Fruit "flavor" is a combined effect of olfactory and gustatory sensation. The olfactory sensation depends upon volatiles in minute quantities in fruits. The response of taste buds to these volatiles and other nonvolatiles (such as sugars, acids, tannins, etc.) is enhanced by chewing or munching. These components cumulatively characterize a specific food flavor. Sweetness, tartness, and astringency are measured by classical methods for testing sugars, acidity, and tannins, respectively. Aroma exists in fruits in very, very minute quantities, however.

The use of gas-liquid chromatography provides a means of measuring fruit volatiles. The complicated requirements of today's flavor research call for quantitative determinations on the picogram level. A picogram is 0.000000000001 gram. By contrast, 454 grams equal 1 pound. Utah State University's gas chromatograph, shown on the front page, is capable of measuring such tiny amounts. Such a precise instrument makes a chemist more honest and a food technologist more realistic. D. K. Salunkhe and L. E. Olson, Department of Plant Science, check some experimental results.

This instrument is providing competition for the human nose. Because fruit aroma is a complex mixture of many volatile compounds, measurement requires the aid of instruments and techniques such as the gas chromatograph, infrared spectrophotometer, and thin layer chromatography. USU is currently conducting research in cooperation with National Institutes of Health (grant EF-00449-01) to identify, characterize and confirm the complex aromas which, for instance, make a peach, a peach of a peach!
CONTROLLING HEAT WITH HORMONES

WARREN C. FOOTE and DOYLE J. MATTHEWS

The continuing cost-price squeeze on agricultural products is forcing livestock producers to use extra ingenuity in management methods to insure maximum efficiency of production. One of the newer areas of interest is hormonal modification of normal physiological processes of animals.

Both in the feedlot and in the breeding herd, estrus among cattle causes problems in management. In the feedlot the occurrence of estrus in nonpregnant heifers increases the activity in all of the animals which may result in decreased rates of gain.

Breeding the heifers will stop this restless situation but pregnant heifers receive a heavy price discount from buyers because of lowered dressing percentage caused by the fetus and associated fetal materials.

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Spaying heifers is expensive in addition to the other risks involved. In the breeding herd, young and small heifers must be managed separately from the rest of the herd to avoid pregnancy before they are sufficiently mature.

Such management is usually inconvenient and results in additional cost. If this special attention is not provided during breeding, heifers with inadequate development will be bred which results in increased difficulty at calving, smaller calves, and greater problems with rebreeding.

SYNTHETIC HORMONES

Many of the hormones used in the control of reproduction in domestic animals are synthetic and are referred to as progestogens. They have actions which are similar to the hormone progesterone which is produced in the ovaries of the female. These hormones act to inhibit heat and are used extensively in controlling many reproductive processes. It was thought that progestogens might increase rate of gain by decreasing activity associated with estrus and also promote gaining efficiency in other ways similar to those resulting from use of other hormones such as stilbestrol.

Proper treatment with these hormones might also allow the running of young replacement heifers or other females with the breeding herd for a desired period of time without their becoming pregnant. It would be of more practical value if the total effect could be induced with only one treatment.

During the winter and spring of 1964, a series of field trials were undertaken with 2 primary objectives, (1) to determine the influence of a long acting progestogen on weight gain and suppression of estrus in feedlot heifers and (2) to determine if a progestogen administered as a single dose could effectively keep heifers, that were running with the breeding herd, from being bred.

FIELD TRIALS COMPLETED

Three field trials were completed to determine the effect of a progestogen (promone) on rate of gain and inhibition of estrus in feedlot

Figure 1. Occurrence of estrus in feedlot heifers increases activity with resultant decrease in gain rates. In a field test, 131 Hereford and crossbred feedlot heifers were separated into 3 groups. Two received hormones to inhibit heat while the third bunch received none and acted as a control group.

F O R  S E P T E M B E R  1 9 6 5

63
heifers. In the first trial 131 Hereford and crossbred feedlot heifers and in the second trial 93 Aberdeen Angus feedlot heifers were tested. The animals in each trial were chute cut into 3 groups. One group received 150 mg, promone, 1 group received 500 mg, promone and the third group served as a control group receiving no hormone.

In the third trial 79 feedlot heifers were also chute cut into 3 groups. One group received 500 mg, promone, 1 group was implanted with 24 mg, stilbestrol and the third group was left uninjected to serve as a control.

The hormone was injected subcutaneously in the ear where it could not contain edible portions of the animal. The animals for each trial were housed together with no attempt to handle the treatment groups separately. Observations of heat were made at least once daily by the person caring for the animals. All animals were weighed at the beginning of the study and re-weighed at intervals during the feeding period with a final weight taken at the end of the study. Carcass grade, as determined by a federal grader, was recorded for each heifer in trial III.

HORMONE EFFECTS ON GAINS, GRADE

In trial I, control heifers averaged 1.35 lbs. gain per day for the total 202 day period as compared to 1.46 and 1.53 lbs. per day for the groups receiving 150 and 500 mg, promone, respectively (table 1). The difference between the control and the 2 treated groups when analyzed statistically was shown to be due to the effect of the hormone.

In trial II, the control group gained at an average of 2.40 lbs. per day for the total 113 day period with average gains of 2.55 and 2.55 for the treated groups (table 2). Although the rates of gain were higher in the 2 treated groups, differences are not large enough to be of statistical significance. The hormone was shown to increase rate of gain during the first period of the trial (65 days), however.

Although rates of gain were almost identical for the groups in trial III (table 3), there was some indication of a beneficial effect of promone on carcass grade (table 4). Forty-eight percent of the carcasses graded choice in the promone treated group as compared to 35 percent in the control group and 27 percent in the stilbestrol treated group. Thirty percent of the promone treated group graded good, whereas 19 percent and 27 percent graded good in the control and stilbestrol groups, respectively.

Twenty-two percent of the promone group graded standard while 46 percent of the control group and 46 percent of the stilbestrol group graded standard. Although the number are too small to allow conclusions to be drawn it appears possible that promone may have improved carcass grade.

STUDY FACTORS

Weather conditions, especially during the first part of the winter, were severe and appeared to affect the response of all animals. This is indicated by the low rates of gains by animals in trial I and also by the fact that stilbestrol failed to increase rate of gain in trial III. It is also important to recognize that because the animals for each trial were run together, any advantage of a quieting affect due to inhibition of heat in the treated groups would be minimized because of activity initiated by the occurrence of heat in the control animals.

Observations of heat were not carried out carefully enough to give a complete picture of the effects of promone on heat. Only a few of

### Table 1. Average performance of heifers in trial I by treatment groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Initial number animals</th>
<th>Initial weight</th>
<th>Final weight</th>
<th>Average Daily Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12/13-1/15 (33 days)</td>
<td>1/15-3/17 (62 days)</td>
<td>12/13-3/17 (95 days)</td>
<td>12/13-7/2 (107 days)</td>
</tr>
<tr>
<td>Control</td>
<td>43</td>
<td>495</td>
<td>734</td>
<td>.88</td>
</tr>
<tr>
<td>150 mg. promone</td>
<td>44</td>
<td>509</td>
<td>812</td>
<td>.80</td>
</tr>
<tr>
<td>500 mg. promone</td>
<td>44</td>
<td>501</td>
<td>806</td>
<td>.84</td>
</tr>
<tr>
<td>Level of significance</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>n.s.</td>
</tr>
<tr>
<td>Average of total</td>
<td>—</td>
<td>502</td>
<td>791</td>
<td>.84</td>
</tr>
</tbody>
</table>

*Statistically significant (P < .05)
Table 3. Average performance of heifers in trial I by treatment groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Initial animals</th>
<th>Initial weight</th>
<th>Final weight</th>
<th>Average Daily Gain (greater than control)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1/2-3/4 (62 days)</td>
</tr>
<tr>
<td>Control</td>
<td>26</td>
<td>660</td>
<td>804</td>
<td>1.67</td>
</tr>
<tr>
<td>24 mg stilbestrol</td>
<td>26</td>
<td>635</td>
<td>791</td>
<td>1.86</td>
</tr>
<tr>
<td>500 mg promone</td>
<td>27</td>
<td>625</td>
<td>782</td>
<td>1.82</td>
</tr>
<tr>
<td>Level of significance</td>
<td></td>
<td></td>
<td></td>
<td>n.s.</td>
</tr>
<tr>
<td>Average of total</td>
<td>640</td>
<td>792</td>
<td></td>
<td>1.78</td>
</tr>
</tbody>
</table>

Table 4. Average results of carcass evaluation from heifers in trial III.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Carcasses</th>
<th>Choice (AA)</th>
<th>(AA) Percent</th>
<th>Good (A)</th>
<th>(A) Percent</th>
<th>Standard Number</th>
<th>Standard Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>26</td>
<td>9</td>
<td>(34.6)</td>
<td>5</td>
<td>(19.2)</td>
<td>12</td>
<td>(46.2)</td>
</tr>
<tr>
<td>500 mg promone</td>
<td>27</td>
<td>13</td>
<td>(48.2)</td>
<td>8</td>
<td>(29.6)</td>
<td>6</td>
<td>(22.2)</td>
</tr>
<tr>
<td>24 mg stilbestrol</td>
<td>26</td>
<td>7</td>
<td>(26.9)</td>
<td>7</td>
<td>(26.9)</td>
<td>12</td>
<td>(46.2)</td>
</tr>
</tbody>
</table>

*Differences were not statistically significant (P > .05).

the treated animals in all 3 of the trials were judged to have shown heat, however, while a high incidence was recorded in the control group.

PREGNANCY PREVENTION

A fourth field trial tested the effectiveness of the material in preventing pregnancy among heifers run in the breeding herd. Of the 134 heifers studied, 75 were injected with 500 mg promone and 59 served as controls. The animals in this trial were not chute cut. The heifers receiving the hormone treatment tended to be smaller than those in the control group. All animals were considered to have reached puberty prior to treatment.

Field trial IV was conducted to determine the effectiveness of this hormone in inhibiting pregnancy, by inhibiting heat and ovulation. The hormone was injected on June 9 and both treated and control animals were placed with bulls in the breeding herd on June 11. Pregnancy was determined 4 months later, October 9, by rectal palpation. Bulls were taken from the breeding herd on October 1.

HORMONE RESULTS

Based on the animals in which positive identification could be made (those still carrying ear tags) less than 2 percent of the promone treated heifers (1 in 75) were pregnant compared to 86 percent of the control group. These results show that this hormone administered as a single 500 mg dose is almost 100 percent effective in inhibiting pregnancy for a period of at least 80 days (assuming pregnancy can be determined by palpation at the forty-first day of gestation).

The results of this study do not provide any information concerning when the heifers would again show estrus or whether the treatment would influence subsequent fertility. They do show, however, that with the use of this hormone females can be run with the bull for at least 80 days without any real danger of their becoming pregnant. This practice might be important from a management standpoint under certain range conditions.

Pinyon Pine Gives Cheery Flame

Pinyon pine has been investigated as a fireplace fuel and results showed it to be long-burning, spark-free, and characterized by a cheery flame. Green pinyon showed an average moisture content of 70 percent, about 50 percent too high for optimum burning qualities. Upon outdoor exposure, split green pinyon dried to 20 percent moisture content in 3 to 4 weeks.

—Walter H. Johnson
Production and per capita consumption of fruit in the United States has substantially increased in the last 2 decades. Increasing attention is being given to processing, convenience, storage, and shipping to the distant market in order to effectively sell and utilize the expanding fruit production.

Demand for and acceptance of fruits and their products in diets is based upon quality — flavor, aroma, texture, color, and nutritive value. These quality factors are dependent on species, variety, maturity, processing, handling, and storage methodology. They are also correlated with the physical structure and chemical composition of the fruit. To maintain maximum quality either in fresh, stored, or processed fruits, it is essential to know the physiology and chemistry of these fruits.

In addition, we must know what specific changes take place in cells and tissues from the time of pollination and fertilization, during development, ripening, and over-ripening. Knowledge of what causes these changes and how these changes can be delayed or accelerated is necessary to retain maximum quality during storage of fruits and fruit products. Experiments along these lines are continuing in Utah State University laboratories.

**PHOTOSYNTHESIS**

The photosynthetic process, as it occurs in green fruits or leaves, is described by the classical equation in which carbon dioxide and water are taken up by the plant and synthesized in the presence of light to sugar with evolution of oxygen. The primary product of photosynthesis is sugar and photosynthesis is also the source of flavor, aroma,
ENZYMES

During the growth of fruits, many enzyme systems perform physio-chemical functions. Enzymes are organic proteaceous catalysts in fruits. They are among the most important constituents of fresh fruits. Through their action, synthesis and alteration of other constituents take place and metabolism processes necessary to the life processes in fruit are performed. Enzymes carry out specific reactions and are responsible for the chemical transformation essential to fruit life.

These enzymes play important roles in development and maintenance of color, aroma, flavor, texture, and nutritive value of our fruits and fruit products. Freshly picked apples become sweeter when stored at 30-35°F for 2 months because starch in freshly harvested apples is converted to sugar by a specific enzyme. Pigment development in fruits is directly related to the activity of a specific anthocyanase enzyme. A firm peach be-
**Sugars**

Glucose, fructose, and sucrose are the predominant fruit sugars. Sweetness of fruits is due to their presence. Total sugar content varies with variety, maturity, and storage procedures. Because of enzymatic activity, sugars are condensed into starch and, likewise, they (sugars) are hydrolyzed from starch during storage or processing. These sugars are consumed within the fruit during respiration which continues in the fresh fruit until it is processed or consumed. They are important attributes of quality of fruits and fruit products.

**Acidity and Astringency**

Sour taste of certain fruits is due to the acidity. Concentration of acids in fruits has certain physiological functions. They may be utilized during respiration while in storage or artificially ripened with chemical treatment. Citric, tartaric, and malic acids are the main acids found in fruits. Astringency of the fruit is due to the presence of substances such as tannins. Figure 4 shows equipment used for acidity and sugar analysis.

**Lipids and Waxes**

Lipids and waxes are present in...
Fruits and fruit skins. They are regarded as the products of metabolism. Cuticle waxes and lipids many times contain substances which are responsible for typical fruit flavors.

To measure flavor attributes, preference, and acceptability the food technologist submits samples of foods to a taste panel which rates them by such characteristics as sweetness, fruitiness, or tartness. These results also are confirmed by the use of pH meter, titratable acidity, refractive index, and chromatograms and then correlated with the taste panel scores.

AROMA

The quality which often attracts us to taste a particular fruit is the aroma. When our sense of smell is impaired because of a cold, our enjoyment of eating the fruit is greatly reduced. Fruit aroma is a specific characteristic of each variety. Aroma exists because a complex mixture of volatile compounds are present in the fruit in very small quantities. These compounds, which are the products of photosynthesis and enzymes, can be classified into types such as alcohols, aldehydes, ketones, and esters.

One of the most difficult problems in fruit chemistry is the separation and identification of the components of the volatile mixture comprising the aroma. This difficulty exists because of the minute amounts present and the complexity of the mixture.

One of the newest and most versatile techniques for the study of fruit volatiles is gas-liquid chromatography, sometimes referred to as gas chromatography (figure 1). A nonvolatile liquid chosen for its absorbive properties called the liquid phase is coated on a porous inert substance which is placed in a column or a tube. An inert carrier gas, such as nitrogen or helium, is then passed through the tube under controlled temperature conditions into a detecting device.

The volatile aroma components of the fruit are injected into the gas-chromatograph column and are carried along by the carrier gas. Because the various components of the
mixture are attracted to the liquid in the column packing in varying amounts, they travel at different rates through the column and become separated from each other. Each component passing through a thermal conductivity or dual flame ionization detector at the end of the column is measured and the amount is continuously inscribed by a recorder attached to the chromatograph.

Not all of the components may be completely separated where complex mixtures are involved and auxiliary treatments may be necessary to effect separations. The chromatogram produced by the recorder shows peaks for each component, the size of which are proportional to the amount of each particular component. While the gas-chromatograph is useful in separating fruit aroma components, it is necessary to use other means, such as infrared spectrophotometry (figure 2) or thin layer chromatography of derivatives of aroma components, for identification of each component. It has been found in our laboratories that varied chromatograms are obtained from differences in species, varieties, maturities, storage duration and conditions, processed products, and growing conditions (figure 5).

Information pertaining to biosynthesis of fruit flavors is notably lacking. Hence, problems of a fundamental nature are under investigation from the standpoint of formation and subsequent deterioration of aroma and flavor. This involves the isolation, characterization, and identification of aroma and odor components. This enables us to better understand flavor changes in fresh, stored, and processed fruits. Such analyses will need to be compared and correlated with subjective sensory evaluation by a trained panel of tasters (figure 3).

COLOR

Fruit color results from compounds called pigments which are located in the various parts of the fruit. These pigments are concentrated in the minute structures called chromatophores or plastids in cells. The color of the green fruit is due to the presence of chlorophyll a and b. As the amount of chlorophyll decreases, carotenoids increase and continue to increase after chlorophylls have disappeared. Some of the common pigments present in tomatoes, peaches, and apricots are lycopene, carotene, and anthocyanin.

The amounts of pigments found in fruits varies with species, varieties, maturities, seasonal variation, regions in which they are grown, and growing and fertility conditions (figure 6).

TEXTURE

Fruit texture is related to fruit hardness or firmness. It is also related to the arrangement and composition of the cells within the fruit. Two of the fruit components which influence firmness are cellulose and pectic substances. Cellulose is the principal cell wall constituent of fruit. Turgidity of the fruit and fruit products is related to the cellulose and other adhering constituents such as pectic substances.

Pectic substances are principally found in the intercellular spaces. They are complex colloidal carbohydrates, believed to function as a cementing material binding cells together.

Pectic substances appear to be laid down in plants in the greatest amount during the early growing stages of the fruit and undergo a definite pattern of change during development and ripening. As fruit ripens, proto-pectin is broken down by the action of the enzyme, protopectinase, to soluble pectins and pectic acids. This process causes softening and loss of fruit texture.

To some degree the texture is a characteristic property of the fruit species but much can be done to affect the texture by carefully controlling such factors as post-harvest temperature and humidity around fresh fruit. Processing procedures greatly influence the texture of processed products (figure 7).

NUTRITIVE VALUE

While the nutritive value of fruits and fruit products may not be a deciding factor in the choice of a particular fruit, it is still important. If the fruit is of high quality it can be an important source of carbohydrates, vitamins, minerals, and proteins. Fruits are an excellent source of carbohydrates, usually pleasantly flavored and a delight to consume. Fruits are important sources of vitamins, particularly A, B, B, B, and C. In general, the higher the quality of the fruit in other respects, the higher the vitamin content of a particular species.

The mineral and protein content of most fruits is not high, but many are good sources.

HIDES GO MODERN

Collagen, the essential protein of animal hide, will be dissolved, spun into fibers, made into films or sheets, and evaluated by scientists of the Midwest Research Institute, Kansas City, Mo., under a 2-year contract awarded by the United States Department of Agriculture.

This contract work is part of an effort to find new uses for cattle hides. Because synthetic materials are being used increasingly in shoes and other items formerly made of leather, U. S. hide supply now exceeds the domestic demand.

To meet this competition from synthetics, the leather industry is considering using only the center portions of hides in making leather. These would provide a more uniform raw material and permit a streamlining of leather-making processes. For this practice to be economically feasible, however, some profitable outlet would have to be found for the belly and other parts of the hide that would be cut away.

The scientists will treat the belly portions of cattle hides in various ways and prepare dispersions of collagen from them. Films, sheets, and fibers made from the collagen dispersions will be analyzed and evaluated for potential use as industrial raw materials.
Problems of Labeling

Staphylococci

PAUL B. CARTER
DHARMENDRA V. ARYA

Not even the miracle drugs have been able to control, much less erase, *Staphylococcus aureus* infections. This ubiquitous microorganism is the most common cause of localized pus-producing infections in man. It also is responsible for many cases of infection in other animals.

The versatility of these obnoxious organisms is a prime factor in their successful survival in today’s drug-conscious world. They can be isolated from the skin, mucous membranes, or gastrointestinal tract of individuals who are apparently in excellent health. *S. aureus* are also found routinely in soil, water, sewage, milk, foodstuffs, and air. In fact, these problematical organisms may be isolated from almost any source.

**STAPHYLOCOCCOSIS IN UTAH TURKEYS**

Many strains of staphylococci are involved in diseases of Utah turkeys. Accumulated evidence indicates that these strains do not originate from a single source. Some strains cause death of the birds throughout the growing period of the flock. Other strains do their damage early in the season and then disappear. Still other strains are not detected until late in the growing season. Thus, an outbreak of turkey staphylococcosis apparently is a continuing series of attacks, first by one strain, then by another.

Many disease-causing bacteria have been controlled by immunization, better sanitation, elimination of insects, or by treatment of the infected patient with drugs. The staphylococci, however, have been more resistant to such treatments. For example, the staphylococci met the threat from antibiotics by developing antibiotic-resistant strains. As a result, many antibiotics are now worthless for treating certain staphylococcal infections. Such infections appear to be more numerous and more virulent than before antibiotics came into use.

**IDENTIFYING STAPHYLOCOCCI**

The widespread distribution of staphylococci and the existence of the numerous strains make it exceedingly difficult to identify the origin and trace the pathways of outbreaks of infection. While major staphylococcal epidemics comparable to the common contagious diseases do not occur, the minor outbreaks can cause considerable distress. The pattern of these eruptions suggests that a single epidemic strain is the culprit. But how can the guilty strain be identified? Identification must precede control.

In bacteriology, the term “strain” theoretically refers to a single kind of bacterium that may or may not show minor differences from the type organism. The differences are referred to as strain differences. These differences may represent a temporary or permanent change from the principal type. “Type,” in turn, commonly designates a group of organisms that belong to the
same species but differ in antigenic structure or some other characteristic.

To further complicate the situation, a given characteristic of a microorganism may change from one day to the next. Stable characteristics must be identified before adequate classification can be achieved.

Strains of *S. aureus* have commonly been grouped by noting differences in biochemical activities, by antigenic analysis, on the basis of variations in susceptibility to parasitic virus (bacteriophage typing), and by testing the sensitivity of the organism to antibiotics. These methods have shown considerable variation and are not always reliable.

**BIOCHEMICAL ACTIVITIES**

Early classifications of microorganisms were based mainly on the size, shape, motility, and color of the bacterium as it grew on the proper food or medium. As our knowledge of chemistry increased it became apparent that certain biochemical properties of microorganisms could be used to differentiate microorganisms. Some of the biochemical activities used for classification are: Ability to break down certain sugars (fermentation), nitrogen requirements, vitamin requirements, oxygen requirements, and ability to produce certain products such as enzymes.

With many microorganisms, biochemical identification can be made through fermentation tests. Such tests have not been too useful with staphylococci, however, since the results are notoriously inconsistent. Even when a pure culture is grown on a suitable medium, it is unusual for 2 colonies to give identical biochemical results. Certain strains of staphylococci can be differentiated on the basis of their fermenting manitol, but in general, such processes are unsatisfactory.

One biochemical reaction has proven useful, however, in separating pathogenic (disease producing) staphylococci from nontoxic producers. The pathogens produce an enzyme-like substance called coagulase. This substance causes the clotting of oxalated or citrated blood plasma. At the present time the coagulase test is universally accepted as identifying disease-producing staphylococci. But this is far from identifying a specific strain.

**ANTIGENIC ANALYSIS**

When so-called antigens gain entrance into an animal body, they stimulate the tissues to produce substances called antibodies. Each purified antigen is specific in action since each one will combine only with the "matching" antibody. If a given strain of staphylococcus has some unique antigenic structure(s), a test can be devised to demonstrate these characteristics and identify the strain. Since the antibodies are found in the blood serum, this method of differentiation is often called serological classification.

A number of subgroups of pathogenic staphylococci have been established on the basis of agglutination, precipitin reactions, and complement fixation tests. These are routine techniques used to demonstrate the combination of an antigen with its specific antibody. In most laboratories, however, serological tests do not discriminate finely enough to permit recognition of staphylococcal strains isolated from widely separated places or at different times.

**ANTIBIOTIC SENSITIVITY**

The increasing resistance of staphylococci to antibiotics has been used as a method in differentiating strains. Freshly isolated organisms are tested against a variety of drugs and their susceptibility recorded. The pattern is termed antibiogram. Some indication of the epidemic strain can be obtained in this way. Changes occur rapidly in antibiotic sensitivity, however, and it is doubtful that this characteristic is sufficiently stable to be used as a good method of tracing epidemics.

**BACTERIOPHAGE GROUPING**

Bacteriophages are viruses that parasitize bacteria. Different phages attack different bacteria and this specificity can be used in identifying unknown bacteria. The sensitivity of a given bacterium to a given phage can be detected by applying a drop of a phage suspension on a Petri dish culture of the bacterium. A clear zone at the point of applica-
tion of the phage indicates susceptibility of that particular bacterium to that phage. If the bacterium is not parasitized by the phage, the bacterial growth over the Petri dish will be uniform (figure 1).

There would be a distinct advantage in using a set of phages, each of which was type-specific and would only lyse (dissolve) a single type of staphylococcus. Type specific phages are not common, however, nor has it been possible to adapt phages to a single staphylococcal type. Most strains of staphylococci must be characterized by "pattern reactions" which represent the susceptibility of the strains to various combinations of phages.

The International Subcommittee on Staphylococcal Phage Typing has recommended that a set of at least 21 phages should be used for routine grouping of staphylococci. With this number of phages, the known staphylococci can be subdivided into 5 groups. The groups are broad, and fine distinctions within each group are based upon the pattern observed. This method has been invaluable in differentiating staphylococci where conventional biochemical and serological tests have failed. Not even this sensitive test, however, can be used to identify all staphylococcal strains.

PHAGES AND TURKEY STAPH
Utah State University personnel have isolated numerous staphylococcal strains from sick and dead birds. Many of these strains could not be identified by the means of bacteriophage testing. In addition, day-to-day variations in the organisms produced changes in the phage patterns.

As a result, the staphylococci could only be assigned to broad groups, and differences between the individual strains were not demonstrated. Since adequate control depends to a large extent on knowing precisely what is to be controlled, a study was begun to try to find a better way to identify staphylococci.

INFRARED SPECTROPHOTOMETRY
In the course of the search we decided to try some physicochemical methods such as infrared spectrophotometry.

When infrared radiations pass through a substance certain wave lengths are absorbed and certain wave lengths are transmitted. Each substance has a characteristic pattern. Specific chemical groupings are identified by their transmitting bands in certain parts of the infrared spectrum. For example, the phenyl group, which contains the benzene ring, absorbs at 3.25 and 6.75 microns (figure 2).

Thus, the infrared spectrum of a substance demonstrates small chemical differences that are important in identifying organic compounds. It seemed reasonable to think that the subgrouping of the phage-established staphylococcal groups might be facilitated by infrared spectroscopy.

The infrared region lies between the visible and the radio regions of the spectrum. This means it involves the wave lengths between one one-thousandth of a millimeter and one millimeter in size. The region most useful for our work was between 10 microns and 14 microns. A micron equals one one-thousandth of a millimeter.

VALID PROCEDURE
To test whether infrared spectrophotometry was a valid means of differentiating staphylococci, various strains of *S. aureus* were isolated from sources such as turkeys, cows, humans, and milk. Phage groupings of these strains were established as fully as possible with the standard International Phages. Both typable and nontypable strains were included in the study.

In the majority of samples, the organisms were killed by placing the suspension in a boiling water bath for 5 minutes. Various physical methods, chemical agents, and antibiotics were used to evaluate the influence of the killing method on the infrared spectrum. After the staphylococci were killed, standard concentrations of the organisms were subjected to infrared analysis. Only small changes in the infrared spectrum were noted when different methods of killing the bacterium were used.

Spectra determined after a period of 9 months gave spectra similar to those prepared 9 months earlier except for slight differences in the maxima and the minima of certain bands.
STANDARD STRAIN

A sample of 1 typable strain was arbitrarily chosen as a standard. Samples of the other strains were then measured against the standard in an infrared recording spectrophotometer.

A total of 125 typable and non-typable strains of S. aureus were examined. The spectrum of each strain was compared to the spectrum of the standard strain. All of the typable strains had similar infrared patterns that closely resembled that of the standard. The standard and typable strains were designated as Group I.

Among the nontypable strains, however, 2 distinctly different spectral patterns were obtained (figure 3). The nontypable group was therefore categorized as either Group II-A or Group II-B on the basis of the infrared spectrum. The nontypable Group II-B strains differ from the Group II-A strains mainly by an additional band at 10.05 microns and lacking bands at 10.4, 10.65, and 13.6 microns. In addition, the bands at 11.5 and 11.8 in the spectra of the Group II-A strains were shifted to 11.6 and 11.85 respectively in the Group II-B strains. About 75 percent of the nontypable strains showed a spectrum that placed them in Group II-A and 25 percent were in Group II-B. All of the staphylococcal strains studied could be placed in 1 of these 3 groups on the basis of their infrared spectra.

POTENTIALS

Our progress in the study of the epidemiology of staphylococcal infections depends upon our ability to identify the strain involved in the outbreak. In the past we have been handicapped by the lack of ways to make fine discriminations among strains and by the day-to-day variations that occur when the organism is cultured in the laboratory. Any method which would help us eliminate these factors would move us toward control of the causative organism.

Since staphylococcal infections are becoming more prevalent and severe we must constantly search for better tools to identify the organism. At USU we are therefore trying to establish more precise definitions within each of the infrared spectro-photometric groupings.

The normal life cycle of an insect pest, the imported cabbageworm, can be upset by exposing it to flashes of light lasting less than one one-thousandth of a second, the U. S. Department of Agriculture reports.

Photoflashes given nightly when the cabbageworm (Pieris rapae) was in the larva or destructive caterpillar stage upset the growth sequence later in the life cycle. The insect developed from a pupa in its cocoon into an adult butterfly at a time when it normally would have entered a dormant stage called diapause.

This new photoflash technique may have potential value as a biological control method against insects. The entomologists say that if insects in their natural environment were forced to bypass diapause and develop into adults "ahead of schedule," the insects would probably be so out of step with nature that they would perish.

Diapause is a physiological state comparable with hibernation. Not all insects diapause, but it is a vital phase of the life cycle of many major insect pests. Diapause is directly controlled by hormones. Activity of the responsible hormones is influenced by environmental conditions such as temperature, humidity, and hours of daylight and dark.

The findings do not prove that photoflash can be used to control insects under field conditions. But this new knowledge is expected to heighten research interest in photoflash as a possible means of control.

The scientists point out one fact, however, that could have great practical significance: light treatments that alter insect development have little or no effect on plant development.

Many plant growth processes can be controlled by exposing plants to flashes of light during the night, but the kinds of light that affect plants and insects are quite different. Red light is most effective on plants whereas green light is most effective on insects. If plants and insects were affected by the same light treatment, an insect treatment might have an undesirable effect on the crop.

Light sources are now available that make insect light treatments in the field feasible. It may someday be desirable to conduct experiments with mobile — even airborne — lights to see if they can upset development of natural insect populations. At present there isn’t nearly enough basic information available for scientists to predict how extensively photoflash might be used as a practical control method.

Dodder Can Synthesize

Studies conducted at Utah State show that dodder is able to synthesize its own organic and amino acids, provided it has been supplied with the necessary nutrients from the host. Although the relative concentrations of certain amino acids appear to vary between host and parasite, the same amino acids were identified in both alfalfa and dodder. They were: lysine, arginine, histidine, asparagine, glutamine, serine, threonine, alanine, proline, tyrosine, valine, leucine, and isoleucine. Organic acids identified from dodder extracts were citric, malic, succinic, glutaric, and another compound thought to be pyruvic acid.

—Keith R. Allred
"Clothes make the man" is an old adage, the truth of which is being emphasized by today's research. The contribution of clothing to the development and adjustment of individuals and families is the primary concern of the teaching and research programs in the Clothing and Textiles Department at Utah State University.

Clothing becomes of greater importance to the individual during adolescence than at any other stage of the life cycle. Families with teen-age boys and girls spend a larger proportion of their income on clothing than families without children in this age group. Research shows that one of the primary areas of conflict between teenagers and their mothers is that of clothing selection. Young people's dress habits also are often in conflict with the codes of church and school.

Figure 1. A teen-age girl's clothing reflects both fad and current fashion. This type of dress shown, "in" this year, may be "out" next year.

Figure 2. Young fellows, desirous of "belonging" to the gang, nearly always reflect the dress of their peers.

Figure 3. High water, skin tight pants, dirty sneakers and a baggy shirt with tails flapping reflect the "casual" attitude of some teen-agers.
CLOTHING AND DEVELOPMENT

The preoccupation of adolescents with clothing is related to their physical, psychological, and social development. Clothing plays an important part in helping them to accept their changing physical bodies, to "belong" and gain status in social groups, and to gain self-esteem and self-confidence. Since the teen-years are the period during which a youngster seeks independence from his parents, he clings to his own age group for needed support. As a result he tends to conform to his own peer group in choice of clothing. He also tends to defy almost everything his parents and other adult authorities recommend.

A study was completed last year, at Utah State University, in which 349 girls in three Cache Valley high schools and the Utah State Industrial School were rated for appropriateness of their school dress and general appearance. These ratings were based upon the appearance of their hair, makeup, hands, and clothing. Results showed that girls who presented a good physical appearance in terms of the dress and grooming factors rated were more popular with their peers, had higher scholastic ratings and fewer behavior problems requiring disciplinary action than girls who were poorly groomed and inappropriately dressed for school. Additional research is planned to study the clothing choices of delinquent girls in relation to selected physical and personality characteristics.

COLOR, DESIGN, AND TEXTURE

Other studies at USU have provided evidence to support the concept that one's self is expressed in one's selection of color, design, and texture choices in clothing fabrics. A paired-choice fabric preference test has been developed in colored film slide form for use by teachers and research workers. The test is comprised of five series of slides. Three series test color preference with relation to saturation, tints and shades; strong and weak contrasts; and warm and cool colors. Preference for design size and textures also is tested.

Fabric choices of students, homemakers, and mental hospital patients have been statistically analyzed in relation to personality factors as measured by questionnaires and projective tests such as the Rorschach inkblot test.

SELF EXPRESSION

In one study, college women who evidenced a preference for small fabric designs also scored high on the good impression scale of the California Psychological Inventory (CPI). This was interpreted as reflecting the use of clothing to present the ideal self as unaffected, natural and modest, the factors being measured on the CPI. The students also projected a high feminine orientation into their preferences for small fabric designs. Those who chose bright colors were more outgoing and forward in their relations with
other people than students preferring pale colors.

A recent study with a group of Mormon Relief Society women in Idaho indicated a relationship between warm color preferences in clothing fabrics and one's attention to human relationships and empathetic tendencies.

Time management among college women has also been studied in relation to fabric color and design preferences. It appears from preliminary studies in this area that individuals who experience ease and success in the management of their time tend to prefer warm colors such as reds and yellows. On the other hand, women who express worry and concern about time seem to prefer more somber, cool colors, such as blue-green combinations.

**FASHION THERAPY**

Clothing has also become a valuable tool in the treatment of the mentally ill. A survey of "fashion therapy" programs being conducted in mental hospitals throughout the United States has recently been completed at Utah State University. Of the 236 hospitals replying to a questionnaire, 60 percent were using "fashion therapy" and an additional 19 percent were interested in learning more about such programs. This "therapy" usually takes the form of weekly classes in grooming, including skin care, use of cosmetics, wardrobe planning in relation to the individual, etc. The effectiveness of these programs has been described in terms of increased self-esteem and self-worth on the part of patients.

A study of the clothing fabric preferences of a group of psychotic mental hospital patients was conducted by the author several years ago. Results indicated that clothing may serve as an extension of the self for these people. Subjects who had weak body-image boundaries as measured through analysis of Rorschach ink blots tended to re-define or reinforce them by choosing fabrics with bright colors and strong figure-ground color contrasts. It was concluded from that study that since the confusion of psychotic patients often involves the limits of their own bodies, efforts directed at attempting to re-identify these limits through clothing should be valuable. This finding may help to explain the positive effects of "fashion therapy" in mental hospitals today.

These are but a few examples of the innumerable fruitful research areas that beckon those interested in clothing-oriented behavior. Researchers at Utah State University will continue to report the results of their current and future exploration into the relationships between man's behavior and the garments he wears.

**YOUNG HENS PRODUCE BETTER EGGS**

As hens grow older their eggs are more valuable for processing into liquid, dried, and frozen products.

Since the eggs of younger hens contain more thick white — preferred for table use — this finding suggests that consumers, producers, and processors alike could benefit from use of eggs on the basis of the layer's age.

Processed products now absorb about 10 percent of the 160 million cases of eggs produced annually.
Up-grading irrigated pastures...

Grasses can be productive

KEITH R. ALLRED

Pastures are valuable in a live-stock program because they provide the least expensive feed to producing animals. Not too many years ago pastures were regarded as "exercise yards" and were not considered to have a place in the regular rotation of cultivated land. More recently, however, research has shown that pasture crops can be profitably included in rotations on the better farm land and that, when properly managed, they will provide their fair share of farm income.

SECOND IN SERIES

This is the second in a series of articles reporting some of the results of a five-year pasture study. The series stresses management techniques that will aid the farmer or rancher in obtaining the best returns from his irrigated pastures. The first article dealt with "The Role of Alfalfa" and appeared in Utah Science 26:36-39, June 1965. This article will consider management factors that are important to attaining maximum returns from all-grass pastures.

The study was conducted at the Greenville Experimental Farm in North Logan, Utah, from 1960 to 1965. The soil was a Millville silt loam. Design of the experiment and management treatments imposed on the pasture mixtures were described in detail in the previous article and are, therefore, only briefly outlined here.

PRODUCTIVE GRASSES

Tall-growing grasses that can produce substantial quantities of good forage are available for use in improved irrigated pastures. Some of these include: orchardgrass, smooth bromegrass, intermediate wheatgrass, reeds canarygrass, and tall oatgrass. Tall fescue and tall wheatgrass are useful on marginal soils with moderate salinity but would not be included in mixtures with the other tall growing grasses on good irrigated land.

Although the value of legumes in improved pastures is recognized, interest is increasing in the productivity of nitrogen-fertilized grass grown without associated legumes. Nitrogen fertilizers are available at reasonable prices throughout the Intermountain Region. The tall growing grasses respond more satisfactorily to applications of nitrogen than do the low growing grasses such as Kentucky bluegrass and red top.

It may occasionally be necessary or desirable to grow pastures that contain only grasses. Such situations may occur when (1) mixtures containing grasses and legumes are seeded but the legumes fail to become established, (2) the pasture is a few years old and the legumes have gone out due to winter killing or mismanagement, or (3) the farmer has had so much trouble with animals bloating on legumes that he wants to plant only grass pastures.

What then should be done to obtain maximum production from the grass, and is it possible to produce enough quality forage from grass alone to make such a pasture program worthwhile?

GRASS RESPONSE TO MANAGEMENT

The all-grass mixture included in the study consisted of commercial orchardgrass (Dactylis glomerata L.), and Manchurian smooth bromegrass (Bromus inermis Leyss.). Seeding rates in pounds per acre were: orchardgrass, 8; and bromegrass, 12.

At the end of the establishment year (1960), plots seeded to this mixture contained 65 percent orchardgrass and 35 percent bromegrass.

KEITH R. ALLRED is an associate professor in the Department of Plant Science.

FARM AND HOME SCIENCE
EFFECT OF CLIPPING FREQUENCY

Dry matter yields for the all-grass mixture during the four years of the study ranged from a high of 4.44 tons in 1962 for the best treatments, to a low of 0.81 tons per acre in 1963 for the least beneficial (table 1). Production was fairly uniform from one year to the next under similar management treatments. The highest yields were obtained when the plots were irrigated at five-day intervals (I-4) and fertilized with 200 pounds of nitrogen (F-4) per season. However, irrigating at 10-day intervals (I-3) with the high rate of nitrogen (F-4) produced nearly as much forage. During the four years, the yield from the I-4, F-4 treatment averaged 4.33 tons per acre compared to 4.19 from the I-3, F-4 treatment.

It should be noted that four tons of dry matter (moisture-free basis) is equivalent to five tons of field cured hay.

Table 1. Yields of dry matter for the all-grass mixture as influenced by irrigation and nitrogen fertilization when harvested four times a season (1961-1964)

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Fertilization</th>
<th>1961</th>
<th>1962</th>
<th>1963</th>
<th>1964</th>
<th>Average</th>
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<tr>
<td>I-1</td>
<td>F-1</td>
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<td></td>
<td>F-2</td>
<td>1.89</td>
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<td>3.74</td>
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<tr>
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</tr>
<tr>
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<td>4.44</td>
<td>4.12</td>
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Forage quality, as measured by protein content, was significantly better from the plots harvested five times. The forage averaged 16.6 percent protein from the C-2 plots and only 14.5 percent from the C-1 plots. This two percent difference is accounted for by the fact that the forage was less mature at
ach harvest when clipped five times during the growing season. Under some conditions a farmer may be willing to sacrifice the small yield difference in order to obtain a higher quality forage.

**EFFECT OF NITROGEN FERTILIZATION**

The largest yield response of the all-grass mixture was associated with the application of nitrogen fertilizer (table 1). Grasses can not fix nitrogen as legumes do, but must depend on applied nitrogen or nitrogen that is released from decaying organic matter for their growth and development.

Dry matter production was very low on plots that did not receive nitrogen fertilization. When harvested four times a season (C-1) the unfertilized plots produced only 1.23 tons per acre. The increased production of the nitrogen fertilized plots over the unfertilized plots amounted to 0.73, 1.31, and 2.71 tons per acre when 50-, 100-, and 200-pounds of nitrogen were applied per acre, respectively (table 2). This increase in yield was consistent during each of the four years of the study.

With nitrogen priced at above 13 cents per pound, "50 pounds would cost $6.50 and would produce three-fourths tons of additional dry matter. One-hundred pounds costing $13.00 would return 1.3 tons while 200 pounds of nitrogen would return 2.7 tons of dry matter at a cost of $26.00. The farmer would have to add in the cost of applying the fertilizer and this would vary depending on the method used.

**STRIKING RESPONSE**

The most striking response of the grass mixture to nitrogen fertilization can be seen when forage production is presented for each harvest during the growing season (figure 4). The upper part of the figure shows forage production for each of four harvests (C-1) while the lower part shows production for five harvests (C-2), at the four levels of nitrogen fertilization.

The F-1 treatment received no nitrogen fertilization at any time.
during the course of the experiment. F-2 received 50 pounds in mid-April of each harvest season. F-3 received 50 pounds in April and 50 pounds after the first harvest. F-4 received 50 pounds in April and 50 pounds after each of the first three harvests. No nitrogen was applied for the fifth harvest of the C-2 plots.

The grass mixture responded to each application of nitrogen fertilizer. At each harvest, plots that had been fertilized with nitrogen produced at least double the forage that was produced by the unfertilized plots. There was very little carryover of nitrogen from one harvest to the next (figure 4). When 50 pounds of nitrogen were applied at the initiation of growth of the grass either at the beginning of the growing season or following a harvest, it was essentially all used to produce forage during that growing period.

LOW YIELDERS

The unfertilized plots were consistently low yielders. On the F-2 plots forage production was good the first harvest but dropped to levels equivalent to those of the unfertilized plots for the second, third, fourth, and fifth harvests. The F-3 plots yielded well when fertilized for the first and second harvests but then dropped to levels equivalent to the unfertilized plots for the remainder of the season. The F-4 plots were fertilized four times and maintained forage production throughout the first four harvests. On this treatment there was some carryover into the fifth harvest on the C-2 plots.

There was no significant difference in the percent protein of the forage as a result of applying nitrogen. Percent protein for the nitrogen fertilizer treatments were: F-1, 15.8; F-2, 15.6; F-3, 14.9; and F-4, 15.9.

IRRIGATION FREQUENCY

Irrigation frequency had a significant effect on the amount of dry matter produced by the all-grass mixture (table 1). Plots which were irrigated frequently gave greater forage yields. Grasses have a fibrous root system that spreads out and permeates much of the topsoil. They obtain most of their water and nutrients from the upper foot or two of soil. On the other hand, legumes, like alfalfa, that have deep tap roots are capable of obtaining water from a depth of several feet in the soil.

The highest yields were obtained when water was applied every five (Continued on page 92)

**RECOMMENDATIONS**

On good cultivated soils in the Intermountain Region all-grass pastures cannot be expected to yield as much as improved legume-grass pastures when both are managed to provide maximum yields. However, if a farmer decides he wants all-grass pastures, he will get his best production by following these management practices:

- Plant tall-growing grasses capable of high production under good management.
- Use a rotation grazing system that will provide a 30-day minimum recovery period between grazings.
- Irrigate at 10-day intervals and apply approximately 2 inches of water per irrigation.
- Apply four annual nitrogen applications of approximately 50 pounds each. An early spring application could be made and then an application following each grazing. Irrigate within two days after applying the nitrogen. If sprinkler irrigation is used, the fertilizer could be applied in the irrigation water.
- Maintain fertility of the soil by applying phosphorus and other elements as required by the grass.
- Do not seed the pastures into winter "grubbed into the ground." Allow some cover to remain as a protection against winter-killing.
- When water is available in the fall irrigate the pastures so that they will go into winter with moisture in the soil.
One of the most persistent and difficult problems faced by the Utah State Land Board is that of determining what to charge for special uses of state lands. The special uses that are most commonly requested include non-grazing surface uses such as recreation developments, commercial sites, or sub-division developments. Features such as location, climate, and topography often define the special use potentials of a particular site. It is up to the Land Board to define leasing terms and fees.

A study recently completed by economists at Utah State University has dealt with the problem of pricing special uses of state lands. Specifically, the study was designed to formulate a framework that could guide decisions about special-use lease fees. This article summarizes that study.

**POLICY OBJECTIVES**

The question of special-use fees cannot be considered apart from the objectives toward which Board operation and policy are directed. Given the objectives, determination of appropriate policies and procedures becomes a more consistent process. For fee levels, the question to be answered is whether Board objectives necessitate policies (and fee levels) directed toward the "social good" or whether they have a narrower monetary orientation.

Based upon legal opinion, a strong case can be made for a monetary-oriented goal for management of State lands. The position of State land agencies as interpreted by the Judiciary was recently summarized in a legal opinion of the Attorney General of California. While this opinion was directed specifically at problems in California, the similarity of enabling laws in all Western states relative to grant lands permits general application of the opinion. The following quotation indicates the general tone of the opinion.

"The state holds title to school lands in trust...The state cannot abdicate its duty as trustee any more than it can surrender its police power in the administration of government and in the preservation of peace and order and it cannot divert the land from its trust purpose, either by a direct donation or through the medium of estoppel. So, it is without power, as trustee, through legislative means or otherwise, public or private, at the expense of the cestui que trust, the public school system of the state, or to alienate the school lands without receiving their full value."

A more specific reference to monetary goals is made in summarizing the ruling of a Nebraska court in the case of State vs. Board of Education Lands and Funds, 1954. The opinion says:

"This case went further in declaring invalid a state statute providing a schedule of rentals for state school lands on the grounds that the receipt of such lesser amounts was contrary to the trusts under which the state held lands. The state was said to have a duty to obtain the maximum return from the use of granted school lands consistent with the preservation of the trust estate."

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E. BOYD WENNERGREN is an associate professor in the Department of Agricultural Economics. N. KEITH ROBERTS is a professor in the Department of Agricultural Economics.
Other comparable legal references can be cited to support the opinion that state lands are to supply monetary support for the school system and other designated recipient institutions.

**FEE SETTING BASES**

Special use fees are subject to many of the economic forces which operate in our economy to establish prices for market place commodities. The potential users and the Board naturally attempt to establish use fees which are beneficial to their individual interests.

The willingness of the user to pay relatively high fees or of the Board to accept relatively low fees reflects the alternatives available to each. In a free bidding situation, the fee that is established will depend upon the bargaining strengths and alternatives of each party.

Specifically, 5 interacting factors influence fee levels: (1) the productivity of the land to be leased, (2) the number of lessors having suitable special use lands available for lease, (3) the number of lessees desiring use of the land, (4) the returns a lessor can expect from the next best alternative lands, and (5) the cost to the lessee of the next best alternate special use lands.

**LAND BOARD'S STANDPOINT**

From the Board's standpoint, fee levels reflect expectations regarding the long-run productivity of the land. In estimating that productivity, all alternative potentials for the lands (other rental uses or sales to private ownership) should be considered. As a general rule, the Board should never be willing to accept a fee if some alternative use would yield a greater monetary return. Likewise, the expected annual return from a fee should at least equal the potential yield from the best alternative.

In other words, the minimum fee the Board should be willing to accept should be based on the appraised value of the land and be at least equal to the yield possible from the best alternative use of the land. If the Board can realize 4 percent on invested capital, 4 percent of the appraised value of the land would constitute an acceptable minimum fee. For example, if the land were appraised at $200 per acre, the minimum annual fee the board should be willing to accept is $8.00 per acre.

On the other hand, users usually have alternative lands to consider which may satisfy their needs. A potential state land user will not pay a fee substantially in excess of the amount he would have to pay for his next best alternative. If the user's best alternative was leasing for $12.00 per acre, he would not be willing to pay more than this amount for use of the state land.

The conditions cited in the 2 examples constitute a situation in which the Board's minimum fee is $8.00 and the user's maximum fee is $12.00. The actual fee could be established within these limits through a bidding procedure. A competitive bidding procedure would best protect the interests of the Board. Either a sealed or public bidding type procedure could be used. The choice would depend upon the conditions of each particular lease negotiation, i.e., number of interested users, etc. Regardless of the procedure used, it would seem most wise for the Board to withhold its fee estimates until an appropriate time in the negotiation.

**OTHER CONSIDERATIONS**

While establishing the initial fee, consideration also must be given to the likely need for subsequent alterations. These are especially probable when long term leases are involved. The Utah State University study indicates that long term contracts might properly be adjusted periodically on the basis of some appropriate price index that reflects changes in the general level of the economy. Such a prenegotiated adjustment arrangement permits both lessor and lessee to participate in economic changes that occur over the life of the contract.

The study also recommends the use of a fee system requiring a specified annual lump sum payment or one combining variable fees with the guaranteed lump sum over one based on a completely variable payment. Under a variable fee system, the annual fee is computed each year on the basis of net revenues or some other productivity measure. Lump sum fees involve less risk to the Board since they guarantee a

Figure 2. The population explosion, ever increasing mobility, improvements in trailers and pick-up-camper combinations have increased the pressure on present camping areas and the demand for development of new sites.
New vs. Old Seed for

FALL WHEAT PLANTING

WADE G. DEWEY

Numberous inquiries are received each year from Intermountain wheat growers concerning the relative merits of year-old seed vs. seed of the current year's crop for planting purposes. The questions take various forms: Is newly harvested seed slow to germinate? Does it require an after-harvest rest period? If so, how long? Do varieties differ in this regard? The issue involves only winter wheat, since with spring wheat there is normally an 8 to 10-month lag between harvest and planting.

The controversy concerning new vs. year-old seed is one of long standing. Interest has intensified in recent years as the time gap between harvest and planting of winter wheat has narrowed. Whereas harvesting operations used to involve most of the summer and early fall, the increasing use of bigger and more efficient harvesting equipment makes it possible for even the largest operators to complete the harvest within a 2- to 3-week period. Under the former conditions, seed harvested at the beginning of the harvest season was usually from 4 to 8 weeks old before planting operations began. In the latter situation harvest and planting frequently are separated by no more than 2 to 3 weeks, and in some cases actually overlap.

COMMON PLANT PHENOMENON

Seeds of many plants, both crops and weeds, are known to require varying periods of time following harvest or maturity before they will germinate. This period may involve a few days, a few weeks, or it may extend for several months or even longer. Various terms have been used to describe this condition. Common among these are dormancy, after-ripening, and rest period. Seeds in this condition have been compared to an automobile with its motor running, but with the gears disengaged.

This dormancy or rest period is actually a protective mechanism which nature has devised to aid in the survival of a plant species. The embryo in an ungerminated seed is well buffered against adverse conditions. Once germination begins, however, the young plant becomes vulnerable to a multitude of hazards. Ofttimes delaying germination for a few weeks or months beyond maturity of the plant places the seedling in more favorable growing circumstances. This situation prevails, for example, with a number of plants whose seeds mature in the fall, but whose seedlings are not sufficiently hardy to withstand the winter.

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Figure 1. Comparative germination of new vs. year-old seed of 8 winter wheat varieties after 2½ days of incubation.
Various workers have reported evidence of post-harvest dormancy in wheat. Most reports have indicated that, where present, the dormancy is generally of relatively short duration. Considerable variation between classes of wheat, (e.g., soft white vs. hard red), and even among varieties within a given class, has been observed.

**NATURE OF THIS STUDY**

The object of this particular investigation was to ascertain the possible presence and duration of post-harvest dormancy in either of the 8 leading winter wheat varieties grown in Utah. Varieties tested were: Cache, Wasatch, Utah Kanred, Delmar, Itana, Tendoy, Gaines and Brevor. The first six are hard red, dryland varieties. The latter two are soft white, irrigated wheats.

The study was carried out in 1964 and consisted of two parts, a germination series and an emergence series. Newly harvested seed of each variety, and seed which had been harvested for periods of 1, 2, 3, 4, 5, and 6 weeks, was compared for germination with year-old seed. Two hundred seeds of each variety and seed age combination were germinated on blotter paper in plastic dishes and a daily germination record kept over a 3-week period. An emergence test was carried out concurrently in greenhouse pots. Daily counts were made as the seedlings emerged from 1½ inches of soil.

**EFFECT OF SEED AGE**

Figures 2 and 3 show the rates of germination and emergence for each of 5 seed ages, when averaged over the 8 varieties. Several conclusions are apparent. New seed germinated much more slowly in the plastic dishes than did year-old seed. Dormancy was not complete in the new seed, but germination was sluggish until the 10th day, when the dormancy appeared to break. Week-old seed was also slower to germinate than year-old seed. The delay was much less pronounced than was the case with new seed, however. By the time seed had aged for two weeks it germinated nearly as well as year-old seed.

An interesting difference was noted between germination and emergence rates for new seed. Whereas less than 50 percent germination in the plastic dishes was observed during the first nine days, over 50 percent emergence took place in the greenhouse pots by the end of the fifth day. This would tend to cast some doubt on the straight germination test as a valid measure of seed dormancy under field conditions. Apparently conditions in the soil were more conducive to germination of new seed
than were conditions in the plastic dishes.

Figure 4 shows the relative emergence and growth of new and year-old seed of the eight varieties nine days after planting. Differences were much smaller than would have been predicted from the germination data.

Although the rates of germination and emergence for seed which had been harvested for less than two weeks fell below the corresponding rates for year-old seed, total germination and emergence for all age groups at the end of the 3-week test period were essentially equal.

**VARIETAL DIFFERENCES**

New seed of all varieties germinated more slowly than did year-old seed (figure 1). Significant differences were observed in the germination rates of several of the varieties when averaged over all seed ages, however (figure 5). Brevor was noticeably slower germinating than the rest. Delmar, which has Brevor as one of its parents, was also slightly below the average of the group in rate of germination. Cache, Wasatch and Utah Kanred germinated relatively rapidly and were so similar in germination pattern that they were averaged together. It can be noted from figure 5 that germination fell off rapidly after the first three days, but that a jump in germination occurred for all varieties on the 10th-11th days. This late “spurt” can be wholly attributed to the “new seed” group which was averaged in with the other seven age groups in making up the graphs.

The emergence patterns for the eight varieties resembled very closely the germination picture (figure 6). Brevor emerged significantly slower than the other varieties. Delmar was somewhat intermediate in emergence rate. If rates of germination and emergence are disregarded, the varieties were quite comparable, since all varieties had germinated between 95-97 percent and had

![Figure 4: Comparative emergence of new vs. year-old seed of 8 winter wheat varieties 9 days after planting.](image1)

![Figure 5: Rate of germination (non-cumulative) of 8 winter wheat varieties averaged over 8 seed ages.](image2)
Rate of emergence (non-cumulative) of 8 winter wheat varieties averaged over 5 seed ages.

Days after planting:
- a = 0-3
- b = 4
- c = 5
- d = 6
- e = 7
- f = 8-9
- g = 10-11
- h = 12-14
- i = 15-21

TENDOY ITANA BREVOR DELMAR GAINES CACHE, WASATCH & UTAH KANRED (Avg.)

Figure 6. Emergence patterns for the 8 varieties resembled very closely the germination picture.

emerged between 93-95 percent at the end of the 3-week period.

PRACTICAL IMPLICATIONS
Considering the 8 winter wheat varieties tested, newly harvested seed appears to be at a definite disadvantage, as seed wheat, when compared with year-old seed. Germination conditions on the drylands during late summer are frequently marginal or are favorable only for short periods following storms. The difference between good and poor stands of winter wheat may well depend on how rapidly seed germinates and seedlings become established. Although new seed, when placed under optimum conditions, may eventually reach a total germination percentage comparable to that of year-old seed, the slower rate of germination of new seed could be a serious drawback under the less-than-optimum conditions which usually prevail in the field.

Except possibly for the variety Brevor, the post-harvest dormancy effect appears to be relatively short-lived in the varieties examined. Seed which had been allowed to “after-ripen” for 2 to 3 weeks between harvest and planting, germinated and emerged essentially as well as year-old seed.

If year-old winter wheat seed is available, it would appear advisable to use it as seed wheat in preference to seed from the current year’s crop, if planting is to follow within three weeks of harvest. Beyond that time, year-old seed would seem to offer little, if any, advantage.

WHAT CROPS ARE SALT TOLERANT?

Studies at the US Salinity Laboratory, Riverside, Calif. have established the relative salt tolerance of vegetable crops as follows:

*Good tolerance*: Garden beets, kale, asparagus, spinach.

*Moderate tolerance*: Tomatoes, broccoli, cabbage, potatoes, lettuce, sweet corn, peppers, squash, carrots, onions, peas, cucumbers.

*Poor tolerance*: Radishes, celery, green beans.

A ready-reference table has been developed for determining the permissible number of salty water irrigations, assuming there is no salt accumulation in the soil. Water containing 1,920 ppm total salts, for example, can safely be used for seven irrigations on asparagus or other vegetables with good tolerance, for five irrigations on moderately tolerant cabbage, and twice on easily damaged radishes.

The amount of salt in water can be determined by measuring its electrical conductivity. Technicians of USDA’s Soil Conservation Service or the Utah Agricultural Experiment Station can tell farmers where to send their water samples for analysis.

Panguitch Pastures Produce

Production from pastures on the Panguitch farm in 1963 was highest ever recorded. Plantings made in 1962 and grazed for the first time in 1963 had a measured carrying capacity in excess of 280 cow days per acre. These data are based on actual grazing records and do not take into account the fact that 75 percent of the grazing animals had calves. A hundred pounds of nitrogen increased yields about 1 ton. High yields of hay and pasture demonstrate the value of improved irrigation systems, land leveling, and a fertility program in the Panguitch area.

—Rex F. Nielson

CONTRIBUTIONS TO RESEARCH

May 1 to July 1, 1965

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FOR SEPTEMBER 1965
Managing the Milk Supply

RONDO A. CHRISTENSEN

Producer cooperatives are actively engaged in efforts to manage the supply of market milk in Utah, and have been for many years. Their objectives are twofold — to reduce seasonal variation of production, and to maintain a proper balance between total supply of market milk and consumption of milk in fluid products. This report discusses the methods used and the success cooperatives have had in achieving these objectives.

SEASONAL VARIATION

Seasonal variations in producer deliveries of market milk lead to serious marketing problems. While the quantity of milk needed for use in fluid products does not vary much throughout the year, demand is lowest in June and July and highest in September through November. On the other hand, farmers in Utah as well as in most milk sheds tend to deliver much more milk in May and June than in the fall. If regular sources of supply are adequate in the fall, when producer deliveries are lowest and demands for fluid milk are highest, a surplus of milk above fluid requirements will exist in most months, reaching a peak in the spring flush period.

Manufacturing facilities must be sufficient to utilize this seasonal surplus. The greater the variation between seasons, the less efficiently can plants operate.

Seasonal variations in milk deliveries, including market and manufacturing milk, in Utah were extremely high in the 1930's, varying as much as 60 percent from low to high months (figure 1). Seasonal variation changed widely from year to year and was 31.5 percent in 1936, the year before the fall premium plan was adopted.

FALL PREMIUM PLAN

In 1937 a newly organized producer cooperative adopted a fall premium pricing plan in an effort to reduce seasonal variation of milk deliveries. Under the fall premium plan, money is set aside in specified spring months to be added to payments to farmers in specified fall months. The result is an increase in differences between fall and spring milk prices, and a price incentive for producers to switch some of their spring flush production to the short-supply period in the fall.

This fall premium plan did not level out producer deliveries rapidly enough and the cooperative abandoned the plan at the end of 1937.

BASE-EXCESS PROGRAM

In search of a more effective system, the cooperative adopted and used a base-excess program in 1938. This plan tied a producer's seasonal incentive to his own efforts. Each producer was given a base equal to...
his average daily deliveries of milk the previous fall.

Milk shipped by each producer in excess of his base was classified as excess milk. By allocating the proceeds from fluid sales to base milk first, a substantially higher price was paid to producers for base milk than for excess milk. The price differential was supposed to provide producers an incentive to switch some of their spring production to the fall to establish as large a base as possible and to maximize the percent of their total production that could be sold at the base rather than the excess price.

The base-excess plan, like the fall premium plan, was abandoned after a year's trial use. Because of its newness on the market, producers did not fully understand nor appreciate the purpose for which the plan was developed.

Seasonal variation of total milk deliveries in the state remained high during World War II and most of the rest of the 1940's, averaging 48.5 percent during the 10-year period.

**RENEWAL OF BASE-EXCESS PLAN**

Efforts by cooperatives to reduce seasonality of market milk deliveries were renewed in 1948. In that year the first mentioned cooperative began again to use a base-excess plan. By 1954, all 4 major dairy cooperatives in the state were using such plans. More and more milk began to be produced under base-excess pricing as market milk increased from 39 percent of all milk produced in the state in 1948 to 74 percent in 1963.

The results were dramatic. Seasonal variations in total milk deliveries decreased from 54.5 percent in 1948 to 19.4 percent in 1964. Since base-excess plans are used only in pricing market milk, seasonality of market milk production has been reduced even further. During 1948, the first year for which data are available, seasonal variation of market milk deliveries was 28.0 percent; by 1963 the variation had dropped to 11.1 percent.

The decrease in seasonality of market milk production, which accompanied the greater use of base-excess pricing, is in marked contrast to the change in seasonality of manufacturing milk production for which no such program is employed. Seasonal variation in producer deliveries of manufacturing milk amounted to 52.9 percent in 1951, the first year for which data are available. The variation still amounted to 45.2 percent in 1963.

**SUPPLY-CONSUMPTION BALANCE**

When base-excess pricing was reintroduced in Utah in 1948 the supply and consumption of market milk were in excellent balance. About 85 percent of market milk was being used for fluid milk products. This is about as high a fluid utilization as can be expected on markets producing their entire supply and not relying on outside supplemental sources in times of short supply. Some reserve is necessary because of seasonal and day-to-day variations in production and consumption.

By 1952 the percent of market milk used for fluid purposes in Utah had dropped to 71 percent, and by 1957 it had dropped to 64 percent.

**MAINTAINING A FAVORABLE BALANCE**

As the supply-consumption balance deteriorated, the cooperatives began using base-excess plans in an effort to control the level of total deliveries of market milk. At least they tried to restrain increased production, rather than simply to shift production to the fall months. The cooperatives did this by changing the amount of base that could be built from year to year with a given increase in production during the base-building period. It was theorized that the more liberal the base building rules the greater the incentive to increase deliveries in order to increase base. The more restrictive the rules the less incentive there is. The base-excess operations of 3 Utah dairy cooperatives were analyzed to determine how effectively they controlled annual changes in total producer deliveries of milk. The study period included 1955 through 1961. Success varied by cooperative. Data on the cooperative receiving the most favorable producer response are presented here to illustrate the control that
has been possible through the use of base-excess pricing plans in Utah.

AN EXAMPLE COOPERATIVE
The cooperative operated a well defined, well publicized, and tightly administered base program. Base-building rules for the coming year were announced to producers well in advance. Exceptions to the rules were seldom made, and then only in cases of extreme hardship. Upon approval, base could be transferred among producers, making it possible for new producers to enter the market by buying base. Base was not given to new producers, however.

The base-building period generally included the months of July through November. Base building was closed, however, during 1960. Base and excess prices were used in paying producers during the entire study period, except from June through December 1956.

Base-building incentive ratios (the pounds of base that could be built by increasing average daily production 1 pound) and percent changes in average daily deliveries of milk from year to year were calculated for both total deliveries and deliveries per producer. This was done for 2 time periods — base-building periods and production years (table 1). Production years (the 12-month period beginning with the base-building period) were studied to determine if the changes experienced during the base-building period resulted in similar changes during the entire year.

BASE-BUILDING INCENTIVE
The relationship between changes in base-building incentive is obvious. Producer deliveries of milk can be seen graphically in figure 2. Trend lines show the index of average daily deliveries of milk per month both on a total and on a per producer basis, with January 1955 equal to 100. Base-building months are shaded. The relative incentive to build base is noted above the trend lines.

During 1960, when base-building...
was closed and there was no incentive to increase deliveries, total deliveries actually declined somewhat. Deliveries per producer dropped back seasonally to the level of the previous year. During 1955 and 1958, however, when base-building was open, but on a restrictive basis, the normal seasonal decline in the fall did not occur. It was partially offset by efforts to increase deliveries during the base-building period. Some peaking of deliveries in the fall after the normal peak in the spring emphasizes this point.

During 1956, 1957, 1959, and 1961, when base-building was the most liberal, producers increased, rather than decreased their deliveries during the fall. Efforts to increase average daily deliveries and build base apparently caused producers to more than offset the seasonal decline which normally would have occurred.

Each year the base-building is open, producers respond by increasing deliveries of milk to new and higher levels. Evidently, the greater the incentive to build base, the greater the increase in deliveries. This type of response can be expected, however, only if producers are fully informed and understand base and excess pricing and base-building programs. If base-building programs are rigidly administered, and if producers know that under normal circumstances no individual exceptions or special adjustments in base will be made, incentive is increased.

**PRODUCTION CHANGES**

Changes in base-building incentive constitute only 1 of many reasons why producers change their level of production. Correlation between changes in base-building incentive and producer deliveries of milk during both base-building periods and production years was +80 percent. The correlation between changes in base-building incentive and total deliveries of milk was not as high. It was only +70 percent during the base-building periods and +59 percent during production years. These figures indicate that production changes adopted during the base-building period were not always continued throughout the remainder of the year.

These findings indicate that base-excess pricing plans, if properly constructed and rigidly administered, can be used to reduce seasonal variation, and, to some extent, control total supplies of market milk. They are presently adequate for controlling seasonal variation of deliveries. Improvement in structure and method of operation is needed, however, if they are to be completely adequate as a device for controlling total supplies of milk.

A peanut fancier with a weight problem will have less to worry about in the future.

A new low-calorie peanut can now be produced by a process that removes 80 percent of the oil, and three-fourths of the calories, leaving intact their original good flavor and high protein content. When the new product goes into commercial production it should open up new markets for peanut farmers, whose production has been climbing faster than the public’s appetite for peanuts.

Exploratory studies, at New Orleans, have shown that the same process used with peanuts might be used to produce low-calorie pecans, walnuts, almonds, Brazil nuts, chestnuts, cashews, and other nut meats.

The procedure is simple: Shelled nuts are brought to a proper moisture content and pressed in a hydraulic press to remove most of the oil, which constitutes about 50 percent of the peanut’s weight. The pressed kernels are flat and misshapen, but they return to their original shape and size when soaked in water.

Salt, sugar, spices, or other flavorings can be added during this “reconstitution” period.

After the low-calorie nuts are dried, they are ready for eating as is, for roasting, or for use in candies and other foods.
Grasses can be productive

(Continued from page 81)

days. There was not much reduction in yield when the irrigations were at 10-day intervals, however. Considering the extra cost of frequent irrigations, the most practical recommendation is to irrigate at 10-day intervals.

Increasing the irrigation interval to 15 or 20 days resulted in a considerable reduction in dry matter. For comparative purposes, unfertilized plots (F-1) irrigated at 5-day intervals (I-4) produced 1.45 tons while at 20-day irrigation intervals 1.02 tons of dry matter per acre were produced (Table 1). Plots receiving high rates of nitrogen (F-4) averaged 4.33 tons when irrigated frequently (I-4) but only 3.55 tons when irrigated at 20-day intervals (I-4). This points out not only the value of frequent irrigations but also the improved efficiency of grass in using nitrogen fertilizer when water is available at frequent intervals.

Satisfactory Treatments

The highest yield of quality forage from the all-grass mixture was produced with the C-1, I-4, F-4 treatment combination. Since it is difficult and costly to irrigate as frequently as every five days, the most practical combination was the C-1, I-3, F-4 treatment. Over the 4-year study this practice produced an average of 4.19 tons of dry matter per acre per season. This was only 0.14 tons less than the best treatment.

Forage production would be reduced by extending the irrigation interval to 15 or 20 days or by limiting the amount of nitrogen applied to 50 or 100 pounds per acre.

Good yields of high quality forage can be obtained from all-grass pastures, but careful attention to detail is essential. Proper nitrogen fertilization must be combined with frequent irrigation and rotational grazing if production and utilization of the forage are to be optimal.

Special uses fees

(Continued from page 83)

fixed annual amount. The combination type fee offers the additional opportunity to share in any unexpected productivity which might occur.

Sanitation control

Leasing and subsequent developing of state lands almost invariably lead to questions of sanitation control. Obviously control of waste disposal in the interest of preventing water and other contamination is a relevant consideration. The degree of Land Board responsibility for insuring compliance with sanitation requirements should be decided through official state policy action, however.

It seems most reasonable to assign sanitation control to a more appropriate state agency than the Land Board. This is not to suggest sanitation problems be ignored by the Board. But their responsibility seems reasonably limited to inserting a conditional statement in all contracts requiring lessee(s) to comply with all local and state sanitation requirements.

Enforcement of the contract itself should lie with duly authorized state and local agencies who are qualified both by experience and law to handle such problems. Such an arrangement would not penalize the Board and its recipient institutions by imposing responsibilities which may inhibit attainment of the Board's prescribed objectives.