in Iran, Dr. Blanch made special economic studies in Turkey and Pakistan.

Dr. Blanch has been head of the Department of Agricultural Economics since 1952 and an employee of the University since 1934. During this period a major part of his time has been spent in research with the Agricultural Experiment Station. He is known for his research and writing on water, costs of producing crops and livestock products, and marketing problems.

Dr. Blanch returned to his position as head of the Department of Agricultural Economics.

DR. LEONARD H. POLLARD

Dr. Leonard H. Pollard, his wife and children, went to Iran in 1958 under the University contract to work with Karadj College in developing an improved teaching, demonstration, and research program in horticulture and field crops.

While in Iran, Dr. Pollard worked with Odeal Kirk, on leave from his position as farm manager of the Howell Field Station for Horticultural Research at North Ogden, and Glen Wahlquist, on leave from the College of Southern Utah, in developing two five-hundred acre demonstration and research farms. The farms are irrigated with large pump wells. Fruit orchards, vegetable crop production, and field crop production have been established. Modern farm equipment, improved crop varieties, and up-to-date farming methods have been carried out.

He resumed his position as head of the Department of Horticulture on August 10, and will renew his research on vegetable crops.

Death of Dr. Bauer Loss to Research

The unexpected death of Dr. Norman Bauer on September 9 was an irreparable loss to research and higher education in Utah. Dr. Bauer, a physical chemist, joined the staff of Utah State University in 1953. He taught advanced courses in physical chemistry and was a leader in the Agricultural Experiment Station research program on nitrogen transformations in soils and plants.

At the time of his death, Dr. Bauer was making distinctive progress on a problem of basic importance to agriculture. About 20 percent of the nitrogen added to soil is lost, presumably by being converted to nitrogen gas and diffusing into the air. The other side of this nitrogen problem is to find how bacteria and plants are able to take nitrogen from air and combine it into compounds useful to life. Dr. Bauer concluded that these two problems were in reality two extremes of the same basic reaction.

He and his students had succeeded in isolating and studying a haemoglobin-like compound from nodules on the roots of legumes and had found how this is able to absorb nitrogen and promote nitrogen fixation. Just before his death he had been working almost day and night to discover the mechanism of the reaction that bacteria use in fixing nitrogen. He had made a special trip to Palo Alto, California, to obtain the use of an instrument not available in Utah. He returned to report his studies in California had verified the existence of a special chemical group of elements that appeared to furnish an important clue to the mechanism of nitrogen fixation.

Few men have the creative insight for solving scientific problems that was possessed by Dr. Bauer. His curiosity and enthusiasm were boundless and contagious. He touched the spirit of his students and inspired them and his associates to advance and achieve. He had a deep conviction of the moral responsibility of a scientist for the welfare of his fellowman. In one instance he paid personally for newspaper space to inform the public of dangers from radioactive fallout.

Dr. Bauer was born in Alta Vista, California, May 25, 1915 and obtained bachelor, master, and doctorate degrees from the University of California. Previous to joining the USU staff he had been on the staff of the University of New Hampshire and of the California Research Corporation. He was widely known for his writings on physical-chemical methods of analysis and for his research on nitrogen transformations. He is survived by his wife Corda Dietzgen Bauer; three sons, W. Dietzgen, W. Perry, and Niels D., and a daughter, Annamarie J.

—Wynne Thorne
It is now known that all species of livestock suffer from joint diseases of known and unknown causes. These diseases of the joints manifest themselves by various symptoms and characteristics which are important in proper management, diagnosis, prognosis, and treatment.

Arthritic disorders are of great importance in veterinary medicine and of economic importance in the livestock industry. During 1957-58 584 carcasses of cattle (.8 percent) and 1,191 carcasses of calves (3.9 percent) were condemned because of arthritis.

Reports of animal diseases at public stockyards reveal the number of animals affected with arthritis. Carcasses of these animals were passed with restriction. During the year 1958, 35,407 (.14 percent) of 23,863,211 cattle were affected with arthritis. After removal of the affected joints, usually of the extremities, the carcasses were passed without restriction. Although figures of this kind are revealing, they do not complete the picture. Many affected animals must be assumed to pass through state and municipal-inspected abattoirs as well as rendering plants. Reactive arthritic processes also demand expensive medical attention and result in poor performance of the affected animal.

**Arthritis — a debilitating disease**

The study of joint diseases is of necessity difficult. Arthritis is seldom fatal and is often a chronic debilitating condition, so that it is hard to obtain cases and material for study when wanted. The cause is not clearly understood in many cases. For this reason, it is not easy to produce cases experimentally of arthritis characteristic of those seen clinically or at necropsy.

The musculo-skeletal system is structurally and functionally a unit. It can be fully understood only if this concept is kept in mind while artificially separated parts of it are studied. This unity is reflected in the close relation between pathological changes of bones, joints, and muscles. Whenever one of the three major components of the locomotor system becomes abnormal the other two will ultimately undergo secondary change.

---

**Fig. 1.** Lower end of thigh bone from a 7-year-old dairy cow showing erosion of cartilage covering the end of bone with marginal abnormal bony formations.

**Fig. 2.** Upper ends of thigh bones from 10-year-old dairy cows. Left: severe erosion, pitting, wearing, and excessive new bony formations. Right: normal cartilage and bone structure.

**Fig. 3.** Hip sockets from two ten-year-old dairy cows. Left: severe pitting and erosion of articular surface with massive new bony formations around edge of cartilage. Right: normal bone, cartilage, and articular surface.
Inflammation of a joint

Arthritis — inflammation of a joint

Arthritis is defined as inflammation of a joint. In anatomic usage a joint has been described as the connection subsisting in the skeleton between any of its rigid component parts, whether bones or cartilages. Inflammation refers to a series of reactive tissue processes following an injury and conceived as being an attempt of the tissues to repair the abnormality. The appearance of arthritis and the inflammatory response of a joint are of necessity variable since joints differ widely in structure, arrangement, and function and the disease process can be due to many causative agents.

Arthritis may be divided into two general types, inflammatory (proliferative) and degenerative. Both types have known and unknown causes. The symptoms and lesions resulting from these disease processes differ markedly. It is also imperative that four characteristics of articular cartilage (1) no direct blood supply (avascular), (2) insensitive, (3) low metabolic rate, (4) poor reparative ability, be fully appreciated.

Inflammatory group

The inflammatory group of arthritides can be due to a number of known causes. Specific infective agents such as Brucella, Erysipelas, Staphylococcus, Streptococcus, PPLO, and Pneumococcus have been isolated from infected joints. These infectious agents can localize in joints and elicit a non-specific syndrome. Some of these acute and subacute septicemic conditions cause periarticular inflammatory involvement resulting in secondary capsulitis that later develops progressive degenerative reactive ar-

(Continued on page 83)

---

**Fig. 4.** Left: Lower end of thigh bone from a 9-year-old dairy cow showing cyst-like areas with erosion on joint surface

**Fig. 5.** Right: X-ray of lower end of thigh bone of a 9-year-old dairy cow showing cysts underneath the cartilage covering end of bone with excessive new bony growths along margin of bone.

**Fig. 6.** Upper end of hind leg bone showing massive new bony formations along articular margins

**Fig. 7.** Joint fluid from arthritic joints showing varying amounts of abnormal fibrin. Left: slight. Middle: moderate. Right: excessive
Soil survey of the Roosevelt-Duchesne Area points up the

Harvesting third crop alfalfa. The soil is Ravola loam, a deep, medium textured, well-drained soil that is well suited to irrigated farming. Proper irrigation practices and drainage facilities are needed to keep this area permanently productive.

Many soils in the Roosevelt-Duchesne area that were essentially free of salts and well-drained in 1940, as shown by data from a survey made in that year, when resampled in 1953 from identical sites, showed a marked increase in salts and usually a high water table. These conditions point up the widespread need for drainage in the area and also for better water management. Thousands of acres of land have deteriorated to the extent that they are no longer used for crop production.

The problem of poor drainage with salt and alkali accumulation is not confined to the shallow soils, unfortunately it is also widespread on deep alluvial soils and on many upland bench soils where the shale bedrock is as much as 10 to 20 feet below the land surface.

Some progress made in reclamation

Some progress has been made in reclaiming these saline-alkali lands and there are some outstanding examples of successful reclamation. This is especially true of areas of Mesa and Fruita soils on North Myton Bench, where both tile and open drains have been installed. The reclaimed lands are now producing high yields of alfalfa and small grains. Reclamation failures are common where drainage has been attempted on shallow soils over shale bedrock.

Drainage and salt and alkali reclamation are expensive and should not be attempted until the soil conditions are known. Much of the needed information is available in the soil report and accompanying maps of the area just published in the Soil Survey Report. The report covers most of the arable and potentially arable land in Duchesne County and in the western part of Uintah County. The area surveyed occupies approxi-
Drainage and reclamation have been attempted on this area of Billings silty clay loam over shale. This soil is difficult to reclaim because of the saline Uinta shales which are only 2 or 3 feet below the surface.

Approximately 644,914 acres and includes most of the land now irrigated or that is likely to be irrigated in the future. Additional information should be obtained from experienced engineers and soil scientists in the Soil Conservation Service and Utah State University before plans are made for drain construction or reclamation.

**Most soils of area are difficult to reclaim.**

The soils in much of the Roosevelt-Duchesne area have developed in a dry climate. They are underlain at varying depths by saline-marine shales and interbedded sandstone and shale. Where the underlying shale bedrock is near the surface or is only a few feet below, the problems of irrigated agriculture are most severe. When these soils are irrigated, the excess water builds up a water table below the shale bedrock, dissolves soluble salts from the saline shale, and carries it into the soil. As the soil dries out, the salts are concentrated at or near the surface. Soils of this nature are difficult to drain and reclaim.

Information about the soils contained in the soil survey report can be helpful to farmers and ranchers in determining the feasibility of reclaiming poorly drained, salt and alkali affected soils as well as the best uses and management of all lands in the area. The report describes the soils and shows their distribution on soils maps that accompany the report. Each different kind of soil is described, and the capabilities and limitations of each are discussed.

The report also gives information about how the soils were formed and how they were classified. The number, kind, and arrangement of horizons in a soil profile determine the characteristics of the soil, and it is on the basis of these characteristics that the soils are identified, described, and classified into groups. Soil profiles that are alike are classified together into a group called a soil series. An example of an important soil series in the Roosevelt-Duchesne area is the Mesa series. Mesa loam is a soil type in this series.

Each owner or operator can locate his land on the map and determine the kind of soils he farms. He can also get information about the soils that will be helpful in management of the good soils as well as the ones that need special attention.

Information about the nature of the various soils as contained in this report is helpful to many individuals such as road planners, those constructing canals, ponds, or reservoirs. It also serves as a basis for land value determinations by assessors, prospective investors, and others.

**NEW PUBLICATIONS**


This bulletin is a study of the effects of new industrial development on Brigham City and its residents.


This publication reports yield tests on legumes other than alfalfa in various parts of the state. Based on the results the authors concluded that alfalfa is the legume best suited for well-drained irrigated land in Utah. However, some other legumes have value in special situations. Alsike clover and red clover are useful for land with a high water table. Red clover and ladino clover are valuable components of an irrigated pasture mixture.

Bul. 422. Carrot seed production as affected by insect pollination, by L. R. Hawthorn, G. E. Bohart, E. H. Toole, W. P. Nye, and M. D. Levin. Utah Agricultural Experiment Station in cooperation with the U.S. Department of Agriculture.

This bulletin studies to determine the relation of different levels of insect pollination on carrot seed yields and quality. Higher seed yields, earlier seed maturity, and increased seed viability, were consistently associated with higher pollination levels.
Broiler and turkey producers may need to change the antibiotic used in their poultry rations periodically if they are to obtain the greatest benefit.

changing effectiveness of antibiotics

We have been adding antibiotics to poultry feeds now for about ten years. This practice was started when it was found that one vitamin B₁₂ supplement stimulated growth more than another. The supplement which stimulated growth most contained an antibiotic in addition to the vitamin B₁₂. When the pure antibiotic was added to rations fed chicks and turkey poults, a marked increase in growth rate resulted. Since that time research has provided the feed producer with many different antibiotics which stimulate growth under field conditions.

Soon after the original report on the value of antibiotics in poultry feeds was made, many researchers conducted similar experiments. Almost everywhere it was found that young chickens and turkeys benefited from the addition of these substances to their diet. Reports indicating a 10 percent increase in the growth rate of chicks and a 20 percent increase in the growth rate of turkey poults were common. Little or no improvement in the performance of older birds was noted unless a disease was present which the antibiotic helped to control.

Table 1. Average growth response from antibiotics in the rations of chicks and turkey poults, 1952 and 1953

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Turkey poults</th>
<th>Chicks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin</td>
<td>12-28</td>
<td>4-12</td>
</tr>
<tr>
<td>Chlortetracycline</td>
<td>10</td>
<td>8-12</td>
</tr>
<tr>
<td>Penicillin and chlortetracycline</td>
<td>15-36</td>
<td></td>
</tr>
</tbody>
</table>

A relatively small amount of antibiotic was effective in producing this increase in growth. From 4 to 25 grams are added per ton of feed to produce the "low level" feeds commonly used today. Higher levels are sometimes fed to control disease; these "high level" feeds contain from 100 to 500 grams of antibiotic per ton. The fermentation processes used to produce these antibiotics have been made so efficient that one can now add an antibiotic to feed at a cost less than that for certain of the vitamin additions. Four grams of penicillin can be added for 25 cents.

Early tests with antibiotics

Penicillin and chlortetracycline (Aureomycin) were among the first antibiotics made available for addition to poultry feeds. In 1952 and 1953 we conducted several experiments to determine how much the addition of these antibiotics to chick and poult rations would increase growth. The average growth responses obtained in the experiments conducted during this period are shown in table 1.

The increases in growth noted were quite consistent and we found that feed efficiency was also improved by the additions of antibiotics. These benefits more than paid for the cost of adding the antibiotic to the feeds. During the next five years one of these antibiotics was added to all feeds used at the Poultry Experimental Farm except where the experimental design would not permit the addition. Penicillin was added to most feeds because its cost was low and it had been so effective in our early...
experiments. Chlortetracycline was added to some rations for laying hens and growing turkeys at levels of 100 to 200 grams per ton.

Earlier antibiotics less effective in later tests

During 1959 and 1960 we have again had occasion to compare several antibiotics as growth stimulants for chicks and poults. The two antibiotics used previously and several others were used in these tests. The average responses obtained during the past two years are summarized in table 2.

In summarizing these results we have considered only data from groups of birds fed the antibiotics at levels of 25 grams per ton or less. Most of the antibiotics were added in the form of a commercial feed supplement. The oleandomycin used in all tests and the penicillin used in the last chick test were highly purified products. Several hundred chicks and turkey poults were involved in these tests during each period. The rations fed during the two periods were not mixed according to the same formula, but they were similar. The birds used were not from the same sources. For these reasons it may not be strictly valid to compare the results. However, when the two periods are compared we note that penicillin and chlortetracycline seem to be less effective during the past two years than they were during the first period. During the early period the responses obtained by the addition of penicillin were statistically significant in most experiments. In only one of the five experiments conducted during the past two years was a significant response obtained.

How antibiotics effected growth

We believe that the antibiotics produce their effect on growth mainly by altering the numbers of various species of micro-organisms in the digestive tract. Some evidence has been presented which indicates that the number of certain detrimental organisms is reduced by the antibiotic; other data have been presented which indicate that the number of organisms which benefit the bird by synthesizing needed nutrients increases. A decrease in the thickness of the intestinal wall has also been reported. It was felt that this might allow the bird to absorb nutrients more efficiently.

The decrease in effectiveness of a given antibiotic after prolonged usage has been noted by others. They have suggested that using one antibiotic over a long period changes the bacterial population in the surroundings from which the birds are infected. Even birds which do not receive any antibiotic in their diet benefit from its previous use on a given farm or area. Less response would be obtained from the addition of the antibiotic because the birds not given the antibiotic have already been influenced by its previous use and grow faster than the average bird. The growth rates of the birds fed the basal diets in the two periods reported here are difficult to compare. If the birds fed rations without an antibiotic grew faster during the last two years, the differences were not great and could easily be explained by other changes in the diets. An increase in the resistance of a bacterial population to a given antibiotic might also help explain the apparent decrease in response in these experiments.

Addition of bacitracin, erythromycin, or oleandomycin to the diets fed during 1959 and 1960 produced significant increases in growth, even though addition of penicillin or chlortetracycline did not. Novobiocin produced smaller increases in growth. This is the antibiotic which has been found to be somewhat effective in controlling staphlococcosis in turkeys.

The results obtained in these tests suggest that broiler and turkey producers may need to change the antibiotic used in their poultry rations periodically if they are to obtain the greatest benefit. A continuous testing program may be necessary in order to do this.

Table 2. Average growth responses from antibiotics in the ration of chicks and turkey poults, 1959 and 1960

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Turkey poults</th>
<th>Chicks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 experiments</td>
<td>2 experiments</td>
</tr>
<tr>
<td>percent increase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin</td>
<td>3-15</td>
<td>-3-0</td>
</tr>
<tr>
<td>Chlortetracycline</td>
<td>3</td>
<td>0-4</td>
</tr>
<tr>
<td>Bacitracin</td>
<td>12-13</td>
<td>5-10</td>
</tr>
<tr>
<td>Novobiocin</td>
<td>2-14</td>
<td>2-5</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>22</td>
<td>6-12</td>
</tr>
<tr>
<td>Oleandomycin</td>
<td>14-21</td>
<td>5-12</td>
</tr>
</tbody>
</table>

LEAVES OF ABSENCE

Robert Gerber, assistant professor of Horticulture, has been granted a two-year leave of absence to go to Iran and assist with the educational program in cooperation with Karadj College.

Dr. W. W. Smith, head of the Bacteriology Department, has been granted a three-year leave of absence to become head of the Swiss-Austrian Mission for the Latter-day Saints church.
Demonstrating the management of

Checking the ground water level

Initial work included installing piezometer batteries to check the water level over the entire farm. Each battery of piezometers consists of four 3/8 inch pipes driven to depths of 10, 20, 30, and 40 feet. At each piezometer battery there is also an 8 foot deep auger hole where the level of the water table can be measured. Pressure readings from the piezometers show a movement of water upward through the ground. The bottom of the 40 foot piezometer is in the artesian aquifer and water in these piezometers rises to heights varying from 3 to 12 feet above the ground surface. The water levels in the 30, 20, and 10 foot piezometers are successively lower; in most cases the water level in the 10 feet piezometer is close to that of the adjacent auger hole. A continuous record of water level readings for a typical piezometer battery is shown in fig. 1.

In the fall of 1957, efforts were made to control surface waters by confining them to ditches. In June of 1958 a long open drain was constructed extending west 3/4 mile along the north side of the farm and then north 3/4 mile where it drops into a natural drainage channel. The drain is 7 1/2 feet deep with a 3 foot bottom width and was built at a cost of $4,500.

After completion of the drain, water which had previously flooded over the surface of the farm was collected in ditches and conveyed to the drain. During the winter of 1958-59 the water table began dropping until in some places it was below the bottom of the drain. During the winter, evaporation and transpiration are near zero, so the dropping water table could not be explained in this way. The water could not be moving downward below about 10 feet since there is a measurable upward gradient from a depth of 40 feet up to about 10 feet. A possible explanation is that the

Soils on the farm

The top soil on the farm is a silty clay loam and varies in thickness from a few inches to three feet. The soils contain varying amounts of salt, but only on 35 percent of the farm do the soils contain sufficient salts to be classed as saline or saline-alkali.

Below the top soil there are layers of heavy brown and grey clays with occasional sandy layers at depths of 10 to 12 feet. Below 12 feet, limited testing indicates the material to be a soft blue grey clay extending to the aquifer at a depth of about 40 feet. The aquifer consists of fine sand and gravel with some pockets of silt and clay interspersed. The thickness of the aquifer is not accurately known, but it is probably greater than 30 feet.

FRED W. KIEFER, JR. is assistant professor of civil and irrigation engineering.

FRED W. KIEFER, JR.

Looking forward toward the reclamation of the many thousands of acres of waterlogged land in the valley bottoms, Cache County, in 1957, purchased land in the poorly-drained lowlands two miles northwest of Logan. They turned the farm over to Utah State University for research in irrigation and drainage and in management of poorly drained soils.

Most of the problems encountered on this farm are the same as those occurring on low valley lands throughout the state. The farm is covered with saltgrass, wiregrass, and other vegetation indicative of a high water table. In 1957 the area was continuously wet with the water table at or near the surface the year round. Water flooding over the surface comes from nearby springs, flowing wells, and irrigation ditches. In addition, an appreciable quantity of water was thought to be moving upward over the entire area from an artesian aquifer.

FARM AND HOME SCIENCE
POORLY DRAINED SOILS

Variation of the water table elevation and the piezometric head in the artesian aquifer for the period 1957-1960 at piezometer battery A-1

Water moves horizontally through some more permeable layer at a depth of about 10 feet. The rate of drop is greater when the water table is near the ground surface, being about one foot per week. At depths of 4 to 5 feet the rate of drop decreases to about half a foot per month or less.

Part of the blame for high water tables existing in Cache Valley as well as other similar areas in the state has been placed upon upward movement of water from the artesian aquifer. The continued drop of the water table during the winter months indicates, however, that the quantity of upward moving water is small. This is further indicated by the small amount of drainage water flowing in the open drain. Using previous estimates of the rate of upward flow, the amount of water flowing in the open drain should have been several times greater than the amount actually measured.

The conclusion that the amount of upward flowing water is extremely small is supported by other evidence. At Logan airport just two miles away, an extensive tile drainage system remains dry most of the year. Water flows in these

(Continued on page 85)
Fig. 1. Average composition of total costs on 20 crested wheatgrass seedlings of publicly owned sagebrush-grass ranges in western Utah, 1952-1954. Total costs were $18.51 per acre.

(Upper photo) Crested wheat grass seeded range at the end of the second year after seeding. (Lower) Cattle graze wheatgrass seeded range. This range was seeded five years previous to the taking of the photograph.

Utah ranges have been grazed by domestic livestock for more than a century. Some rangelands have been used so intensively that productivity has been reduced seriously. The most expedient measure for improving many of these badly depleted ranges is by seeding with adapted grass species.

In 1952, 1953, and 1954 the Bureau of Land Management (BLM) planted crested wheatgrass on approximately 54,000 acres of publicly-owned sagebrush-grass range throughout western Utah. Costs and returns for 20 seedings and nine reseedings are as follows:

Removing competing vegetation and preparing a seedbed

Sagebrush or other plants often must be removed before an improved forage species is planted. A single land treatment (such as plowing or burning) may accomplish both brush removal and seedbed preparation.

Costs should include considerations for owning, operating, and repairing machinery used. A fairly reliable guide for estimating costs is the prevalent contract rate for
Does range seeding pay?

C. WAYNE COOK
RUSSELL D. LLOYD


**Planting**

Seed may be drilled or may be broadcast from aircraft, fertilizer spreaders, or tractor-mounted broadcasters. Where soil and terrain permit, drilling is considered most likely to result in success. Costs of drilling on the projects in western Utah totaling over 37,000 acres averaged $1.28 an acre. Costs varied from $.90 to $2.30 an acre.

**Seed**

Seed prices vary among grass species, years, and localities. Crested wheatgrass is the most commonly recommended species for sagebrush ranges. Average retail prices for crested wheatgrass seed in the United States varied from $0.28 to $0.58 per pound and averaged $0.43 between 1947 and 1957.

Seeding recommendations vary from 4 to 8 pounds of crested wheatgrass seed per acre. The average planting rate for the projects studied in western Utah was 6 pounds per acre; thus, the cost of seed was calculated at $2.58 per acre.

**Nonuse until the new grass is established**

A newly planted seeding must be protected from livestock until the grass is ready for use. Premature use of a new seeding may destroy it. It is generally recommended that range seedings be protected for at least the first two growing seasons. Drought or poor stands may necessitate longer nonuse periods.

Nonuse is a cost to the rancher whether the newly seeded land is his or is publicly owned. When a range is removed from use because of seeding, the rancher whose stock normally graze it must make some adjustment in his operations. Since nonuse is expected to be a relatively short-term matter, most ranchers will adjust by (a) increasing use of purchased or harvested feeds or of irrigated pastures, (b) leasing additional rangeland, or (c) intensifying use of owned or leased ranges.

Nonuse cost is the additional expense of feeding animals displaced by nonuse of a seeded area. When it is necessary to fence areas of native range along with the seeded lands, the seeding bears the cost of alternative feed replacing all the range made unavailable by nonuse.

Seeded ranges in this study had capacities of from 8 to 14 acres per annual unit month (AUM) before seeding. Nonuse periods varied from 1 to 4½ years, with 3 years the most common. Total nonuse costs varied from $0.07 to $1.47 and averaged $0.52 per seeded acre.

**Fencing**

Fencing costs are those which result from construction of fences necessary for protection and success of a seeding and which would not be built if a seeding project were not undertaken.

Costs to construct fences around seedings of public ranges between 1952 and 1954, varied from $477 to $964 and averaged $767 per mile of fence. Materials cost $260 to $310 per mile. Costs of labor and machinery were affected by distances men, machinery, and supplies were hauled; amount of brush and trees which was cleared from the right-of-way; nature of the terrain; and difficulty of digging post holes and driving steel posts.

Fencing is charged to the seeded acres benefiting, and per-acre costs of fencing vary more than per-mile costs. In the cases where partial or entire fencing was required the per-acre costs averaged $0.96.

**Water development**

If it is to be properly and profitably used, a successful seeding may require development of stock water.

(Continued on page 85)
Utah’s red meat
Slaughtering and packing industry

N. K. ROBERTS and BOYD WARNICK

Utah’s red meat slaughtering and packing industry is a substantial one; an industry that is favorably located in relation to growing markets in the West and to transportation facilities to most parts of the nation.

Red meat refers to carcass cuts of beef, veal, lamb, mutton, and pork resulting from slaughter in Utah regardless of the origin of live animals. This report does not include other classes of meat such as poultry and fish, edible offal, all canned meat, and other processed meat except cured wholesale carcass pork cuts.

Red meat production from slaughter

According to the Agricultural Marketing Service, there were 52 slaughter plants in Utah in 1958. These plants varied widely in nature and size of operation. Some killed only a few head of animals for local custom slaughter. Some large plants operated as branches of national packing companies and killed several thousand animals each month.

Slaughtering plants engaged in interstate trade are required to have animals inspected by federal inspectors before, during, and after slaughter. The federally inspected plants in Utah are the larger plants. In 1958, seven slaughter plants in the state were under federal inspection. Others were under state inspection with the exception of those in Utah County.

Volume of slaughter

Total number of animals slaughtered in Utah increased 60 percent between 1950 and 1958 (table 1). Considerable fluctuation has occurred in numbers slaughtered within animal types, however; the trend has been upward over the period for each type except calves. There has been a similar trend in total slaughter for the nation. However, the percentage increase in animals slaughtered in Utah since 1950 exceeded that for the nation as a whole. There has been a decrease in number of animals slaughtered since the high point in 1955. Approximately 60 percent of hogs slaughtered in Utah in 1958 were imported; also, an undetermined quantity of cattle and sheep were imported for slaughter, mostly from Idaho.

Red meat produced in Utah plants in 1958 amounted to nearly 164 million pounds (table 2). Total pounds of beef produced were nearly twice those of pork and almost five times greater than lamb and mutton.

Interstate movements of red meat

Utah imports as well as exports red meat. Though exports far ex-

---

Table 1. Commercial slaughter in Utah plants by type of animal, 1950-1958

<table>
<thead>
<tr>
<th>Year</th>
<th>Cattle</th>
<th>Calves</th>
<th>Hogs</th>
<th>Sheep and lambs</th>
<th>Total</th>
<th>Yearly total as a percent of 1950</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>108,500</td>
<td>21,700</td>
<td>246,700</td>
<td>155,000</td>
<td>531,900</td>
<td>100</td>
</tr>
<tr>
<td>1951</td>
<td>100,300</td>
<td>12,900</td>
<td>256,000</td>
<td>197,000</td>
<td>566,500</td>
<td>106</td>
</tr>
<tr>
<td>1952</td>
<td>105,000</td>
<td>13,600</td>
<td>255,000</td>
<td>217,300</td>
<td>667,400</td>
<td>113</td>
</tr>
<tr>
<td>1953</td>
<td>152,900</td>
<td>15,500</td>
<td>243,000</td>
<td>256,000</td>
<td>667,400</td>
<td>125</td>
</tr>
<tr>
<td>1954</td>
<td>171,100</td>
<td>18,100</td>
<td>224,000</td>
<td>359,100</td>
<td>772,300</td>
<td>145</td>
</tr>
<tr>
<td>1955</td>
<td>175,100</td>
<td>17,700</td>
<td>258,000</td>
<td>418,000</td>
<td>868,800</td>
<td>163</td>
</tr>
<tr>
<td>1956</td>
<td>195,300</td>
<td>20,100</td>
<td>273,000</td>
<td>379,000</td>
<td>867,400</td>
<td>163</td>
</tr>
<tr>
<td>1957</td>
<td>194,500</td>
<td>20,700</td>
<td>301,000</td>
<td>343,000</td>
<td>859,200</td>
<td>162</td>
</tr>
<tr>
<td>1958</td>
<td>173,400</td>
<td>13,300</td>
<td>300,900</td>
<td>364,700</td>
<td>852,300</td>
<td>160</td>
</tr>
</tbody>
</table>


---

DR. N. KEITH ROBERTS is associate professor and BOYD WARNICK is a graduate assistant in agricultural economics.

FARM AND HOME SCIENCE
ceed imports, imports contribute about 5 percent of the total supply in the state.

Red meat imports

More than eight million pounds of red meat carcass cuts were shipped to firms in Utah in 1958. Most of this meat originated at branch plants of the large national meat packing companies in Iowa, Nebraska, and South Dakota. Quantities of meat shipped to Utah were 2,925,000 pounds from Iowa, 2,700,000 pounds from Nebraska, and 2,500,000 pounds from South Dakota. These shipments were largely wholesale carcass cuts of fresh and cured pork such as sides of bacon and hams. A considerably smaller amount of the total quantity consisted of beef and veal.

Red meat exports

The Pacific Coast is a major population growth center in the nation. Large quantities of meat are shipped to that area to meet increasing consumption needs each year. Situated directly on many of the principal routes between the Midwest and West Coast, meat packers in Utah are in an excellent position to compete for West Coast markets.

Approximately 50 percent of the beef and veal, 95 percent of the mutton and lamb, and 10 percent of the pork produced by slaughter in Utah is available for export. Utah meat packers indicated that 68,557,000 pounds of red meat were shipped out during 1958 (table 3).

Nearly all of the red meat going from Utah to western points in 1958 was shipped by truck. All

Most red meat importers used both rail and truck common carrier service. Approximately 10 percent of the meat was shipped into the state by railroad and about 90 percent was moved in by trucks.

Red meat exports

Table 2. Commercial red meat production in Utah slaughter plants by kind of meat by months, 1958*

<table>
<thead>
<tr>
<th>Month</th>
<th>Beef</th>
<th>Veal</th>
<th>Pork</th>
<th>Lamb and mutton</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>8,721</td>
<td>248</td>
<td>5,153</td>
<td>1,019</td>
<td>15,141</td>
</tr>
<tr>
<td>Feb.</td>
<td>6,970</td>
<td>248</td>
<td>3,767</td>
<td>748</td>
<td>11,656</td>
</tr>
<tr>
<td>Mar.</td>
<td>7,714</td>
<td>248</td>
<td>4,488</td>
<td>644</td>
<td>12,027</td>
</tr>
<tr>
<td>Apr.</td>
<td>6,917</td>
<td>248</td>
<td>4,090</td>
<td>927</td>
<td>12,102</td>
</tr>
<tr>
<td>May</td>
<td>7,499</td>
<td>248</td>
<td>3,562</td>
<td>1,431</td>
<td>12,694</td>
</tr>
<tr>
<td>June</td>
<td>7,704</td>
<td>248</td>
<td>3,800</td>
<td>1,209</td>
<td>12,979</td>
</tr>
<tr>
<td>July</td>
<td>7,984</td>
<td>248</td>
<td>3,494</td>
<td>2,521</td>
<td>13,989</td>
</tr>
<tr>
<td>Aug.</td>
<td>7,834</td>
<td>248</td>
<td>3,434</td>
<td>2,831</td>
<td>14,315</td>
</tr>
<tr>
<td>Sept.</td>
<td>8,324</td>
<td>248</td>
<td>3,828</td>
<td>3,242</td>
<td>14,611</td>
</tr>
<tr>
<td>Oct.</td>
<td>8,988</td>
<td>248</td>
<td>4,389</td>
<td>1,964</td>
<td>15,510</td>
</tr>
<tr>
<td>Nov.</td>
<td>7,266</td>
<td>248</td>
<td>4,141</td>
<td>1,352</td>
<td>12,925</td>
</tr>
<tr>
<td>Dec.</td>
<td>8,047</td>
<td>248</td>
<td>4,486</td>
<td>1,265</td>
<td>13,976</td>
</tr>
<tr>
<td>Total</td>
<td>93,968</td>
<td>2,310</td>
<td>48,612</td>
<td>18,933</td>
<td>163,843</td>
</tr>
</tbody>
</table>

*Red meat produced in slaughter plants in Utah without regard to source of animals. Does not include home slaughter. Does not include edible offal, canned nor highly processed meats such as sausage, precooked meats, sliced meats, and soup meats.

Table 3. Red meat exports from Utah to selected market areas, 1958

<table>
<thead>
<tr>
<th>Area</th>
<th>Red meat exports</th>
<th>Proportion percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>24,650</td>
<td>36</td>
</tr>
<tr>
<td>Eastern States</td>
<td>14,580</td>
<td>21</td>
</tr>
<tr>
<td>Nevada</td>
<td>12,940</td>
<td>19</td>
</tr>
<tr>
<td>Idaho</td>
<td>7,170</td>
<td>10</td>
</tr>
<tr>
<td>Montana</td>
<td>6,900</td>
<td>10</td>
</tr>
<tr>
<td>Wyoming</td>
<td>2,317</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>68,557</td>
<td>100</td>
</tr>
</tbody>
</table>

have the advantage. Over greater distances rate differentials widened in favor of rail transportation and the advantage shifted in the direction of rail transportation.

Intrastate movements of red meat

Although slaughter was widespread over the state in 1958, large quantities of red meat were

Table 4. Intrastate shipments of red meat from the Salt Lake-Weber-Davis County area along principle motor routes, 1958

<table>
<thead>
<tr>
<th>Direction from north central slaughter area</th>
<th>Highway</th>
<th>Quantity 1,000 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>U.S. 91</td>
<td>4,425</td>
</tr>
<tr>
<td>South</td>
<td>U.S. 99</td>
<td>1,677</td>
</tr>
<tr>
<td>North</td>
<td>U.S. 89 &amp; 91</td>
<td>2,505</td>
</tr>
<tr>
<td>West</td>
<td>U.S. 40</td>
<td>819</td>
</tr>
<tr>
<td>East</td>
<td>U.S. 40</td>
<td>251</td>
</tr>
<tr>
<td>Southeast</td>
<td>U.S. 50 &amp; 160</td>
<td>942</td>
</tr>
<tr>
<td>Total</td>
<td>10,620</td>
<td></td>
</tr>
</tbody>
</table>

*Weber, Davis, and Salt Lake Counties.

shipped by truck to all major areas of Utah from the north central slaughter area (table 4). Movements of red meat were to well-defined, geographically separated areas along principal transportation routes. Outside of the north-central area most slaughter plants were small, and there was little evidence of intercounty shipping except to immediately adjacent areas.

Weber, Davis, and Salt Lake

(Continued on page 85)
ECONOMICAL WATER TROUGH AND MINERAL BOX

for cattle on pasture

MILO L. DEW and LORIN E. HARRIS

A plentiful supply of water and minerals should be available to cattle on pasture. An economical and efficient water trough or a mineral feeder can be made from a discarded oil drum.

Water trough

The water trough is made by cutting an old 50 gallon oil drum in half and setting it on concrete blocks to raise it to a convenient height to allow the animals to drink from it easily. A 1 1/16 inch hole to allow a 3/4 inch water pipe to extend into the trough is drilled in the bottom of the barrel 4 inches from the edge.

The pipe extending into the trough should be threaded back 2 inches. A 3/4 inch lock-nut is screwed on this pipe followed by a 1/2 inch rubber union washer, the barrel, another 1/2 inch union washer and a 3/4 inch lock nut. The lock-nuts should be securely tightened against the union washers to prevent the trough from leaking. A 3/4 inch coupling and a 3/4 inch bob float valve then mounted on the pipe as shown in figure 2. A 1/4 inch by 10 inch copper float rod is inserted into the arm of the bob float valve. Two 1/4 inch nuts are placed on the free end of the float rod with a 4 to 5 inch piece of brass chain inserted between them. A 1/4 inch stove bolt is inserted into the other end of the chain and screwed into a copper float as shown in figure 2.

By loosening the thumb screw on the hinged arm of the bob float valve and adjusting the float rod up or down, the level of the water can be regulated to the desired height.

One trough can be made to serve two separate pastures by inserting it between two posts in the fence line as shown in figure 3. A trough such as this when attached to an artesian well or a city water system, provides plenty of water for a herd of 100 or more feeder steers on pasture.

Combination salt and mineral box

The combination salt and mineral box is made from a discarded oil barrel by cutting an opening approximately 16 x 18 inches in one side about 7 inches from the bottom (figures 4 and 5). A 2 x 8 inch board of suitable length is fastened across the bottom with 1/4 x 2 1/2 inch lag bolts to separate the barrel into two compartments so that salt and a mineral mixture, such as half salt and half steamed bone meal, may be placed in the container at the same time.

The barrel can be made portable by attaching it at the desired height to a portable manger. It may also be used to feed supplemental feed when necessary to prevent bloat, or to supplement pastures. It is attached to the manger with two 3/8 inch machine bolts. These are inserted through
a short 2 x 4 inch board, the barrel, and the manger and washer and nuts are applied as needed (figures 4 and 5). The 2 x 4 helps to strengthen the barrel when it is attached so that it cannot be broken off the manger by the cattle. A piece of scrap iron can be used in place of the 2 x 4 and lag bolts substituted for the machine bolts if desired. The drum may also be attached to a fence post or other structure if a portable manger is not used.

A mineral container such as this protected the salt and mineral mixture from the weather when used under pasturing conditions in Utah County.

**MILO L. DEW** is a research assistant and **DR. L. E. HARRIS** is professor of animal husbandry.

---

**ARTHRITIS**

*(Continued from page 71)*

Arthritic conditions characteristic of osteo-arthritis.

Clinical diagnosis presents few difficulties to one familiar with the syndromes of joint diseases. A careful and complete history of the case and clinical findings are helpful in differential diagnosis. In addition, in differentiating between inflammatory and degenerative arthritis one must be mindful of spastic paresis of hind limbs which at times has been confused with arthritis.

The inflammatory type of arthritis is commonly serous, fibrinous, or purulent. The primary chance is a proliferation of the synovial membrane and of the outer layer of the articular cartilage combined in many cases with proliferation of connective tissue. The joint is enlarged due to thickening of the articular capsule and an increase in the amount of joint fluid. Erosion of the articular cartilage does not occur, apparently, because the ends of the bones are invariably covered with a layer of newly formed tissue, which in a measure takes up the function of the articular cartilage. Such symptoms as elevated body temperature, hot swollen joint(s), anorexia or depressed appetite, and suppressed ruminations may be present. Manifestation of pain will not be alleviated when the animal assumes a recumbent position.

**Spastic paresis**

Spastic paresis of hind limbs causes marked disturbances of movement of one or both hind limbs. The condition appears early in life and most cases are removed from the herd before one year of age. The entire cord of the achilles tendon that attaches muscle to the hock region appears to be stretched.
taut, and the bone it is attached to is drawn out of normal position. In advanced cases the entire limb appears shortened. Palpation of the bone produces no pain anywhere, nor are any indications of acute or chronic inflammation discernible. At first the general health is not disturbed as long as the animal receives an adequate diet and care, but as the abnormality continues secondary musculo-skeletal changes occur.

Degenerative arthritis

Degenerative arthritis has been described in some of the oldest veterinary medical books. Several terms have been used to designate this form of arthritis, such as, arthritis deformans, osteo-arthritis, chronic articular rheumatism, chronic osteo-arthritis, hypertrophic arthritis, degenerative joint disease, and chondromalacia arthrosis. The different names applied to this disease entity have been influenced by such criteria as symptoms of the case, abnormal tissue changes, and x-ray findings associated with the specific disease conditions.

Slow progressive lameness involving the larger freely movable weight-bearing joints in cattle over 5 years of age appears to be the most frequent and constant symptom associated with degenerative arthritis. The trouble is rarely limited to one joint or limb. A prominent symptom is manifestation of pain on locomotion and standing which is relieved when the animal assumes a recumbent position. In many advanced cases crepitus can be readily discerned on motion. Secondary wasting away of muscles associated with the disease and malfunctioning joints become evident as the disease progresses in severity. The degree of clinical manifestations and course of the disease vary with the individual biological response of the animal. It is important that one becomes familiar with the normal anatomy and aging processes of the species in order to detect the presence of pathological changes. It appears in some herds and cases that inheritance is definitely a factor in this arthritic condition. Cattle with straight hind legs are more susceptible because of constant strain and trauma to the joints, resulting from improper support of the body weight. However, there are many straight-legged cattle that do not develop this condition and conversely, some of the seriously affected animals are not straight-legged.

In older bulls degenerative joint changes are associated with the inability to breed. Impaired locomotion and activity resulting from affected joints have resulted in the slaughter of many valuable bulls. Crampiness and spastic contractions of the hind limbs have been seen in both bulls and cows, but most frequently observed in older bulls. A number of yearling bulls go through a period of boggy hocks and suggestive arthritis, but they tend to overcome the condition as they mature. The age of the animal and management are associated with the disease process and the clinical manifestations.

The tissue changes associated with degenerative arthritis are influenced by many factors. Age is important, as this disease occurs chiefly in older individuals. The anatomical structure and basic function of joints influence the manifestation and incidence of lesions and symptoms. The larger freely movable joints are more severely and more frequently involved. To date, some correlation has been noted between the weight of the animal and the degree of pathology. Constant irritation, trauma, and shearing action are correlated with the severity and extent of lesions. Faulty conformation and malalignment of joints predispose the intra-articular tissues to greater stress and wear.

The initial stage of degenerative arthritis appears to begin in the cartilage covering the ends of the bones (articular cartilage). The normal, wet, smooth, and glistening cartilage takes on a dull, dry, opaque, yellowish, granular appearance. Small clefts and fissures then appear, followed by splitting and fibrillation of the articular cartilage. Progressive cartilage erosion continues until underlying bone is exposed. The exposed bone underlying the denuded areas slowly becomes smooth, polished, and at times, grooved. These lesions help to bring about malalignment and malposition of joints resulting in a slow progressive vicious cycle, constantly aggravating and extending the injury.

The degree of involvement of joint capsules and fluid within the joint capsules varies with the severity of the case and the individual animal. In advanced stages fibrosis and thickening of the joint capsule occur with an increased amount of joint fluid containing increased protein, masses of fibrin, pieces of bone or cartilage, increased nucleated cell count, and joint bodies. Intra-articular ligaments and structures show varying degrees of fragmentation and shedding. Synovial villi which produce the joint fluid become thickened and fibrotic. Fibrosis and hemorrhage of the periarticular tissue may or may not be present, depending upon the duration and extent of the disease.

As the disease becomes progressively worse, overgrowth or compensatory changes begin to appear. Bony growths along articular margins become evident. Abnormal new outgrowths of bone of varying sizes, shapes, and density appear along articular borders. The density of bone adjacent to eroded areas becomes considerably altered.

Abnormal changes along the backbones are most evident in heavier, older animals. These new bony outgrowths usually occur on the posterior thoracic and anterior lumbar vertebrae. In cases that exhibit hind limb spasticity, hyperextension, and disturbed locomotion, narrowing of the spinal canal occurs with resultant pressure on the spinal cord and nerves. Marginal abnormal new bone formations on adjacent vertebral bodies cause
bridging and malignment of intervertebral joints.

X-ray correlations can be made with the degree and extent of lesions. Early articular cartilage degeneration and erosion cannot be discerned by x-ray. Cysts underlying the cartilage covering the ends of bones have been observed prior to erosion and compensatory overgrowth of new bone. Marginal new bone formations, alterations of the ends of bone, and increased density of bone adjacent to areas of eroded articular cartilage can be demonstrated.

Arthritis in the bovine is as old as veterinary history itself. The disease presents definite clinical symptoms and lesions of diagnostic, prognostic, pathological, and economic importance. Relatively few studies of the cause and pathology of this important disease have been reported. The large number of animals condemned each year at slaughter plants because of this condition places great economic importance on the disease. The etiology and pathogenesis is of major importance. Comparative evaluation of arthritis in man and animals has been most valuable.

**U T A H ' S R E D M E A T**

(Continued from page 81)

Counties contain about 63 percent of the total population of the state. This area is also the center of slaughter activity; a large amount of red meat moves to markets within these counties in trucks owned by packing companies. Approximately 65 percent of the red meat shipped to points within Utah from the north central slaughter area was handled by private carriers over regular daily or weekly delivery routes. The rest moved in common carrier trucks.

**R E T U R N I N G F R O M L E A V E**

Roice H. Anderson returned from a leave of absence on July 1. During the past year he has been at Stanford University studying economic problems related to the food industry.

Drains only after periods of rain. While the upward artesian pressure may not be contributing any significant amount of water to the water table, it does prevent water applied to the surface from moving downward. Water applied to the surface moves down until it reaches the water table and then can only move off in a horizontal direction. Because of the flatness of the land, the rate of movement in the horizontal direction is slow.

There are several other areas in the state with conditions similar to those in Cache Valley because of their like geologic history. These lowlands may be reclaimed in several ways. It seems evident that irrigation water must be applied in carefully controlled amounts to avoid raising the water table to critical levels. In addition, some water must move downward carrying with it excess salts. Neither of these objectives can be easily met because of the physical conditions.

The use of tile drains is one possible solution, but this is not economically feasible. The highly impermeable subsoils would require tiles spaced too closely. Use of plastic lined mole drains shows promise. These drains cost much less than tile drains and can be placed at closer intervals. However, before mole drains can be widely used, additional improvements must be made on present designs and methods to assure effective and reliable operation over a long period of time. An experiment comparing lined and unlined mole drains at shallow depths and close spacings has been initiated on the farm. Preliminary results are favorable.

**C A R E F U L W A T E R A P P L I C A T I O N**

Some improvement in productivity of this land might be effected without drainage just by applying water in carefully controlled amounts. Sprinkler irrigation is one way to control adequately the amount of water added, or perhaps carefully controlled border and furrow irrigation can be used.

Work on each of the above methods is being carried out on the Cache Valley Reclamation Farm at the present time. Several years of experimentation will be required before specific recommendations can be made. In addition to control of the water table, reclamation of the land involves solution of such problems as salt accumulation, low soil fertility, use of soil amendments, and tillage practices.

**D O E S S E E D I N G P A Y ?**

(Continued from page 79)

**Interest on investment**

It is necessary to charge interest on money invested whether it is borrowed or owned. The rate of interest applicable to a particular problem may be determined by the rate paid if money is borrowed or by the rate a rancher could earn on his own money if it were used in other investment opportunities.

Since money is invested many months before the new forage is ready for use, it is necessary to compute and charge, as an initial cost of seeding, interest accumulated on initial investment from the time of planting until the seeding is grazed. This is the compound interest on investment during the nonuse period. It may be determined simply by multiplying initial investment per acre by an appropriate compound interest factor.

In addition to the interest charged on initial investment during the nonuse period, interest is also chargeable during the payment (amortization) period over which total costs are spread. By using amortization factors, interest is automatically included as part of a computed average annual payment. Average annual cost = (amortization factor) x (total initial investment).

The payment period will depend
on the estimated useful life of the seeding. An amortization period of 20 years may be assumed for successful crested wheatgrass seedings, conservatively managed. This assumed longevity is based on data available from research in Utah.

Interest is a major expense of seeding. From this study, the average initial investment was $8.92 per acre. Total interest, that accumulated between planting and use plus that payable during amortization, was $9.59 per acre. This represented an average of about 52 percent of total costs of the seedings (see figure 1).

Based on a 20-year amortization period and an interest rate of 6.0 percent, the average total cost for the 20 seedings was $18.51 per acre, and average annual cost was $0.93 per acre.

Other costs

Other annual costs associated with using or maintaining a seeding may be incurred. These should be added to the amortized annual costs to determine the total annual costs of seeding. Such costs include maintenance of fences and watering facilities and renovation practices.

Returns

Annual market returns from seeding (the change in returns resulting from the use of the seeded land) can be estimated figuring the increased amount of feed available and the increased amount of beef or lamb produced. Unseeded sagebrush range at Benmore has been estimated to have a capacity of 10 acres per animal unit month. When used by yearling cattle it gave average gains of 1.2 pounds per day. Seeded range has a carrying capacity of about 3 acres per animal unit month and yield gains of 2 pounds per day. Price of beef expected was $2.20 per pound. Seeded range produced an added return of $4.68 per acre.

Unseeded sagebrush range near Eureka has a carrying capacity of 4 acres per sheep month with an average lamb crop of 117 percent and average daily lamb gains of .52 pounds per day. Similar range seeded has a carrying capacity of .75 acres per sheep month with a lamb crop of 135 percent and lamb gains of .58 pounds per day. The expected lamb price was $.19 per pound. Seeded range thus returned $4.23 per acre above range not seeded.

On 15 cattle allotments studied, seedings had carrying capacities of 1.3 to 8.2 acres per AUM with an average of 3.8. Before seeding, these ranges had carrying capacities ranging from 7.9 to 13.9 acres per AUM with an average of 11.3.

If gains for yearlings are assumed to be two pounds per day on seeded range and 1.2 on unseeded, and beef is sold at 20 cents per pound, the average annual gross return because of change as a result of seeding would be $3.60 per acre when grazed by yearling steers.

If used by cows and calves, assuming no difference in percent calf crop and selling calves at 20 cents per pound, the average annual gross return because of seeding would be $1.99 per acre. Data on gains of calves were used from studies at Benmore where they averaged 2.2 pounds per day on seeded crested wheatgrass pastures and only 1.3 pounds per day on unseeded sagebrush range.

Studies on five sheep allotments showed that capacities before seeding varied from 8.8 to 10.4 acres per AUM with an average of 9.6. After seeding on these allotments, capacities ranged from 1.5 to 11.6 acres per AUM with an average of 2.8.

Using data on lamb gains and lamb crops from studies near Eureka, the calculated average annual return from seeding on the five sheep allotments was $4.93 per acre.

Uncertainty

So far it has been assumed that anyone attempting a range seeding is assured a satisfactory stand of grass. In actuality the outcome of a seeding is uncertain. Possibility of failure, is present every time a seeding is attempted.

From the standpoint of obtaining a satisfactory stand, which has been arbitrarily set at not less than one established plant per 4 square feet, most of the seedings in the present study were successful. From a field examination of 31 projects planted during 1952-54, it was estimated that the rate of seeding failure was approximately 35 percent. The general belief was that most of these areas received subnormal precipitation during these years. In another study near Eureka, Utah, from 1949 to 1958, six seedings out of 24 were considered failures (25 percent). These 24 areas were sagebrush areas that were plowed and planted by the best known methods. Annual precipitation during the years of seeding varied from 8 to 13 inches, with an average of about 12.

Uncertainty of success of range seedings is generally a result of unpredictable weather. Nothing can be done about the weather, but many failures can be prevented by following closely the practices recommended by range scientists.
COLLECTING WATER
(Continued from page 67)
sheeting is used, site sterilization can be eliminated, since apparently butyl sheeting is not penetrated by vegetation.

Installation of ground covers

The site for an installation should have some slope — a slope of 5 percent is adequate. Lesser slopes can be tolerated and somewhat steeper slopes do not present any problem. If the site has a concave shape, some earth work is saved. If not, some shaping will be necessary. The area should be bladed to remove all vegetation and smooth out larger ridges and depressions. To anchor the ground cover, a trench around the outside edge is used. If the installation is large, anchoring the butyl sheeting or film at intervals is probably desirable. This can be done by having tails on the material and burying these in trenches. Ridges should be constructed along the edges of the installation to insure concentration of the runoff. To avoid the possibility of overwash on the ground cover in larger storms, a diversion dyke should be constructed just above the installation. The features of a typical installation are shown in the sketch (page 67). Here a collapsible bag is shown as providing storage for the water. The bag should prevent practically all evaporation and provide storage at a relatively low cost. Two of our test installations are shown in figure 1. A collapsible bag partially full of water is shown in figures 2, 3, and 4. In the test installations, no provision was made for collecting the water, but the runoff was measured. It may be of interest to note that in light showers — showers too light to be measured in the rain gauge — some runoff was recorded.

Storage is an essential feature of every ground cover installation. The storage structure could be any one of the conventional types, such as tanks or reservoirs provided for storing water obtained from springs or wells. If reservoirs are used, they should be made watertight by lining. A closed storage structure has the added advantages of reducing evaporation losses and keeping the water clean.

Installation costs

Although storage is an essential part of the ground cover development, for our present purpose let us consider only the cost of intercepting the water and conveying it to some central point, since this is the chief way in which developing water by means of ground covers differs from other types of development. The materials which might be used to intercept precipitation differ widely in kind and cost. There are ground covers which can be installed for $1.00 per square yard and will probably last ten years or more. Assuming a cost of $1.00 per square yard and a ten-year life, the cost of collecting water in an 8-inch annual rainfall area neglecting interest is $2.20 for 1,000 gallons. Amortizing the cost, using an interest rate of seven percent, the cost is $3.10 per 1,000 gallons. In some areas, and for some uses, costs as low as this should be attractive.

A great deal of research and development is going into the production of fresh water from sea water. According to Allen V. Knees of the Federal Reserve Bank of Kansas City, some of the most advanced installations are reported to be producing fresh water from sea water at a cost of $1.75 per 1,000 gallons. It will be seen from table 1 that water can be developed by means of ground covers at comparable costs. The use of ground covers has some advantages in that a large expensive plant is not required. An individual home owner or rancher could develop water for his own use and develop it at the site where it is to be used.

Ground covers look promising as an approach to water development in some areas. Should large scale use develop, the cost of installations will probably be reduced. As less expensive and better materials are developed, the cost of water developed by this method will be correspondingly reduced.

Table 1. Cost of developing water by means of ground cover*

<table>
<thead>
<tr>
<th>Annual precipitation</th>
<th>Life of cover</th>
<th>Cost per 1,000 gallons</th>
<th>Cost per acre foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>inches</td>
<td>years</td>
<td>dollars</td>
<td>dollars</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>3.10</td>
<td>1020</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>2.08</td>
<td>660</td>
</tr>
<tr>
<td>18</td>
<td>10</td>
<td>1.37</td>
<td>447</td>
</tr>
<tr>
<td>8</td>
<td>15</td>
<td>2.32</td>
<td>760</td>
</tr>
<tr>
<td>12</td>
<td>15</td>
<td>1.54</td>
<td>503</td>
</tr>
<tr>
<td>18</td>
<td>15</td>
<td>1.03</td>
<td>337</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
<td>1.93</td>
<td>630</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
<td>1.29</td>
<td>423</td>
</tr>
<tr>
<td>18</td>
<td>20</td>
<td>.66</td>
<td>283</td>
</tr>
</tbody>
</table>

*Assuming ground cover in place costs $1.00/sq yd

NEW USDA FACILITIES

Construction has started on the USDA Crops Research Laboratory. This will be located on the eastern part of the campus just west of the Armory. The main laboratory-office-headhouse building will be about 170 x 40 feet and will face the north. To the south of this building there will be three greenhouse units, and further south a service building which will provide general work and some garage space. When completed, early next spring, the sugar beet research group in Salt Lake City will be moved to Logan. Dr. F. V. Owen is head of this group. There will also be two nematologists with Edward Jorgensen in charge. Also moved to the new building will be USDA collaborators in forage crops and possibly other state employees.

Steps are being taken to obtain an IBM 650 computer. No definite information is available yet as to when this will be obtained and placed in operation.
NEW APPOINTMENTS

Dr. Dexter Rogers from the University of Oregon has been appointed assistant professor in nutrition in the College of Family Life, Department of Foods and Nutrition. He fills a position that has been vacant for a year, formerly occupied by Mrs. Leora Galloway. Dr. Rogers' training is in biochemistry. He has done research in microbial metabolism and nutrition. He has an extensive publication record. His education was obtained at Oregon State College. He obtained the doctorate degree in biochemistry. After that he was a National Science Foundation post-doctoral fellow at Stanford University working with Dr. E. L. Tatum. He has conducted research and taught at the University of Michigan and the University of Oregon. Dr. Rogers is on appointment with three-fourths research with the Experiment Station and one-fourth teaching in nutrition in the College of Family Life. Dr. Rogers is married and has four children.

Dr. David Walker has been appointed associate professor in the Department of Horticulture with responsibility for teaching and research in the field of pomology. Dr. Walker obtained his B.S. and M.S. degrees in Horticulture at Utah State University and the doctorate degree at Cornell University. He has been at North Carolina State College in the Horticulture Department during the last six years. There he made an outstanding reputation in research. He will fill the position vacated by Dr. Norton. David is married to Janéé Smith of Logan. They have six children.

George Stoddard was appointed head of the Dairy Department at the last Board meeting. He has been professor of dairy husbandry for several years.

During the absence of Dr. W. W. Smith, Dr. Lewis Jones will be acting head of the Department of Bacteriology. Dr. Jones was formerly an employee of the Experiment Station but has been teaching full time for the past four years. Dr. Jones has been on leave of absence at Stanford University during the past year.

J. M. Bagley has returned to the staff to continue his appointment as assistant professor in the Department of Civil Engineering. He is on appointment with the Experiment Station for two-thirds of his time. He has been studying at Stanford University toward the doctorate degree.

Donald Dobson has been appointed assistant professor at the Snow Field Station at Ephraim, effective September 1. He will be responsible for research on turkey production problems as a major assignment with a secondary assignment of research with the dairy cows. Donald has been on an appointment as a graduate assistant in poultry nutrition during the last three years. He obtained his B.S. degree in poultry husbandry from Utah State University and his M.S. degree in animal nutrition from Cornell University.