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Personnel of the new U.S. Department of Agriculture Crops Research Building: Bottom row, left to right, Joan Larsen, Afton Jenkins, Jewel Seamos, Barrie Thorne, Gladys Nichol, secretaries; Dr. M. W. Pedersen, alfalfa investigations; President Chase; Dr. D. W. Thorne, director of the Agricultural Experiment Station. Second row, Dr. A. C. Hull, Jr., range seeding research; E. C. Jorgensen, nematology; A. T. Bleak, range seeding research; Earl Otley, statistical assistant, sugar plant research; Dr. John W. Carlson, alfalfa and clover investigations. Third row, Dr. Douglas R. Dewey, grass breeding; Fred Wilkinson, agricultural research technician, grass breeding; C. H. Smith, sugar crop research; L. D. Silver, technical aid, oil crop investigations; Lee Uria, agricultural research technician, oil crop investigations; Allen Taylor, agricultural aid, alfalfa investigations; G. K. Rysier, sugar crop investigations. Fourth row, Dr. W. J. Apt, nematology; Dr. L. N. Leininger, oil crop investigations; Myron Stout, sugar crop investigations; Dr. D. E. Zimmer, oil crop investigations; L. W. Eyre, greenhouse foreman, sugar crop investigations; Clarence Austin, agricultural research technician, alfalfa investigations. Absent when the picture was taken, Doris Reeder, administrative assistant; Dee Turner, agricultural research technician, sugar crop investigations.

New crops research center

The new U.S. Department of Agriculture Crops Research Laboratory, located on the eastern fringe of the Utah State Campus, now houses cooperative research investigations in forage, range, grass breeding, sugar crops, oil seeds, and nematology. Twenty-five technical and research personnel now have offices and research laboratories in the building. The Tobacco and Sugar Crops Branch and the Nematology Branch were moved to Logan from Salt Lake City. Researchers in forage and range and oil seed crops moved from other parts of the campus.

Money for the building was approved by Congress and building was begun in June, 1960. The building will be dedicated with appropriate ceremonies October 26, 1961. The building has office and laboratory space, a garage, work building, and two greenhouses. The structure (Continued on page 85)

FARM AND HOME SCIENCE
Lilies are the most noble and exquisite of flowers. They are little known and neglected in our gardens with the exception of the Madonna, Tiger, and Candlestick lilies. In the minds of most people, lilies are unpredictable, requiring special cultural treatments. They are enthusiastically admired in an ideal garden setting when well established, but there is a fear that they will decline early and will die out in a few years.

Many varieties are poorly adapted to our western gardens. An increasing number of new introductions, however, are easy to grow. Many of them combine beauty with great vigor and these should have a permanent place in our gardens. During the past decade lily hybridization has been most successful in improving adaptability as well as increased vigor. The improved lines are propagated as clones or their progenies are selected from thousands of seedlings and sold as strains. Lilies are classified in the following types: cup shaped, trumpet, Turk’s cup or martagons, and wide open outward facing type.

Description of some hybrids

The Bellingham hybrids are the result of cross pollination between various species of American lilies. The Fiesta hybrids were developed from the Preston hybrids which originated in Canada and have as their parentage a cross between a Lilium dauricum seedling and Lilium davidi. To improve their color range, crosses were made with Lilium amabile and Amabile luteum. The Mid-Century hybrids originated from hybrids of tiger lilies and L. hellandicum, the candlestick lily. Both parents are known for their hardiness. The Olympic hybrid lilies, which have great potential, are the product of numerous intercrosses and backcrosses between various trumpet lilies and the continuous selection of the progenies. New colors and improved forms have been achieved mainly with various varieties from China, especially L. sargentiae and sulphureum. The Green Mountain hybrids also came from the above combinations and have shown considerable promise in our flower trials. The Aurelian hybrids originated in France by crossing trumpet lilies with the Turk’s cup flowered Lilium henryi. Before this a similar cross succeeded in the Royal Botanical Garden at Kew, England but the lines were lost. This cross has shown more promise than most of the others and has resulted in many entirely new forms and colors. Golden Clarion and Aurelian Sunburst are selections from this cross. The Regal lily has been one of our most popular trumpet lilies. It is easy to grow and propagate. It was discovered together with the Lilium sargentiae in China in 1903. These two, together with the sulphur lily imported from Burma and the Chinese White lily, Lilium leucanthum, were the early building blocks of the new trumpet lilies. The beautiful white trumpet

OTTO RIEHMANN has charge of the work in floriculture at the Utah Station. All lilies in the variety testing program were donated by Jan de Graff, Oregon Bulb Farm, Gresham, and Edgar L. Kleine, Lily Bulbs and Seed, Lake Grove, Oregon.
lily, *Lilium princeps*, now named *L. imperiale*, is a hybrid between *L. regale* and *L. sargentiae*. This lily has just been added to our trials, but it has been grown successfully in other Utah gardens.

**Lily variety trials at Farmington**

Testing of various species and hybrids of lilies began at the Farmington Field Station in the fall of 1954 with a planting of 28 varieties. Additions of 9 varieties were made in 1957 and 17 in 1958. The lilie's hybrids of lilies began at the Farmington Lily trials, but it has been grown satisfactorily in open-field culture in a sandy, gravelly loam soil with good drainage. Every spring the lilies received a new mulching of coarse compost and fertilizer in a combination of 10 percent nitrogen to 20 percent phosphate.

### Variety testing

The rate of growth and flowering of the various varieties during a period of five years for the first planting and two years for the later planting are shown in table 1. Information is given on height, the number of flower stalks, and the number of flowers produced by each plant, also the frost resistance. The figures are the averages from three to twelve plants. Variety testing has provided information on adaptability of the varieties to our area. The trials will be continued and new varieties will be added as they become available.

Jillian Wallace, Jauricum Wilsoni, and Martagon have never grown satisfactorily; they declined early and disappeared. Parade, Golden Chalice, and Enchantment weakened in the third and fourth years. The young bulbs, which were produced in large numbers, did not grow to the size of the mother bulb. Stems were weak with few or no flowers. Others such as Harmony, Pagoda, and Valencia produced bulbs of normal size and continued to bloom. Bellingham hybrids produced so many new bulbs that the bulbs could not develop to normal size because of the crowded conditions. This resulted in decreased growth and flowering. Separation and new planting of this variety must be made more often. Fiesta hybrids made little improvement the first two years, but gained good vigor after the third year. Aurelian Sunburst, Green Mountain, and Olympic hybrids, Viking, Regale Album, and Joan Evans grew well in the trials. They produced a substantial number of large bulbs which resulted in the development of good flowers. These results are presented in table 2.

### Increase of bulbs

The harvested bulbs were sorted into large, medium, and small size. Because of the great differences in bulb size between varieties, the arrangement in groups in table 2 may not do justice in all cases, but when this information is used along with the bulb weight and the number of flowers listed in table 1, a fairly good determination of the variety performance can be made. The bulbs classified as "large" will generally produce excellent flowers the following year. The "medium" bulbs may produce flowers, but in a smaller number the first year after planting or in some cases may not bloom until the second summer. The "small" bulbs may not develop to flowering size in the home garden. It will depend on the vigor of the variety.

(Continued on page 80)

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**Table 1. Growth and flowering of lily varieties, 1956-1959**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Height in inches</th>
<th>No. flowers per plant</th>
<th>No. flower stalks per plant</th>
<th>Late spring frost resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afterglow*</td>
<td>40</td>
<td>40</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Aurelian Sunburst hybrids</td>
<td>63</td>
<td>50</td>
<td>30</td>
<td>45</td>
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<tr>
<td>Bellingham hybrids</td>
<td>57</td>
<td>46</td>
<td>120</td>
<td>5</td>
</tr>
<tr>
<td>Croesus*</td>
<td>26</td>
<td>35</td>
<td>11</td>
<td>32</td>
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<tr>
<td>Felicity*</td>
<td>26</td>
<td>45</td>
<td>6</td>
<td>75</td>
</tr>
<tr>
<td>Fiesta hybrids</td>
<td>28</td>
<td>45</td>
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<td>75</td>
</tr>
<tr>
<td>Golden Chalice hybrids</td>
<td>28</td>
<td>45</td>
<td>13</td>
<td>20</td>
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<td>Golden Clarion hybrids</td>
<td>4</td>
<td>42</td>
<td>4</td>
<td>8</td>
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<td>Golden Harvest hybrids</td>
<td>44</td>
<td>48</td>
<td>21</td>
<td>24</td>
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<tr>
<td>Green Mountain hybrids</td>
<td>44</td>
<td>46</td>
<td>10</td>
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<td>Hansoni</td>
<td>25</td>
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<td>2</td>
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<td>Henry</td>
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<td>18</td>
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<td>Maxwell</td>
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<td>40</td>
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<td>Mid-Century hybrids</td>
<td>38</td>
<td>12</td>
<td>37</td>
<td>4</td>
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<td>Enchantment</td>
<td>29</td>
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<td>18</td>
<td>63</td>
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<td>Harmony</td>
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<td>Joan Evans</td>
<td>31</td>
<td>27</td>
<td>16</td>
<td>22</td>
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<tr>
<td>Pagoda</td>
<td>27</td>
<td>27</td>
<td>22</td>
<td>22</td>
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<td>Parade</td>
<td>44</td>
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<td>38</td>
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<td>Tangelo</td>
<td>23</td>
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<td>38</td>
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<td>Valencia</td>
<td>28</td>
<td>28</td>
<td>19</td>
<td>41</td>
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<td>Olympic hybrids</td>
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<td>Viking</td>
<td>42</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
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</table>

*Two years*

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**FARM AND HOME SCIENCE**

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GRAINS
AS SUPPLEMENTAL PASTURE FOR SHEEP

They add stability to the spring forage supply and provide flexibility to the livestock operation

PHIL R. OGDEN and DARRELL H. MATTHEWS

Irrigated fall grains can add stability to the spring forage supply for livestock and provide a livestock-farming operation with flexibility to meet fluctuating water supplies. These are observations from the use of fall-planted barley, wheat, and rye at the Livestock and Range Field Station at Cedar City.

Early fall seeding often makes fall grazing possible

We have obtained good grain stands from planting fall barley or wheat during late August and early September. Our procedure has been to prepare the ground during the summer and when the pressure for pump irrigation water lets up in the fall, to use this water to establish the grain. We do this by irrigating the land and then following the irrigation as soon as possible with a light disk ing and harrowing. We then plant into the damp seedbed. The Cedar City area normally has a dry September and without preirrigation the success of fall plantings has been poor.

If the grain is planted early enough, and weather conditions are good, some fall grazing may be realized from the planting the first fall. This was true of wheat planted in the fall of 1956. Grazing and forage production records of this wheat planted during late August of 1956 illustrate the return one might realize from grazing the grain. The wheat furnished some fall pasture for sheep the first year it was planted. In the spring of 1957, the wheat was grazed beginning May 4. Enough sheep were put on the field that 90 percent of the grain had been used by June 4. The weight gains of

(Continued on page 81)
A Way to Better Venison

The 100,000 deer killed annually in Utah yield a dressed weight of an estimated ten and a half million pounds of meat. This is an important resource to the people of the state

GRACE J. SMITH, ETHELWYN B. WILCOX, JESSOP B. LOW

Nearly 100,000 deer have been killed annually in Utah for the last ten years, according to the Utah State Fish and Game Department. In 1960 this figure reached the high point of 130,946 deer. In terms of dressed weight these deer would yield an estimated ten and half million pounds of meat. This meat represents an important resource to the people of the state. For this reason studies have been made to determine the best methods of field care, preservation, and cooking of venison.

Field care of meat

Tenderness, juiciness, and flavor and acceptability of venison are not affected by the washing and cooling of the meat if careful field care is taken after the animal is killed. Studies were first conducted on the meat from three deer, two raised in captivity since fawns and the third killed in the wild during a late November hunt. The first two deer were killed at the abattoir and handled the same as domestic animals. The third was cleaned, dressed, cooled, and transported home, but it received no special treatment such as washing or immediate skinning. All animals were aged approximately two weeks before the meat was frozen.

In a later study, the meat of 31 yearling deer from the Cache deer herd was carefully cleaned and dressed. Variations were then made in the treatment of the carcass: (1) immediate cooling in the field compared to later cooling after transporting the warm carcass; (2) washing carcass in the field compared to nonwashing; and (3) variation in the aging period.

Cooking procedures

Because venison has little fat in the muscle tissue, a moist heat method of cooking was used in preparing the meat for judging. Unseasoned roasts were placed in pans containing heavy aluminum foil, which was left open in a 425° F. oven for 20 minutes. The foil was then wrapped firmly around the meat and the oven turned to 325° F. until an internal temperature of 175° F. was reached. Meat was cooled for a half hour before opening and cutting.

Tests were made on rump, shoulder, loin, and leg roasts. When compared with beef roast, judges were unable to distinguish which samples were beef. Restricted activity and controlled diet of the two deer in the first study did not appear to improve the meat. Aging of the venison for two weeks resulted in more tender meat from all roasts except the loin which was most tender when aged for one week. Aging for a period longer than two weeks produced a fine texture which judges found not as desirable as meat aged for two weeks. Flavor preference was shown for female over male deer for all except leg roasts. Tenderness scores were best for roasts from the female deer with the exception of shoulder roasts.

Quality of venison fat

Qualities of venison fat were investigated by making a comparison of three fats, beef suet, pork fat, and venison fat, each combined at three levels with ground lean venison. One half pound, one pound, and one and one half pounds of fat were used to five pounds of lean meat. The ground meat was frozen and stored for two different periods, eight weeks and six months. The meat was then tested for tenderness, juiciness, flavor and acceptability, and rancidity of fat.

Tenderness was improved by the addition of each kind of fat and this increased as the level of fat increased (fig. 1). The longer period of frozen storage increased the tenderness. Pork fat gave more juiciness to the meat but showed a higher rancidity test. However, in six months of storage the rancidity had not reached the level where all judges could detect it. Beef and venison fat had much lower rancidity numbers than pork (fig. 2). Beef showed the most rapid increase in rancidity during the period of time the meat was in frozen storage.

Flavor scores were close for each kind of fat and lean meat mixture at both periods of storage. This showed that venison fat did not contribute an undesirable

GRACE J. SMITH received her M. S. degree in foods and nutrition in June from USU. This article is based on her research. DR. ETHELWYN B. WILCOX is professor of foods and nutrition. DR. JESSOP B. LOW is in charge of the Utah Wildlife Research Unit at USU which is cooperative with the U. S. Bureau of Sport Fisheries and Wildlife, the State Department of Fish and Game, and the Wildlife Management Institutes.
flavor to the meat. This study did not support the notion that venison fat is objectionable and must be discarded.

It made little difference whether the meat was frozen, refrigerator-thawed, or thawed to room temperature at the time it was placed in the oven.

Degree of doneness

Dryness in venison is related to overcooking. Thick round steaks were cooked to a rare, medium well-done, and well-done stage to observe the effect on the palatability of the meat. As the internal temperature of the meat increased, the tenderness and juiciness decreased sharply. Juiciness was (Continued on page 84)
TURKEY IN PUBLIC EATING PLACES

E. BOYD WENNERGREN

In recent years, much of the promotion for greater use of turkey has been directed at influencing household consumption. Public eating places also offer a potential market for increased use of turkey. The higher tempo of living and the rising disposable incomes are among the factors which have expanded the use of public eating places. For example, in Utah during 1958, $56 million in sales volume was transacted by 1350 public eating establishments. This represented an increase of 24 percent over the sales volume recorded in 1954. The importance of turkey in these sales is unknown; however these establishments offer excellent opportunities for making turkey available to consumers in a variety of appealing dishes. In addition,

1) Approximately three fourths of 117 public eating places in Utah's five major cities had served turkey during the preceding year. Small restaurants most commonly did not serve turkey. These smaller restaurants were handicapped by lack of preparation facilities to handle the present type turkey products.

2) Lack of storage facilities do not seem of great importance in restricting use of turkey. The storage function has been assumed by suppliers which permits restaurants to purchase on an "as needed" basis. However, this method reduces their ability to take advantage of favorable price situations by making quantity purchases. It may, however, insure consumers of a better quality meat through more adequate storage facilities.

3) High preparation costs restrict use in many restaurants. Information on efficient preparation procedures plus new products may alleviate this. Reliable data on the cost of preparing and serving turkey would establish a sound economic basis for pricing meals.

4) Use of turkey in restaurants is subject to some seasonal variations. Most of the variation is found between the fall holiday season and the two months immediately following. According to operators using turkey, fluctuation in consumer demand is the most important restriction on the use of turkey in restaurants.

5) Prices of turkey meals were higher than for beef and pork meals and closely approximated menu prices for chicken.

DR. E. BOYD WENNERGREN is assistant professor of agricultural economics. More detail on the study reported here can be obtained from Bulletin 427, Use of turkey in Utah's public eating places. A copy of this publication will be sent free on request.

Big birds, 20 pounds and over, are especially popular in restaurants, since they hold down overhead costs in cooking and preparation, and also sell at a premium

This restaurant features a series of turkey items on its menu daily. It will use as high as 50,000 pounds of turkey annually.
restaurants are in a position to use and promote turkey throughout the entire year.

How extensive is the present use of turkey in Utah restaurants? What factors limit its use? Is restaurant use subject to seasonal fluctuations? What type and grade of turkeys do restaurants use? How do prices of turkey meals compare with prices of other meats? Investigation of these and other questions was the purpose of a study of 117 restaurants in Utah's 5 major cities conducted late in 1959. In addition, the major meat packers in these areas who supply turkey to restaurants were also interviewed.

**Turkey use in restaurants**

Turkey had been used by most of these restaurants during the 12 months preceding the interview (table 1). Seventy-three percent indicated some turkey had been used during this period. Those who did not use it were the smaller restaurants and drug store counters.

**Seasonality of use**

Not all of the restaurants offering turkey used it the year around (table 1). In 20 percent of the restaurants use of turkey was discontinued during certain seasons. Fifty-three percent used turkey the year around; however, the amounts used by some of these restaurants were reduced during part of the year (fig. 1).

Turkey use during October, November, and December was seasonally high, reaching a peak of 13.9 percent of the year's total in both November and December. January to May usage was below the annual average, particularly in January and February.

Grade C birds were most commonly used making 46 percent of the total, while grades A and B represented 29 percent and 25 percent, respectively. Toms accounted for 91 percent of the total used.

**Reasons for not using turkey**

Reasons for not using turkey (Continued on page 82)
The trail of a snow surveyor

Deep snow drifts yield late summer water.

A deep drift on a high wind swept ridge. Can drifting be managed to increase late summer streamflow?

When the snow begins to melt, the snow reservoir yields its water. Photographs by Bert Allen and William Boley.

The "Trackmaster" snowmobile must perform in all kinds of country on the way to and from the snow fields.

many uses of SNOW SURVEY DATA

CLEVE H. MILLIGAN

In years of extreme drought, such as the present, everyone becomes more aware of the value of water and the relations between snow in the mountains and water in the streams. In Utah most our summer water supply comes from melting snow on mountain watersheds. If the accumulation of snow during winter months is great then the summer streamflow will probably be ample. There may even be a surplus of runoff which can be stored in reservoirs for use in future drought periods. On the other hand, when the accumulation of snow is considerably below normal, the streamflow is also below normal, and drought may occur espe-
cially on streams with no holdover storage. Recognizing these simple facts, J. E. Church as early as 1909, developed snow surveying equipment and procedures as a basis for forecasting summer streamflow. Since these early efforts of Dr. Church, improved snow surveying and streamflow forecasting techniques and equipment have been developed and are in use in all of the Western States.

**Development of snow surveying in Utah**

The U. S. Weather Bureau and Salt Lake City initiated some snow surveys in the Wasatch Mountain Range of Utah as early as 1911. Measurements of snow depth were made previous to this, but these measurements did not include determination of the water content of the snow. Subsequent correlations between snow depth and streamflow were poor. Consequently, snow depth measurements alone were of little value in streamflow forecasting.

Snow surveying in Utah, in which both the depth of snow and its water content were measured, received its greatest impetus under the leadership of George D. Clyde of the Utah Agricultural Experiment Station. Measurements were first made in Spring Hollow and on Mount Logan in 1924. The snow survey network was rapidly expanded to all of the major river systems in Utah until at the present time measurements are being made on 140 different snow courses. As the snow course network was expanded, several collaborators were brought into the program, including the U. S. Soil Conservation Service, Forest Service, Bureau of Reclamation, National Park Service, and Geological Survey, the Utah State Engineer, and several private organizations.

In 1946 the operational phases of the snow survey program, which included the supervision of snow surveys, maintenance of the snow survey stations, and computation and publication of the streamflow forecasts were transferred to the U. S. Soil Conservation Service. Each month, beginning with February 1 and ending with May 1, the Soil Conservation Service publishes snow survey and water supply forecasts for the Utah, Bear, and Colorado River Basins.

The U. S. Weather Bureau also publishes a monthly forecast of the water situation based on precipitation, wind, and temperature data.

The work of the Experiment Station included not only the establishment of the snow survey network and the development of forecasting techniques, but also the development of improved equipment for making snow surveys. This included a light weight, aluminum snow sampler tube used for cutting and collecting a core of snow at designated representative sampling points on the snow survey course, a tubular aluminum scale for weighing the snow core and for giving its water content directly in inches, and "snowmobiles" for transportation of snow surveyors in mountain areas. The snow sampling equipment developed under the project has been adopted by the Soil Conservation Service for snow survey measurements in most of the Western States. The snowmobile, originally developed under this project, has been greatly improved by the Utah Scientific Research Foundation, an affiliate of Utah State University, and will be manufactured on a commercial basis by Thiokol Company under the name "Trackmaster." The "Trackmaster" is now being used by the U. S. Army in its Alaskan operations. Thus the results of the snow survey research have been far reaching.

**Streamflow forecasting relations**

In the early history of streamflow forecasting, before sufficient data were available to develop a forecasting graph or equation, the water content of the snow for the particular year of the forecast was expressed as a percentage of the previous year, or as a percentage of the normal for the previous years. Then it was assumed that the runoff would be this same percentage of the runoff for the previous year or years of record. Sometimes the forecasted volume of runoff was adjusted by judgment to allow for precipitation during the snow-melt period and after the last snow or for other factors which might, in the judgment of the forecaster, affect the predicted volume of runoff.

As more snow survey data were made available, forecasters began to develop simple diagrams and mathematical equations to assist in the forecast (fig. 1). These simple relations, and the forecasts made from them, assumed the water content of the snow cover to be the predominant factor influencing the runoff. For many years this assumption produced forecasts which were fairly accurate. However, as the number of years of record increased, this single factor was demonstrated to be inadequate for predicting all years, although it is the factor of greatest importance. So the search began to find other factors and methods for inclusion in the prediction relations. Some of these are the total rainfall dur-

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**CLEVE H. MILLIGAN** is professor of irrigation engineering and head of the Department of Civil and Irrigation Engineering. He now has charge of the streamflow forecasting research.

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(Continued on page 84)
On November 30, 1960, the Utah State Agricultural Stabilization and Conservation Committee reported that 956 farmers in 22 counties of Utah had contracts with the federal government under the conservation reserve program (soil bank). About 237,673 acres were included. Under the program these acres were planted to some prescribed cover crop and were not to be harvested for any use for the number of years specified in the contract. When present contracts expire, farmers are faced with the problem of shifting these lands back into production. Since most of the lands are dry farm lands and most of the farmers are wheat farmers, there may be some inclination to overlook alternatives other than putting the full allotment back in wheat.

Under some conditions grazing cattle on unretired soil bank lands can result in more income than from producing wheat. These conditions can be determined for each dry farmer. Given his price-cost-yield expectations, he can reach a rational decision and calculate limits for which variables must change before it would pay to shift land use one way or the other.

An integrated ranching operation which substitutes grazing for ration feeding and an animal purchase-sales program can compete favorably with wheat production and need to be seriously considered by dry farmers.

Leasing soil bank forage to others at current rates or substituting soil bank grazing for public land grazing do not compete favorably with wheat production.

Livestock grazing

Before livestock grazing is practical, however, the land must be fenced, water facilities provided, and in some cases the land must be reseeded to assure adequate forage cover.

The original investment for constructing a permanent four strand barbed wire fence on cedar posts one rod apart is about $165 per

Crested wheatgrass pastures provide excellent spring and fall range. When land is reseeded, other grasses such as intermediate, pubescent, and tall wheatgrasses may be better adapted to some conditions than crested wheatgrass.
100 rods. Depreciating $165 over 20 years and charging 5 percent a year for maintenance gives an annual fencing cost of $16.50 per 100 rods.

Conditions are so variable that quoting water development costs provides little help to the individual farmer. Well development on public lands between 1955 and 1960 varied from $1.50 to $12.50 per foot in well depth. Maintenance costs also varied considerably. In this article annual water development costs are assumed to be $100 per year, but each farmer will have to estimate his own costs.

If the plant cover is not adequate, renovation or even reseeding may be necessary before grazing becomes feasible. In their study, "Seeding Utah's ranges," (Utah Agr. Exp. Sta. Bul. 423) Lloyd and Cook developed costs of reseeding with crested wheatgrass. Their results have been modified to fit dry farm conditions and amount to about $0.98 per acre per year over a 20 year amortized period.

Livestock alternatives

Three types of cattle operations have been analyzed. 1) An integrated ranch operation wherein a cover crop may provide a rancher with much needed spring and fall grazing. 2) An animal purchase-sales program where a farmer may buy animals to graze his dry farm crop and then sell them. His gross benefits would be the difference between his total expenditures for the cattle and his total receipts from sale. 3) Leasing soil bank forage wherein a farmer may lease to a rancher looking for spring or fall range. His gross benefits would be the total lease fees received.

To estimate gross economic benefits, some physical data are needed on livestock response to the type of forage available on soil bank lands. Studies on crested wheatgrass pastures at Benmore provided these data (table 1). Moderate use permitted about 27 animal units to graze 100 acre pastures each spring and 12 animal units again in the fall. Spring grazing at the rate of 3.69 acres per animal unit was continuous from about April 20 to June 20. Fall grazing was for about 48 days at the rate of 8.31 acres per animal unit. Crested wheatgrass grazed at a moderate intensity (60 to 65 percent utilization) is expected to maintain itself for at least 25 years before serious renovation is necessary.

Animals on this type of range gained an average of 3.01 pounds per day per animal unit for the 60 day spring period. They gained 1.05 pounds in the fall during a 48 day period. If the animals had been rationed during this time, the feed cost for the same gain would have amounted to about $1,128.

Dry farm wheat production

Utah Station economists, Morrison and Withers, have found that the per acre cost of producing wheat on northern Utah dry farms during 1959 was $25.24. Yields on the farms studied averaged about 20 bushels per acre. When priced at $1.80 per bushel, total receipts amounted to $36.00 an acre. Net returns are about $10.76 per acre of wheat planted. If the above wheat prices and production costs hold, a yield of about 14 bushels per acre would equate costs and returns.

Wheat vs. livestock

Many alternatives could be analyzed as prices, costs, and yields vary. Only a few will be presented here. Farmers are urged to put their particular price-cost-yield situations to a similar analytical test before making a decision to plow up cover crops at the end of soil bank contract periods.

Alternative 1: Suppose a farmer-rancher has 100 acres of well established crested wheatgrass as a result of his conservation reserve program. Also, suppose that if he puts it back into wheat, his allotment would only permit 50 acres of wheat per year. The rest he would fallow. His per acre wheat yields, prices, and costs are the same as those above. Thus, his net returns for 50 acres of wheat would be about $538 per year representing annual returns for the whole 100 acres.

He could use the crested wheatgrass for spring and fall grazing. Previously he has had to ration feed his cattle during these periods. His herd composition and gain are the same as those at Benmore (table 1). To produce the same livestock products that graz-

(Continued on page 83)
Farm resources for specific income levels

Author discusses resources needed for various income levels on grade A dairy farms in northern Utah

Farmers frequently ask, What farm resources do I need to make an adequate income? How much land, capital, and livestock do I need for a satisfactory level of living? What quantity and use of resources will give me an income comparable to incomes in nonfarm employment? What combination of resources is most efficient and will maximize profits?

These and other questions have been analyzed for grade A dairies on diversified irrigated farms in northern Utah. The specified levels of earnings for the labor and management of farm operators were set at $2,500, $3,500, $4,500, and $5,500. These levels seem to be in line with the earnings of nonfarm workers and with the upward trend in size of farm.

Our main objective was to determine what organization and use of resources would produce the four earnings at "least cost" in terms of inputs. This type of analysis should be helpful to people who are 1) trying to improve their earnings through reorganizing their farms, 2) contemplating entry into farming, or 3) looking for a measure to help in choosing between farm and nonfarm occupations. Farm budgeting was used to estimate incomes; several important assumptions are listed.

Sizes and types of farms

These farms varied in size from 70 to 109 acres of irrigated land. They included 14 to 21 acres of sugar beets. Dairy cow numbers ranged from 27 to 43 head, plus replacement stock. The crops grown were alfalfa, rotation pasture, corn for silage, barley, and sugar beets.

Value of resources

A beginning farmer would need from $70,000 to $95,000 of capital or credit to buy and equip such farms. The average or depreciated values of the resources for the four income levels range from $56,000 for operator's earnings of $2,500 to $80,000 for earnings of $5,500 (fig. 1). Land and water are the biggest investment items on these farms. At $425 per acre, this investment is about 55 percent of the average total investments. Investments in buildings and equipment (55 percent of new cost) are relatively

IMPORTANT ASSUMPTIONS

1. Prices received are based on long-time price projections of the U. S. Department of Agriculture. The price of butterfat assumed is $1.20 per pound, or $4.32 per hundredweight of 3.6 test milk. Sugar beets are priced at $14.35 per ton.
2. Prices paid are 1959 prices.
3. Capital charge is 5 percent.
4. Land and irrigation water are priced at $425 per acre. Dairy cows are inventorized at $250 per head.
5. Production per cow is assumed to be 350 pounds butterfat. Alfalfa yield is 4.5 tons per acre and sugar beet yield is 17.0 tons per acre.
6. The operator is limited to 2,500 hours per year and family labor to 1,500 hours.
7. Family labor is charged at the hired wage rate of $1.25 per man-hour equivalent.
8. Loose housing, a double-3 herringbone milking parlor, and pipeline milkers and tank are included for the dairy unit.
9. Custom hire is assumed for major harvesting operations.
10. Labor per cow and replacements are based on a range of 75 hours per cow unit (25-cow herd) to 65 hours per unit (45-cow herd).
11. All forage is produced on the farm; in substance, this assumption determines the total number of acres of land.
12. A residence is not included as part of the farm business.
constant within this size range. New costs for buildings and equipment at 1959 prices would be from $31,000 to $35,000.

**Allocation of gross farm incomes**

The gross farm incomes go to many kinds of resources and to numerous people. Some of the main categories of claims to gross incomes are shown in fig. 2. Cash expenses and purchases of machinery, building materials, and live-

stock represent funds that leave the farm. The operator gets returns for his labor and management and for whatever equity he has in the farm business. His family receives income for their labor on the farm.

Gross incomes ranged from $16,000 to $25,000 for the four income situations (fig. 2). This increase of $9,000 was necessary for an in-

crease of $3,000 in operator earnings (return to management and to 2,500 hours of labor). Family and hired labor became increasingly important with size since the operator was restricted to 2,500 hours of labor, time somewhat comparable to that spent by nonfarm workers. Family and hired labor including custom work and contract hire increased from $3,400 at the $2,500 level to $5,529 at the $5,500 level.

Sales of sugar beets amounted to about 23 percent of the gross income on the smallest farm and 20 percent on the largest farm. Grade A dairy farms without sugar beets or other cash crop enterprises show smaller net incomes in total and in terms of resources needed. Mechanization of sugar beet operations apparently places this enterprise in a favorable position in conjunction

with livestock enterprises on irrigated farms.

If the operator owns all of the farm resources, return to operator and family labor, management, and capital investment ranges from $6,815 to $11,387. The difference in these returns of $4,572 is more than half of the change in gross income. These amounts would be available for family living, investment, and savings after payment

(Continued on page 85)
Knowledge of the amount of water that can be retained by the soil and later removed by growing crops to satisfy their needs is essential to planning irrigation systems. It may also give information that will indicate the amount of plant growth to be expected from the water in the soil.

Permanent wilting point

Man has known for many years that all cultivated crops reduce the amount of water remaining in the soil to almost the same value when the plant wilts to the point that it can no longer recover unless water is added. The amount of water retained under these conditions is called the "permanent wilting percentage." For many years it was believed that all plants were able to exert the same pull or suction on the water around the roots and remove it until the attraction of the soil for the water was equal to the pull that the plant could exert. It is now known that this concept is oversimplified; actually some plants are able to remove more water than others and the reason that most succulent crop plants reduce the soil water to about the same value is because the work required to remove a small amount of water increases greatly with each small increment of water that is removed as shown in fig. 1. The reason for this is that water is held to the surface of the soil particles by strong forces of adsorption and ionic attraction. If all of the surface area of the individual particles of Millville silt loam were spread out in one large flat sheet, there would be enough surface in 66 grams (about 2½ ounces) of soil to cover an acre (fig. 2). When this soil is at field moisture capacity it will have 14 cubic centimeters (about ½ fluid ounce) of water spread out over the acre of surface. This corresponds to a layer of water only 12 molecules thick (fig. 3). When at the permanent wilting point there will be only about 5.3 cubic centimeters (about 1/5 ounce) of water adsorbed to the acre of surface (fig. 4). The 5.3 cubic centimeters correspond to a film thickness of only about 3 or 4 molecules of water, and they are held so tightly that plants cannot remove them.

Influences of temperatures on the water that plants can remove from soil

STERLING A. TAYLOR
PEDRO URRIOLA-MUNOZ
Arrangement of water molecules

The water molecules in these thin films are orderly arranged by the soil particles and the ions that are attached to the soil (fig. 5).

They are arranged more orderly than the molecules in liquid water so that when the water is removed from the environment of the soil particle it is necessary to overcome the orderly arrangement as well as to pull the molecules away from the soil. The work that is expended in removing the water is released again as heat when the soil is wetted. This heat causes the temperature of the soil to rise. The temperature rise has long been known as heat of wetting; it is high in clay soils and in dry soils and low in sandy or moist ones.

Influence of temperature

Water molecules that are adsorbed and arranged in an orderly manner on the surface of soil colloids are affected more by temperature than are molecules of free water. Consequently more water should be removed with the same amount of work if the soil is warm than if it is cool. This has been demonstrated experimentally as shown in fig. 6.

Since in a mechanical system with a given amount of work, more water will be removed from warm soils than from cool ones, it was reasoned that a plant might also remove more water from a warm soil than from a cool one before it wilted permanently. An experiment was conducted in which a garden variety of sunflowers (Helianthus annuus) was grown in cans. The cans with the soil were kept at a constant temperature by immersing them almost to the top of the can in a constant temperature bath. The leaves and stems were allowed to grow under the ambient conditions of the greenhouse. When the plants were young, the leaves and stem were led through a hole in the lid of the can. When they were about 18 inches high, the soil was watered and the cans were sealed to prevent water from evaporating from or condensing on the inside of the can. Plants continued to grow in the soil at a known constant temperature until they wilted and failed to recover after overnight in a humid atmosphere. The water content of the soil was then determined.

The results of the experiment are shown in table 1. It is apparent that the plant removed significantly more water from the warm soils than from the cool ones. While 1.7 percent water may not seem much water, in a soil that is 50 cm (20 inches) deep it is equivalent to 1.1 cm (0.43 inches) of rainfall or irrigation. This may be of economic significance in a dry year.

Engineers can use the knowledge that permanent wilting point is dependent upon temperature to get more reliable information about the amount of water that the soil will supply to a crop. This will allow a more precise calculation of the amount of water that must be supplied to meet the plant requirements.

These results also suggest that some plants might continue to live even after the soil has dried to the region of permanent wilting by using water that is made available through the slow increase of soil temperature. While the water made available during the hot season by increasing soil temperature is probably inadequate for rapid vegetative growth, it may be quite important in the survival of perennials during dry years or in dryland areas where irrigation is not possible. This water is most critical because it is made available during the hot part of the season when the evaporative demand is greatest.

Table 1. The influence of temperature on the water remaining in soil when sunflower plants wilt and fail to recover overnight in a humid atmosphere

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Temperature °F</th>
<th>Millville silt loam percent water</th>
<th>Benjamin silt loam percent water</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>59</td>
<td>8.38 ± 0.13</td>
<td>11.63 ± 0.23</td>
</tr>
<tr>
<td>25</td>
<td>77</td>
<td>7.34 ± 0.17</td>
<td>10.47 ± 0.26</td>
</tr>
<tr>
<td>35</td>
<td>95</td>
<td>6.66 ± 0.16</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 5. Water in soil is arranged orderly by influence of soil and ions**

**Fig. 6. Influence of temperature on the work required to remove a unit of water as soil becomes drier**

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**DR. STERLING A. TAYLOR is professor and PEDRO URRIOLA-MUNOZ is a graduate student in soil physics. Dr. Taylor has left the campus for a year of study and research at the University of Brussels in Belgium on a grant from the National Science Foundation.**
DISEASES among domestic turkeys cause a multi-million dollar loss each year in the form of mortality, growth depression, lower product quality, and the costly use of prophylactic and therapeutic medicines. The forces combating these losses delve intricately into all disciplines known to biological science and beyond this, call assistance from many areas outside biological fields. Pathology, bacteriology, pharmacology, biochemistry, nutrition, physiology, and genetics are among the sciences most vitally concerned in deterring losses from disease. The latter of these (genetics) will here be considered in its role as a tool in fighting the costly disease complex.

DR. DAVID W. CARSON is associate professor of poultry husbandry. His research is mainly on poultry breeding.

Genetic resistance

Plant breeders have clearly demonstrated and applied genetic resistance to such infections as covered smut in wheat (a fungus), curly top in sugar beets (a virus), and wilt in alfalfa (a bacterium). Animal breeders have been less dramatic, although nature has done a marvelous work in selecting resistant animal forms in populations not exposed to artificial selection. DDT resistance in flies and resistance of staphylococcal bacteria to most antibiotics are two examples. Many domestic animal species show strain variation to disease resistance. Mice exhibit a high genetic difference in immunizing capacities, as would likely most other species if properly tested and selected for this characteristic. Current research with chickens shows an astounding heritability for resistance to leucosis and most large breeders give attention to this fact in designing the selection program. The prospects of genetic resistance to disease in turkeys have been less explored, although use of basic transmission genetics holds bright promise.

Research at Utah State

Breeding research in turkeys at USU has concerned itself primarily with strain variability for factors of reproduction. Resulting from these specific experiments, distinct strains of Broad Breasted Bronze turkeys have come under close observation as to their differential performance in several characteristics. Death loss from the three principal diseases involved in the flock has been observed and determined by laboratory examination of each specimen. In considering mortality resulting from blackhead (a protozoa), synovitis (a bacterium)

Heritibility of disease resistance in turkeys

J. DAVID CARSON

FARM AND HOME SCIENCE
and sinusitis (a virus) it should be kept in mind that the experiments were not designed for detecting interstrain differences in disease susceptibility nor has selection been used to widen these differences. No intended selection was made for disease resistance, although natural selection could have played some slight role by eliminating disproportionate members of the unfit forms. While this may have happened, and does happen to some extent in all species, it does not account for much of the difference noted between strains. Thus the strains, while different, are not highly resistant because the natural disease challenges have not been severe. In 1957 the flock sustained an outbreak of sinusitis and for this reason data from this year are presented. Synovitis and blackhead are responsible for low incidence of mortality in any year.

Facts and figures

Three figures are presented to show percentages of mortality for the three diseases by strains. Total overall mortality for the year was 5.7 percent, a low figure to detect strain variation. Strain 5 sires show 3.0 percent mortality from blackhead when mated to strain 5 females and only 0.8 percent when mated to females other than strain 5 (fig. 1). Strain 4 sires show no mortality at all, while strain 7 and 9 sires are intermediate. In resistance to synovitis (fig. 2) once again strain 4 shows no mortality, while strain 5 again has the greatest. It is significant to note the increase in mortality in strains 7 and 9 when these sires are mated to strain 5 females. Strain 7 sires mated pure show only 0.5 percent, versus 2.3 percent mated to the more susceptible strain 5. Strain 9 mated pure has 1.3 percent mortality and 2.2 percent when mated with strain 5 females. In each instance the matings with females other than from strain 5 have lower mortality.

Mortality from sinusitis (fig. 3)

(Continued on page 86)
The problem of salty irrigation water

Can a farming operation using salty water be permanent?

J. P. THORNE
R. G. RICKENBACH

Irrigation waters are never pure. All contain dissolved minerals. The amounts and the kinds of these determine the quality of water. Water may be unsatisfactory for irrigation for one or both of two reasons: because it contains too much mineral in solution, or because too much of the dissolved mineral is sodium.

A saline water

A water that contains enough solids in solution to be injurious to growing plants or to soils on which it is used is saline or salty. Various methods have been proposed for measuring the amount of salts in waters but the ability to conduct electric current is the one most commonly used for irrigation waters. When mineral salts dissolve in water they split into positively and negatively charged particles called ions. The higher the concentration of these ions the greater the ability of the water to conduct electricity. To express this conducting ability in usable figures the specific electrical conductance (EC) is used. Since most natural waters contain only small amounts of dissolved solids a small unit of conductivity, the micromho, is employed.

According to the classification system developed by the U. S. Salinity Laboratory, a water becomes mildly saline for irrigation when its electrical conductivity reaches 250 micromhos. Yet ordinarily in Utah we have no difficulties with waters causing salinity problems until their electrical conductivity values reach 750 micromhos or more. Because of the great differences in the salt tolerance of crops we cannot establish definite limits on how saline a water can be before it produces crop damage. Cultural practices are also important in determining the success or failure of crop production when saline waters are used for irrigation.

A saline soil

As is the case with irrigation waters, soils too are classified as saline when they contain enough soluble salts to interfere with the growth of crop plants. Again no hard and fast lines can be drawn between saline and non-saline soils, but electrical conductivity values are chosen which represent as near as can be determined the significant levels of salinity. A sample of soil is mixed to a saturation point with distilled water to measure its degree of salinity. After coming to equilibrium with the soil, this moisture is then extracted by suction and its conductivity measured the same as with irrigation water. The measurement here is known as the electrical conductivity of the saturation extract (ECe) and is expressed in millimhos, or units which are one thousand times larger than the micromhos used for irrigation.
waters. Soils with EC values of 4 or greater are saline. Generally such soils contain .2 percent or more of soluble salt and restrict the growth of some or all crop plants. Saline soils, of course, occur naturally but can also be formed through the use of salty irrigation waters.

**A sodic soil**

The clay particles in soils hold cations such as calcium, magnesium, potassium, and sodium in a semi-bound position. Normal soils hold relatively high amounts of calcium, magnesium, and potassium compared with sodium. When more than 15 percent of these exchange positions are held by sodium the soil is said to be a sodic soil, and it usually has undesirable chemical and physical properties. For example, it is often caustic, having an alkaline reaction of pH 8.7 or higher. Individual soil particles do not form aggregates as they do in normal soils but remain dispersed. Sodic soils are difficult to till and to wet properly during irrigation. Sodic soils can also be hard to reclaim because of their resistance to the movement of water which is an essential part of the reclamation process. Repeated irrigations with water high in proportion of sodium, or in other words having high SAR values, can produce sodic soil.

**The problem**

In farming we are concerned with providing the kind of soil and moisture environment that will result in optimum growth of the crop. The growing plant must obtain its moisture and mineral nutrients from the soil. The concentration of the soil solution is therefore important because when it becomes too high, as it does in saline soils, the plant cannot extract enough water to grow normally. The amount of salt in the irrigation water directly affects the concentration of the soil solution.

A real problem exists when saline water is the only water available for irrigation. Since at the present time there is no practical means of removing salt from irrigation water, the only solution, and it may be only partial, is using irrigation and cultural practices that will minimize the salinity damage. The application of the irrigation water and its ultimate drainage away from the soil must be accomplished in such a way as to
prevent as much as possible the build up of soluble salts.

Some practical methods of irrigating

One way to do this is to flood irrigate the land keeping the net movement of water downward. If drainage through the soil is good, this method may give the best control of salinity although larger quantities of water are required than would be needed were salinity control unnecessary. A second way is to use the furrow system of irrigation but plant and irrigate so as to keep the plant roots in the least salty portion of the soil. The salt concentration in the soil at the bottom of the irrigation furrow, or slightly to the side and below the furrow, is less than it is in the crests between the furrows. These crests act as wicks carrying soluble salts near to the surface where the water is evaporated leaving the salts behind.

It is impractical to remove the sodium from irrigation water. However, the proportion of sodium can be reduced by adding soluble calcium. Gypsum (calcium sulfate) is often added to irrigation waters that are not initially too salty in order to reduce the proportion of sodium and thus the tendency of the water to form a sodic soil.

Studies in the field

In the summer of 1960 we made studies in Millard County where salty well waters are being used for irrigation. Samples of soil were taken from irrigated and nonirrigated fields adjacent to each other. The latter fields were still in native brush. Data obtained on these samples and the corresponding irrigation waters are shown in Table 1.

The amounts of salts in the soil solutions were only slightly higher than in the waters used for irrigation. Usually soil solutions have concentrations of 2 to 5 times those of the applied irrigation water.

If a water of a constant composition were used for irrigation on a given piece of land one might expect that in time soil conditions would exist in equilibrium with the water composition. The time required to establish this equilibrium would depend upon the amount and kind of salts in the water and the amount of water used. The kind of soil and the drainage conditions would also be important. We do not know if the soils studied in Millard County have reached equilibrium. However, on farm A the soluble salts in the soil appear to have been reduced by irrigation, while on farm B salt concentrations appear to have been increased. In considering these data, differences in the original soil conditions as well as the irrigation waters must be kept in mind.

Last year both waters were used to irrigate alfalfa, which has a fair degree of salt tolerance. Barley, sugar beets, and some of the grasses also have good tolerance for salinity and alkali and could be grown on both of these irrigated fields in their present condition. But the real question is: Are the current salt levels near an equilibrium for a long term or are they likely to increase still further? If the compositions of these waters remain constant and the amounts used are not reduced, then the main concern might be that of a sodium hazard. Perhaps wise use of soil amendments could minimize if not prevent a serious problem with sodium accumulation.

According to the U. S. Salinity Laboratory rating system, water A is class C4-S3 and water B is poorer than C4-S4. The "C" refers to the electrical conductivity described earlier and so to the salinity hazard involved in using the water. The "S" refers to the proportion of sodium and so to the alkali hazard. The best waters under this classification are C1-S1 and the poorest C4-S4.

Can a farming operation using waters such as these be permanent? Actually this question cannot be definitely answered, neither can we say that waters like these with conductivities over 4500 microhms cannot be used profitably over a period of years, although at the present time, we know of no waters this salty that have been used successfully in Utah for as long as 10 years.

Increasing demands for water emphasize the need for more information on the suitability of waters for various purposes. Studies will be continued in an effort to solve some of the problems that arise from the use of saline irrigation waters.

Table 1. Qualities of two saline irrigation waters and respective irrigated and non-irrigated soils

<table>
<thead>
<tr>
<th>Water samples</th>
<th>Soil samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrigated</td>
</tr>
<tr>
<td></td>
<td>Depth (inches)</td>
</tr>
<tr>
<td>A</td>
<td>46</td>
</tr>
<tr>
<td>B</td>
<td>67</td>
</tr>
</tbody>
</table>

NEW PUBLICATION

Bul. 429. Control of Roemeria poppy in winter wheat, by D. C. Tingley, Department of Agronomy. 12 p.

Data from control tests show that the poppy can be controlled with a fairly high rate of 2,4-D applied at or before the bloom stage. However, even though good control was obtained, wheat yields were not increased. Either the poppy is not too competitive with winter wheat or 2,4-D in rates high enough to control the weed does about as much damage as the poppy.

Single copies of this publication will be sent free on request to the Utah Agricultural Experiment Station, Logan.
TOMATOES with their bright color, tempting flavor, and high vitamin and mineral content are one of the most popular vegetable crops for fresh consumption as well as for consumption when processed. They are Utah's most important vegetable crop. Approximately 6,000 acres are grown and the crop is valued at nearly one and a half million dollars.

Tests made by the Utah Station to determine quality of the tomatoes for processing showed that the crop compares favorably with tomatoes produced in other states. Tomatoes harvested during the peak of the season rated higher than the ones harvested in the early and late season. The qualities judged were acidity or pH, percent soluble solids, and color.

The samples tested were collected from cannery-run tomatoes delivered to nine canning companies from the tomato canning areas of the state. The canning companies furnished the samples from 90 different loads from 40 growers. Five varieties were tested: Moscow, Loren Blood, Stone, Pearson, and Home Grown. Several hundred samples were checked over the period from August 26 to October 6, 1959.

**pH or acidity**

The acidity or pH of tomatoes is an important factor in determining the flavor. It is also important for the processor. Butyric, thermophilic, and putrefactive anaerobic bacteria find difficulty in growing when the pH is below 4.3. If the pH is higher the spores of the bacteria are difficult to destroy. If the pH is high even for a short time during processing because of the high concentration of the lye solution used to loosen the skin, there is a spoilage hazard. Also, when the pH is high, the cooking time must be lengthened, thus reducing the quality, especially the color, and the nutritive value of the processed product.

The stage of maturity and the variety of tomato influence the pH. Riper fruits were higher in pH values than pink fruits of a given variety, regardless of the harvest period. There was little seasonal trend in acidity. pH varied considerably during the first eight-day period; less during the next three eight-day periods, with a decided leveling off during the last period.

**Soluble solids**

The consistency and yield of the tomato products are correlated with the total solids. The flavor of both the raw and processed product is directly related to the amount of soluble solids. Soluble solids are predominantly sugars and sweetness is an
important attribute of flavor. The amount of these solids depends on the number of leaves, the irrigation practices, and the fertility of the soil. There is a direct relation between soluble and total solids.

There was considerable variation in the percentage of soluble solids during the first eight-day harvest period, not so much during the second harvest period. The third and fourth periods showed wide variability, while the last period showed little deviation.

**Color**

The color of a fresh or processed product is important because the consumer buys by appearance and by the reputation of the trade mark. The color of the raw tomato is related to the color of the processed product. Color of fresh tomatoes varies with the season, the picking, the grade, the lycopene and carotene content, the variety, and the maturity of the tomatoes.

Color tests showed that Utah tomatoes were slightly darker than the standard tomato. The average of each six-day period except one was redder than the standard.

Regardless of the variety, there was a greater color variation in the beginning of the season. Cold and rain affected the color during the fourth harvest period causing the tomatoes to ripen unevenly. The tomato puree was thicker and more pectin-like near the close of the season.

### Table 1. pH, soluble solids, and Hunter color and color difference values obtained on tomato puree in relation to picking time (based on all varieties, growing locations, fertility levels, irrigations) in 1959-60

<table>
<thead>
<tr>
<th>Picking duration</th>
<th>pH values</th>
<th>Percent soluble solids</th>
<th>Hunter color measures*</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean†</td>
<td>Range</td>
<td>L</td>
</tr>
<tr>
<td>Sept. 3 — Sept. 10</td>
<td>3.60—4.50</td>
<td>4.06 4.06</td>
<td>4.86—6.15</td>
<td>5.60</td>
</tr>
<tr>
<td>Sept. 11 — Sept. 18</td>
<td>4.00—4.50</td>
<td>4.24 4.24</td>
<td>4.94—6.19</td>
<td>5.62</td>
</tr>
<tr>
<td>Sept. 27 — Oct. 6</td>
<td>4.00—4.31</td>
<td>4.20 4.20</td>
<td>4.60—6.87</td>
<td>5.40</td>
</tr>
</tbody>
</table>

*Standard tomato color tile with readings of L = 24.45; *L = 24.26; ‡L = 11.5.
† Usually mean of pH values is not presented. However, to see the trend, it is calculated for this article.

**How the study was made**

Four boxes of tomatoes were selected at random each day from a load of cannery-run tomatoes. From each box, five tomatoes were selected at random and placed in a paper bag.

Each sample of five tomatoes was crushed in the laboratory and the resulting tomato puree was used for acidity, soluble solids, and color determinations. Several hundred such samples were studied. Acidity or pH measurements were made with the Beckman pH meter (fig. 1). Soluble solid determinations were made by use of the Abbe-type refractometer (fig. 1) at a constant temperature of 20 degrees C. Color was measured with the Hunter color and color difference meter (fig. 2). Data on pH, soluble solids, and color values are presented in table 1.

**LILIES**

(Continued from page 60)

and the condition under which it is grown. It is best for the home gardener to grow varieties which will consistently produce flowering size bulbs. The size of bulbs produced every year depends on the size and the health of the plant above ground. Deep green, vigorous shoots will produce large bulbs. The size, of course, will also depend on the variety.

Joan Evans had a large number of one ounce bulbs, but produced many flowers in 1959. The large number of bulbs which this variety produces also indicates the necessity of separating and replanting before the bulbs become too crowded. Fiesta hybrids had only medium sized bulbs of 1½ to 2 ounces, but grew satisfactorily. Some Mid-Century varieties and others classified in the medium sized group had low bulb weights. As a result they decreased in vigor and in the number of blooms produced.

**Pointers for the successful growing of lilies**

For lilies nothing is more important than a soil with good drainage. Lilies cannot grow in poorly drained soil. Humus is essential in the soil. The humus content can be increased by the addition of a good soil conditioner such as leafmold, compost, peat moss, old manure, or sawdust. Any average garden soil with good drainage and a low lime content is satisfactory. Proper nutrition with a complete fertilizer broadcast around the plant and worked in the soil every spring is beneficial. Fertilizers in organic form and especially well prepared compost are preferable. Mulching with one of the various media such as straw, peat moss, sawdust, coarse compost, and leafmold provides the necessary cooling effect around the roots. It also helps in providing uniform soil moisture and helps control weeds.

Sunlight is normally recom-
hybrids of the pink group. Lilies grow successfully in open soil. The spacing should be covered with 4 to 6 inches of soil. The spacing should be less than 1½ feet. Lilies can be propagated by dividing the old bulb clumps, by using the bulbils collected from the leaf axils of some varieties sown 1 inch deep, or by the scales removed from the scaly mother bulb and planted in a special location protected against winter frost. Interesting types may also be obtained from plantings of seed.

Lilies effectively landscaped

Lilies like some other ornamentals are enhanced in their beauty when informally arranged in natural settings. They are beautiful in front of backgrounds of dark green woody ornamentals. They may also be associated with perennials or in combination with ground covers. But care must be given to prevent heavy competition from feeding roots of neighboring plants.

GRAINS FOR PASTURE
(Continued from page 61)

ewes and lambs, forage use, and forage production on this wheat pasture compared to an alfalfa-bromegrass field, and to sheep on crested wheatgrass pastures during the same time are shown in Table 1.

The ewe gains on wheat were significantly higher than those from the other two pastures. Although the lamb gains were higher on the alfalfa-bromegrass, these were not significantly different.

Value of wheat as pasture

The value of the wheat as pasture, of course, depends on the alternatives the operator has to feed his livestock. Figuring the forage requirement for ewes and lambs plus a considerable amount for trampling to be about eight pounds of air-dry feed per day, the carrying capacity of the wheat was 464 sheep days per acre. Figuring a day’s grazing for a ewe and lamb to be 4 cents, this would be a return of $18.56 per acre for the forage. This would be more than pay for the seed, equipment use, labor, and irrigation of the grain.

Table 2. Increase of bulbs during a 2 and 5 year period

<table>
<thead>
<tr>
<th>Variety</th>
<th>Loss of planted bulbs</th>
<th>Percent increase by size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>percent</td>
<td>oz.</td>
</tr>
<tr>
<td>Afterflow*</td>
<td>33</td>
<td>200</td>
</tr>
<tr>
<td>Aurelian Sunburst hybrids</td>
<td>25</td>
<td>478</td>
</tr>
<tr>
<td>Bellingham hybrids</td>
<td>8</td>
<td>1225</td>
</tr>
<tr>
<td>Croesus*</td>
<td>0</td>
<td>66</td>
</tr>
<tr>
<td>Felicity*</td>
<td>0</td>
<td>133</td>
</tr>
<tr>
<td>Fiesta hybrids</td>
<td>58</td>
<td>560</td>
</tr>
<tr>
<td>Green Mountain hybrids</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Golden Chalice hybrids</td>
<td>80</td>
<td>600</td>
</tr>
<tr>
<td>Golden Clarion hybrids*</td>
<td>83</td>
<td>700</td>
</tr>
<tr>
<td>Golden Harvest hybrids</td>
<td>58</td>
<td>80</td>
</tr>
<tr>
<td>Hansoni</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>Henryi</td>
<td>58</td>
<td>180</td>
</tr>
<tr>
<td>Maxwell</td>
<td>40</td>
<td>133</td>
</tr>
</tbody>
</table>

Mid-Century hybrids

<table>
<thead>
<tr>
<th>Variety</th>
<th>Loss of planted bulbs</th>
<th>Percent increase by size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>percent</td>
<td>oz.</td>
</tr>
<tr>
<td>Enchantment</td>
<td>25</td>
<td>44</td>
</tr>
<tr>
<td>Harmony</td>
<td>58</td>
<td>680</td>
</tr>
<tr>
<td>Joan Evans</td>
<td>8</td>
<td>1282</td>
</tr>
<tr>
<td>Pagoda</td>
<td>58</td>
<td>800</td>
</tr>
<tr>
<td>Parade</td>
<td>83</td>
<td>725</td>
</tr>
<tr>
<td>Tangelo</td>
<td>66</td>
<td>311</td>
</tr>
<tr>
<td>Valencia</td>
<td>25</td>
<td>83</td>
</tr>
<tr>
<td>Olympic hybrids</td>
<td>58</td>
<td>540</td>
</tr>
<tr>
<td>Prosperity*</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>Regal Album</td>
<td>50</td>
<td>660</td>
</tr>
<tr>
<td>Sulphureum hybrids</td>
<td>66</td>
<td>200</td>
</tr>
<tr>
<td>Valiant</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>Viking</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

*Two years

Table 1. Weight gains for ewes and lambs, use and production of various spring pastures at CSU Valley Farm, spring 1957

<table>
<thead>
<tr>
<th>Type of pasture</th>
<th>Average gain for 31 day period</th>
<th>Forage use</th>
<th>Air-dry forage June 4, 1957</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lamb</td>
<td>Ewe</td>
<td>percent</td>
</tr>
<tr>
<td>Wheat</td>
<td>20.4</td>
<td>15.9</td>
<td>90</td>
</tr>
<tr>
<td>Alfalfa-bromegrass</td>
<td>22.2</td>
<td>13.9</td>
<td>11</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>19.9</td>
<td>13.4</td>
<td>56</td>
</tr>
<tr>
<td>Crested wheatgrass</td>
<td>83</td>
<td></td>
<td>232</td>
</tr>
</tbody>
</table>
Water was available to give the grain three irrigations following grazing and we obtained a good crop of grain in addition to the forage. If water had been in short supply this year, we could have gotten our investment back out of the grain by the spring grazing and used the water on other crops. In good years when our dryland pastures produce well we would not need to graze the planted grain and could mature grain directly.

Following harvesting, the stubble has yielded a good amount of fall grazing, which is much needed by many livestock operations.

Fall barley also has possibilities

Alpine barley planted in September of 1960 and grazed in the spring of 1961 did not produce the forage that the wheat did in 1957, but the carrying capacity was good and ewes and lambs did well on the barley. Alpine barley fits well into our program because it is winter hardy and produces a grain which fits into our concentrate feeding program better than wheat or rye.

Planting intermediate wheatgrass into the stubble of Alpine barley following fall grazing in 1960 has given us a good stand of intermediate wheatgrass this year and appears to be a way to establish this type of permanent pasture.

TURKEY

(Continued from page 65)

were associated with the size of restaurants. "Lack of adequate preparation facilities" and "offer only a limited menu" were most commonly given by operators of small or medium sized restaurants.

Specialty houses (pizza, sea food, hamburger stands) generally did not use turkey. These establishments restrict their offerings to their specialty item plus a few staple meats, not including turkey, for those not desiring the specialty foods. Even where another poultry product (chicken) was the specialty, turkey was seldom offered.

Among restaurants using turkey, restriction in the amount used was most often attributed to fluctuations in consumer demand (fig. 3). The "high cost of preparation" or "low profit" in comparison with other type meats was also listed frequently as a limiting factor. These responses were given with equal frequency by both "seasonal" and "year around" users. "Lack of adequate storage" was restrictive in a comparatively few cases.

Of the eighty-five operators using turkey, 39 percent indicated that nothing of significance was limiting use of turkey in their restaurants. Ninety-one percent of these responses came from restaurants using turkey the year around.

Menu pricing of turkey and other meats

Competition between turkey and other meats served in restaurants is mostly in the nature of price competition. Restaurant operators, with the possible exception of specialty houses, tend to rotate the special meat items they promote from day to day. Items served with various type meats (vegetables, salads, soup, dessert) within a meal classification (dinner, for example) tend to be comparable. Consequently, the relative price of meat items may be an influential determinant in a consumer's selection.

Average menu prices of turkey dishes were relatively high, ranking first or second in each meal classification (table 2). Average turkey prices ranked second to chicken prices for dinners and lunches and first for hot and cold sandwiches. Turkey prices most closely approximated chicken prices with the greatest difference occurring in the lunch classification. Average prices of roast beef and pork in each meal classification were approximately the same, reflecting the close competition and cross-substitution of these meats.

Average price differences within meal classifications were the largest in the dinner and lunch groups. Average dinner prices had a differential of $.13, ranging from a high of $1.42 for chicken to a low of $1.29 for roast pork. The average price differential for luncheon

Table 1. Use of turkey by various size restaurants, 117 restaurants, Utah, 1959

<table>
<thead>
<tr>
<th>Size of restaurant*</th>
<th>Number</th>
<th>Use turkey year around</th>
<th>Use turkey seasonally†</th>
<th>Don't use turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>37</td>
<td>35</td>
<td>19</td>
<td>46</td>
</tr>
<tr>
<td>Medium</td>
<td>36</td>
<td>56</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Large</td>
<td>30</td>
<td>73</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Extra large</td>
<td>10</td>
<td>70</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Other‡</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>117</td>
<td>53</td>
<td>20</td>
<td>27</td>
</tr>
</tbody>
</table>

*Classification based on owner's estimate of customers per week:
Small—less than 1,000 customers per week.
Medium—1,000 to 1,999 customers per week.
Large—2,000 to 5,000 customers per week.
Extra large—over 5,000 customers per week.
†Seasonal use in this instance refers to restaurants who discontinue use of turkey during some part of the year. It does not include those who merely reduce the amount used.
‡Owners would not estimate number of customers per week.

Table 2. Average price of various meals classified by type of meat, 85 restaurants, Utah 1959

<table>
<thead>
<tr>
<th>Type of meat</th>
<th>Dinner</th>
<th>Lunch</th>
<th>Hot sandwich</th>
<th>Cold sandwich</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dollars</td>
<td>dollars</td>
<td>dollars</td>
<td>dollars</td>
</tr>
<tr>
<td>Roast turkey</td>
<td>1.59</td>
<td>.97</td>
<td>.76</td>
<td>.60</td>
</tr>
<tr>
<td>Chicken</td>
<td>1.42</td>
<td>1.07</td>
<td>.71</td>
<td>.59</td>
</tr>
<tr>
<td>Roast beef</td>
<td>1.31</td>
<td>.94</td>
<td>.71</td>
<td>.51</td>
</tr>
<tr>
<td>Roast pork</td>
<td>1.29</td>
<td>.92</td>
<td>.71</td>
<td>.51</td>
</tr>
<tr>
<td>Average</td>
<td>1.35</td>
<td>.98</td>
<td>.72</td>
<td>.55</td>
</tr>
</tbody>
</table>
meals ranged from a high of $1.07 for chicken to $0.92 for roast pork, a difference of $0.15.

Little variation was found in the average prices for hot sandwiches.

Prices for cold turkey and cold chicken sandwiches were approximately the same and averaged about $0.09 higher than cold beef and pork sandwich prices.

**ALTERNATIVES FOR SOIL BANK LANDS**

(Continued from page 69)

...ing his crested wheatgrass would do would cost him the equivalent of about $1,128. If 200 rods of permanent fence were needed and if depreciation and maintenance costs were as described earlier, annual fence costs would be about $33. Suppose a water system cost $100 a year for depreciation and maintenance, but it served two 100 acre pastures. Annual water costs per 100 acres would be $50. Expected net economic benefits from grazing 100 acres would be about $1,128 - ($83 + $50) = $1,045.

Wheat production would net about $507 less than grazing under the specified conditions. With these price-cost relations, wheat yields would have to average about 25.6 bushels per acre before wheat would be more profitable than grazing. Given wheat yields and costs, wheat prices would have to rise above $2.31 per bushel before wheat would be most profitable. Given wheat prices and yields, costs of producing wheat would have to fall below $15.10 per acre before wheat would be more profitable than grazing. Given wheat net returns and the feed equivalent to do the job that grazing did, the average price of feed saved could fall below $1.00 per hundred pounds before grazing would be least profitable.

Suppose, instead of ration feeding as a substitute for dry farm grazing, that good spring and fall range could be leased from the Bureau of Land Management (BLM) at $0.20 per animal unit month (AUM). If the farmer-rancher shifted from BLM range equivalent in productivity to his soil bank land, he would save $14.60 a year. So, $14.60 would represent the annual gross value to him of his 100 acres of crested wheatgrass. It would not pay the cost of providing water and fence.

If the farmer-rancher had to reseed his 100 acres to get an adequate cover for grazing, another $98 a year cost would have to be added to each situation discussed under this livestock alternative. Thus, with ration feed at $2.60 a hundred, grazing his 100 acres would net about $947 a year—still more than from wheat production.

**Alternative 2**: Suppose a farmer purchased 600 pound yearlings each spring at $0.20 a pound to graze 100 acres of his soil bank forage for 60 days then sold them for $0.21, then bought 1,000 pound pregnant cows in the fall for $0.14 a pound to graze for 48 days before selling them for $0.15. Also, suppose his animal yields were the same as those at Benmore. Let annual water and fence costs be the same as in alternative 1; also, charge 6 percent on his investment. He would have to buy about 45 yearlings in the spring and about 19 cows in the fall to stock at the intensity suggested in the ex-

---

**Table 1. Experimental results from moderate grazing of 100 acre crested wheatgrass pastures by cattle, Benmore, Utah**

<table>
<thead>
<tr>
<th>Class of animals</th>
<th>Weight per animal</th>
<th>Animals per 100 acres</th>
<th>Daily gain per animal</th>
<th>Animal unit equivalent†</th>
<th>Animal units per 100 acres</th>
<th>Daily gain per animal unit</th>
<th>Quantity of substitute ration required</th>
<th>Cost of substitute ration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs.</td>
<td>no.</td>
<td>lbs.</td>
<td>AU's</td>
<td>AU's</td>
<td>lbs.</td>
<td>lbs.</td>
<td>dol.</td>
</tr>
<tr>
<td>Spring, 60 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yearlings</td>
<td>600</td>
<td>4.00</td>
<td>2.55</td>
<td>0.63</td>
<td>2.52</td>
<td>4.05</td>
<td>3,413†</td>
<td>89</td>
</tr>
<tr>
<td>Dry cows</td>
<td>800</td>
<td>6.37</td>
<td>3.25</td>
<td>0.93</td>
<td>6.00</td>
<td>3.49</td>
<td>8,128†</td>
<td>211</td>
</tr>
<tr>
<td>Pregnant cows</td>
<td>900</td>
<td>2.66</td>
<td>3.10</td>
<td>1.02</td>
<td>2.71</td>
<td>3.04</td>
<td>3,671†</td>
<td>95</td>
</tr>
<tr>
<td>Milking cows</td>
<td>850</td>
<td>9.32</td>
<td>2.72</td>
<td>1.53</td>
<td>15.84</td>
<td>2.67</td>
<td>21,458†</td>
<td>558</td>
</tr>
<tr>
<td>Calves</td>
<td>180</td>
<td>9.32</td>
<td>1.82</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milking cows with calves*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Total spring</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fall, 48 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant cows</td>
<td>1,000</td>
<td>15.30</td>
<td>0.23</td>
<td>0.64</td>
<td>9.79</td>
<td>0.36</td>
<td>14,858§</td>
<td>149</td>
</tr>
<tr>
<td>Calves</td>
<td>400</td>
<td>6.80</td>
<td>1.33</td>
<td>0.33</td>
<td>2.24</td>
<td>4.03</td>
<td>2,368§</td>
<td>26</td>
</tr>
<tr>
<td>Total fall</td>
<td></td>
<td>22.10</td>
<td>0.57</td>
<td>0.92</td>
<td>12.03</td>
<td>1.05</td>
<td>17,226†</td>
<td>175</td>
</tr>
</tbody>
</table>

*Cows and calves were combined to calculate these values.
†Digestible energy (DE) needed for maintenance plus production for one animal unit is 32.06 megacalories. An animal unit is defined as one 1000 pound cow producing 25 pounds of milk per day. Other classes of cattle were converted to animal units on the basis of DE required for maintenance plus gain. Formulas for these conversions can be furnished by the authors.
§The substitute ration for spring grazing is 10 percent barley, 59 percent corn, 24 percent alfalfa hay, 5 percent cottonseed meal, solvent extracted, 1 percent salt, and 1 percent bone meal. It would cost about $2.60 per hundred pounds using normal prices.
§§The substitute feed for pregnant cows grazing in the fall was assumed to be about 20 pounds of alfalfa hay per day per cow. With normal prices it costs about $20 per ton.
††The substitute ration for calves grazing in the fall was assumed to be 10 pounds of alfalfa hay and 3 pounds of barley per day per animal. It costs about $1.10 per hundred pounds.
experiments as well as transport these animals about 10 miles at the beginning and end of each grazing period. If the planting of crested wheatgrass was well established over the soil bank period and prices and costs were as before, he would realize net returns of about $1,363 a year.

A 20 bushel per acre wheat crop on half of 100 acres at $1.50 per bushel would net about $825 less than grazing the entire area. However, wheat would net more if 1) prices, yields, and costs stayed as above except wheat yields rose above 29 bushels per acre, 2) wheat prices rose above $2.63 per bushel, 3) wheat production costs dropped below $8.74 per acre, 4) yearling cattle sold for less than $0.184 per pound, or 5) fall cows sold for less than $0.105 per pound. Of course, combinations of factors could also change to favor either wheat or cattle.

Since price of cattle fluctuates, there may be some advantage in working out an agreement with a large cattle operator to furnish the cattle and pay for the gain put on by the operator owning the grass.

Alternative 3: Suppose a farmer had a good cover on 100 acres of his former soil bank lands, and he wanted to lease the forage. If he could get $3.50 per AUM, his 73 AUM’s of forage would return him about $255 per year. Subtracting out water and fence costs ($83 per 100 acres) would leave him $172 per year. Given the price-yield-cost relations above, wheat production would be more profitable unless 1) wheat yields fell below 16 bushels per acre, 2) wheat prices fell below $1.43 per bushel, 3) wheat costs rose above $32.56 per acre, or 4) lease fees rose above $7.37 per AUM.

**BETTER VENISON**

(Continued from page 63)

most sensitive to decrease as the meat was cooked longer.

**Flavor combinations**

Chops, steaks, roasts, ground venison, and stew meat were used in various venison dishes. Recipes were chosen which would give a broad selection of flavors and a variety of methods in preparation. In all dishes the venison combined with other flavors effectively. Recipes using beef, pork, or veal were adapted successfully to use of venison. Acceptability was greater when the meat was cooked to a medium stage of doneness. Moist heat methods produced meat that was much more tender.

**How the tests were made**

In these studies tenderness tests were made on the Warner-Bratzler shearing machine and on the Orchard Press. A panel of nine judges scored samples of meat for tenderness, texture, juiciness, and flavor on a scale from 1 to 9. A high score showed the best acceptability. Juiciness was determined on the succulometer by the amount of juice it was possible to express from a sample. Rancidity was measured by change in peroxide value.

**SNOW SURVEY**

(Continued from page 67)

(Continuing particular groups of days, weeks or months, usually in early fall or late spring, accumulated temperatures for similar units of time, and soil moisture at selected stations.

**Current developments in streamflow forecasting at USU**

The advent of high speed computing machines now makes it practical to include many more factors in the prediction formulas. For example, the forecasting equations recently developed for the Logan River contain 22 independent variables, five characterizing antecedent runoff, five characterizing antecedent precipitation at a valley Weather Bureau observation station, five characterizing antecedent temperatures at a valley Weather Bureau observation station, and seven, the water content of the snow cover at seven snow survey courses on the watershed. Not only can the total April-September runoff be predicted with considerable accuracy, but also the expected runoff for each month can be predicted with fair accuracy. The same techniques developed for the Logan River have been applied to the Blacksmith Fork and Beaver Rivers of Utah with improvement of accuracy of the forecasts.

Soil moisture, snow water content, and air temperatures measured at 6 stations on the Logan River watersheds indicate that winter snow melt may be considerably more in some years than in others. This may account for some of the error in previous forecasts. Techniques are now being developed to permit inclusion of soil moisture data in the forecasting relations.

**Value of snow survey data**

In years such as the present, advance information on impending drought can be especially helpful to farmers, irrigation companies, power companies, and municipalities because early planning and action can help avert drought. Farmers with poor water rights can plant only early maturing crops, leaks irrigation structures can be repaired, ditches can be lined, alternate sources of water supply can be sought. Irrigation companies can develop other supplies if available; they can line canals to conserve water, they can repair leaky structures, and they can work out operation schedules for distribution of water which will be fair and equitable. Of course, many of these water conservation measures would be helpful any time, but particularly so in years of drought.

This year the Utah Power and Light Company used steam power plants during the nonirrigation season and permitted water which ordinarily would have run into Great Salt Lake to be impounded in irrigation storage reservoirs. This water was sold to irrigation companies to help avert the water shortage. Thus, advance informa-
tion on probable streamflow made available by streamflow forecasting techniques can be useful in many ways in helping to avert severe drought.

Since the program was originally initiated by the Utah Agricultural Experiment Station, a considerable volume of weather information has been collected in Utah mountains by agencies collaborating in the snow survey program. This information may eventually serve purposes far beyond those of streamflow forecasting. These data are already being used in hydrologic and meteorologic research. In these days when weather control is an important and far reaching objective of the great nations, the body of information made available by the snow surveying program may serve national security purposes.

The mountains are our water producing areas. How can we manage these areas to increase the water yield and still maintain the soil cover? The data collected in the snow survey program will contribute materially to the answer of this important question.

FARM RESOURCES
(Continued from page 71)

of income taxes. However, the amount available for family living could be reduced greatly depending on the supply of family labor and the extent of farm indebtedness and interest.

Returns for labor and management of the operator

Total labor required on these farms ranged from 3,754 to 5,388 hours. Hired and contract labor varied from 542 to 1,388 hours. The labor of the operator is limited to 2,500 hours so that family labor was 1,200 to 1,500 hours on these farms.

As farm size gets larger, more management is required. But returns to management also increase. The smallest farm returns $1.25 per hour to the operator for 2,000 hours of labor. The other three farms each return $1.25 per hour for 2,500 hours of operator labor plus $375, $1,375, and $2,375, respectively, for management. The return for the labor and management of the operator is $2.25 per hour on the largest farm.

Some efficiency factors on these farms

As pointed out earlier, much of the investment expense remains relatively constant over the size range of these farms. It becomes profitable, then, to increase acreages and livestock numbers so that buildings and equipment can be used efficiently. Of course, lack of capital and other obstacles often prevent achievement of the higher and more efficient levels of operations.

Gross income was around $230 per acre on all four sizes of farms. This constancy arose because acreage and dairy cow numbers were tied closely together by an assumption that all forage would be produced on the farm. The ratio of acreage to cows was about 2.5 to 1.0.

Gross income per dollar of investment ranges from $0.29 on the smallest farm to $0.32 on the largest farm. Cash expenses as a percentage of gross income range from 58 to 55 percent as farm size increases.

Investment per dollar of operator earnings declined substantially as size increased—from $22 to $14 at the $2,500 and $5,500 levels. Or stated differently, operator earnings increased 120 percent while total investment increased only 43 percent between these two extremes of operator earnings.

The ratio of operator earnings to gross income was about the same (20 to 22 percent) for the three largest income farms. This ratio was only 15 percent on the smallest farm. This may be attributed primarily to the fact that certain costs are the same (fixed) for each size of farm. Therefore, costs are relatively higher on the small farm and, in turn, total income needed to achieve the specified operator earnings is relatively high.

The gross value of output per hour of all labor increased from $4.30 to $4.71 as farm size increased. The capital investment per hour of labor was about the same on all farms or nearly $15. The total capital investment per acre of irrigated land declined from $800 to $735 as size increased, another indication of greater efficiency on the larger farms in terms of income.

What a dairy farmer could earn

On the basis of a 40-hour week, a farmer could earn a wage for his labor of $1.25 per hour on a grade A dairy farm of 70 irrigated acres and 27 milk cows and 5 percent return on his total investment of about $56,000. If he worked an average of 48 hours per week and had a capital investment of $80,000, including 109 acres of irrigated land and 43 milk cows, he would earn $2.25 per hour for his labor and management under the assumptions of this study. This income would be enhanced substantially for him and his family, depending on their equity in the farm and the time the family worked on the farm. Assuming no hired or family labor, one man would have to work an average of 10 to 15 hours every day of the year to meet the work requirements on these farms.

NEW CROPS BUILDING
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ture will be essentially completed when a third greenhouse is added and several plant growth chambers are installed. It is anticipated that the total investment will be between $750,000 and $800,000.

The main building is 170 x 40 feet and has three floors with 20,-400 square feet of floor space. There are ten offices and six laboratories on the main floor and fourteen offices and nine laboratories on the second floor. A large work area on the main floor is available for greenhouses. In addition to the machinery and furnaces,
the basement has a large cold storage room, dark room, transfer room, conference room, storage room, growth chamber, and four laboratories.

The support building is 160 x 27¾ feet in size and has a 30 x 20 foot soil sterilizer room attached to the east end. This facility has room for a limited amount of automobile storage. As it can be heated, it will be used for research work and storage as needed.

The two greenhouses 130 x 32 feet in size, each has five 26 x 32 foot sections equipped for summer cooling.

DISEASE RESISTANCE IN TURKEYS

(Continued from page 75)

is still lowest in strain 4 with strain 7 also low. Strains 4 and 7 are lowest for all three diseases while strain 5 is highest for all three. Strain 5 mated pure has a high of 11.3 percent for sinusitis and drops to 1.7 percent among cross-strain matings. Strain 9 sires again do poorly when mated to all strains of females; however, strain 9 sires mated solely to strains 9 and 1 females show some increase in mortality (4.9 percent). This is nicely explained by the fact that strains 9 and 1 are closely related genetically, giving an inbreeding effect. The same pattern is repeated with cross strain sires 7 x 1. Here the mortality is 6.2 percent when 7 x 1 sires are mated to all female strains, but jumps to 11.9 percent when mated to only strains 9 and 1, then drops to a low 2.9 percent by eliminating strain 9 and 1 females.

These three figures show rather well the high susceptibility of strain 5 and the relatively good resistance of strain 4. Intermediate responses of strains 7 and 9 are less attractive although they do represent the median classes generally encountered in quantitative inheritance of this type. It would be expected that even greater strain differences could be realized under a deliberate selection program with controlled pathogenic challenges to identify weak and strong genetic types.

research reports

Sheep losses from halogeton poisoning prevented by using dicalcium phosphate

Sheep losses caused by eating halogeton can be prevented by use of dicalcium phosphate, a common feed supplement. Alfalfa pellets containing 5 percent dicalcium phosphate can be fed to protect the sheep against the poisonous oxalates in the weed.

Halogeton may contain from 8 to 30 percent oxalates which may kill sheep in 9 to 11 hours by depleting blood serum of its calcium content or by forming oxalate crystals in the kidneys. Apparently dicalcium phosphate ties up the oxalates in the intestinal tract or is readily absorbed by the blood to replace calcium removed by the poison.

This finding is a result of the research conducted under the direction of Dr. Wayne Binns of the Agricultural Research Service in cooperation with the Utah Agricultural Experiment Stations.

Newly-bred ewes were grazed on several separate ranges infested with the weed in experiments conducted near Arco, Idaho. Of the 41 ewes that conceived, 13 bore "monkey-faced" lambs. The scientists believe that the fetus is affected within 7 to 17 days after conception. In drylot feeding experiments, deformed lambs resulted when ewes were fed the weed during the first 30 days after conception.

These experiments suggest that the toxicity of false hellebore to lamb embryos depends upon such factors as soil and water conditions, the altitude at which the plant grows, and its stage of development when eaten by the ewes. The exact conditions required are not known.

Deformed lambs develop only after ewes have grazed on certain high-altitude summer ranges during the breeding season that starts
about Aug. 10. The deformity has been known to occur for the past 50 to 60 years only in parts of southeastern Idaho, although the weed also grows on ranges in Utah, Wyoming, and Colorado. The condition, which causes losses to sheep producers of $15,000 to $75,000 each year, has never been found in sheep bred outside these areas.

This malformation affects only the heads of lambs. A slightly deformed upper jaw may be the only indication of the conditions, but in extreme cases — called complete cyclops — lambs may have only a single eye in the center of their heads. Monkey-faced lambs born alive are killed by sheepmen because the lambs have trouble nursing.

Prolonged gestation, in which lambs grow to excessive size in the ewes, is another condition often associated with consumption of the poisonous weed. Lambs, during long gestation, can become two to four times normal birth size, are always severely deformed, and cause ewes to die.

Alfalfa seed germination increased by exposure to electric energy

Brief exposure to radio frequency (r-f) electric energy increased germination of alfalfa seed 35 percent in laboratory studies conducted by USDA scientists at the University of Nebraska. They found that 95 percent of alfalfa seed containing a high proportion of hard seed germinated after being treated 28 seconds with r-f energy at a frequency of 39 megacycles per second and a field intensity of 3,000 volts per inch. Only 60 percent of identical untreated seed germinated.

Storing the treated seed for two years did not change its acquired ability to germinate.

Smaller germination increases were also observed in other legumes. Exposure to r-f increased germination of red clover from 74 to 86 percent.

Scientists have not yet learned whether germination due to r-f treatment results from chemical or physical changes in the seed or from both. Exposure to r-f heats seeds and chemically changes the sugars of certain varieties. Exposure also increases the capacity of some hard seeds to absorb water, which seems to be a likely cause of increased germination.

Unusual softening and discoloration of Montmorency cherries

A fruit processor reports that the cherries from four orchards were graded in his plant as fancy (high quality) by the state inspector. However, when these cherries were soaked in water, as a regular practice in the processing industry, in an attempt to firm them and to facilitate pitting, they became progressively more colorless in a few hours and in the process of pitting they became soft and subsequently turned brown. The frozen product graded poor. This rapid change from excellent to poor quality took place within 2 to 3 hours. Similar drastic changes were evidenced in cherries harvested from one other orchard. When these cherries were soaked in tap water for a few hours the pits were at the bottom of the tank and the brown flesh and the skin were floating at the top.

In an attempt to inhibit the softening of the cherries they were treated with calcium chloride and alum. To inhibit browning they were treated with ascorbic acid. It was thought that this softening, discoloration, and subsequent discoloration might be the result of microbial growth; hence, the cherries were treated with D.H.A-S and potassium sorbate. No beneficial effects of these chemicals, singularly as well as cumulatively, were evidenced.

The malady was discussed with several experienced growers, professors, faculty members at the Utah State University, Dr. John Brekke, food technologist at the Western Utilization Research Laboratory, Albany, California, and Dr. Charles Bedford, professor of food technology, Michigan State University, East Lansing.

Several of them thought that the malady might be due to the sprinkler irrigation which might have done physical damage to the fruits and such damage might be accelerated by soaking. Others thought that the damage might be due to the high fertility of the soil; however, these orchards had not been fertilized in the last four years. Many thought that powdery mildew might be the cause of softening; however, we were unable to find any powdery mildew in the orchards. Some thought that the age of the orchard might have something to do with the condition of the fruit. Usually tender fruits are produced in young orchards. Some thought that these unusual changes could be due to the high temperature (over 100° F.) and dry season just before harvest which may have "cooked" the tender fruits on the trees and upon putting them in cold water the biochemical (enzymatic) reactions that are responsible for softening and discoloration of anthocyanins may have been accelerated.

We shall appreciate hearing of any ideas on or experience with this malady and its control.

—D. K. Salunkhe and Anson B. Call, Jr.

Effects of fluorides in the air on human beings

Gross histological and chemical studies conducted on 127 human cases, 18 of which came from industrial areas known to have elevated fluoride levels in the atmosphere and on the vegetation, indicate that these levels were not responsible for gross or histological changes in soft tissues or bones of humans.
ADDITIONS TO THE STAFF

Dr. Jack T. Spence, assistant professor of chemistry at USU since 1958, is replacing the late Dr. Norman Bauer on the Station staff. Dr. Spence received his bachelor’s and doctor’s degrees from the University of Utah and has done post-doctoral research at the University of Oregon.

Miss Lois M. Cox was appointed assistant editor April 1, 1961. Miss Cox has a B.S. degree from the University of California at Davis and has had considerable experience in technical editing. A third of her time will be spent in University research.

Elmer C. Clark, formerly extension poultryman, and recently returned from the University of Maryland where he received his M.S. degree, is a new addition to the research staff in poultry husbandry. Prof. Clark will do research in poultry physiology.

Dr. J. LaMar Anderson is an addition to the staff in pomology. Dr. Anderson took his M.S. degree from Utah State in 1955 and his Ph.D. from the University of Wisconsin in 1961.

Dr. John Cary, soil physicist in the Agricultural Research Service, will take over part of the research of Dr. Sterling Taylor. Dr. Taylor is on leave for a year on a National Science Foundation Grant. He will study and do research at the University of Brussels in Belgium.

Dr. Cary received his Ph.D. degree from Utah State in 1961.

Other projects of Dr. Taylor will be undertaken by Gaylen Ashcroft, assistant professor of soil physics. Mr. Ashcroft is a graduate of USU in soil physics and is completing the requirements for the doctorate at Oregon State University.

Jack Keller, assistant professor of irrigation engineering, will take the position on the research staff formerly held by Jay M. Bagley who has transferred to the Engineering Experiment Station. Prof. Keller, who came to Utah State in 1960, received his B.S. degree from the University of Colorado and his M.S. degree from Colorado State University.

Dr. Willy J. Derksen is a new assistant professor of agricultural climatology. Dr. Derksen received his education in Holland and holds the Drs. degree from the University of Amsterdam. He has worked for five years at the Netherlands agricultural university at Wageningen. His research at USU will be in the area of microclimatology.

Dr. Johannes Storz has been appointed assistant professor of veterinary science effective October 1. Dr. Storz is a native of Schramberg, Germany, and received his veterinary training in that country. After practicing for a year he came to the University of California where he received his Ph. D. degree in 1961.

When the U. S. Department of Agriculture dairy research herd was moved from Huntley, Montana, to Logan, David Kopland, who had had charge of the herd for thirty years, was transferred to Logan. He will continue here with the breeding projects begun with the herd in Montana.

Dr. Melvin J. Anderson, dairy nutritionist, Agricultural Research Service, will also work with the Department of Dairy Industry. Dr. Anderson received his B.S. degree from Utah State and earned his Ph.D. at Cornell University. He was on the staff of the University of Maine before coming to Logan.

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NEW PUBLICATION


This publication is a review of literature on the subject of evaporative drying with special reference to soils.

Single copies of this publication will be sent free on request to the Utah Agricultural Experiment Station, Logan.