Cover Picture: Trays containing "puff" dehydrated apricot, sour cherry, and peach juice powders. During World War II research was undertaken to develop powdered fruit juices in U.S.D.A.'s Western Utilization Research Laboratory, Albany, California. In spite of unpleasant memories of dehydrated foods during the war, dehydrated foods have found an important place on American markets because of their ease in handling, transportation, storage, concentrated nutritive value, rapid reconstitution, stability, and above all, high quality. Considerable research work has been conducted in the Albany laboratory on powdered fruit products and as a result several of these powdered juices have been placed on the market. Incidentally, the "puff" dehydration method was developed at the Albany laboratory. Dr. D. K. Salunkhe, associate professor of food science and technology, has been working cooperatively with the Food Technology group at the Albany laboratory for the past ten years on the several projects of mutual interest. The article presented in this issue is a result of cooperative study to determine the feasibility of using Utah-grown fruits for juice powders. Dr. Salunkhe believes that these products have tremendous implications in our economy as well as in food preservation methods.

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Director D. W. Thorne and Dr. Sterling A. Taylor, professor of soil physics, returned in early August from a mission to Venezuela where they went at the request of the U. S. Agency for International Development. Dr. Taylor helped design and set up three experiment stations where soil and water problems will be studied. These stations are now in the process of construction, crops are being planted and irrigation systems installed.

Dr. Jacob Kijne, who is now studying for his doctorate at USU will return to Venezuela early in January to take charge of the research work. Dr. Taylor will return in the spring to evaluate the program.

Dr. Thorne advised with the Venezuelan government in the planning of irrigation research and in training programs for research scientists in that country.

Cleon Cotter is now acting as information specialist for both the Agricultural Experiment Station and the Extension Service. Cotter will be responsible for general information releases pertaining to the Station's research program. He replaces Courtney Brewer who is now working full time for the Extension Service.

Dr. John E. Butcher, associate professor of animal husbandry, attended a special seminar in statistics during the summer at North Carolina State College, Raleigh.

Dr. J. LeGrande Shupe flew to Ireland during August to testify at hearings on fluorine damage.

Daryl Chase, President Utah State University
Wynne Thorne, Director Agricultural Experiment Station
Gladys L. Harrison, Editor
federal grant lands in utah

OBTAINING MAXIMUM RETURNS

E. BOYD WENNERGREN
N. K. ROBERTS

INSURING appropriate returns in the public interest from Utah's federal grant lands is the concern of those charged with their custodial management. A clear understanding of the possible alternative ways to achieve this goal necessarily must precede its realization. The benefits that may be derived from various management alternatives must be known before valid judgments can be made as to which will permit realization of the highest possible level of worthwhile returns. In a previous article in this series (Utah Farm and Home Sci. 24:38-39, 45. 1963) we took a position in opposition to any general indictment of Land Board policy which is carried to the point of prohibiting consideration of the sale of federal grant land in Utah. A blanket "no sale" policy is not in the best interest of the state, and certainly does not insure proper management of the lands retained. In fact, the sale alternative is one of the two major ways in which the Utah State Land Board may insure maximum returns to the surface use of these lands. The other major alternative is to hold the land.

The sale of all state land

First, let us consider the impact on surface revenues from the hypothetical sale of the approximately 2,900,000 acres of land currently held by the state. The potential returns which might be realized from sale of all state land at various average prices are summarized in table 1. The interest returns have been calculated on a per acre basis. For example, if funds received from selling land at $2.50 per acre were invested at 3 percent interest annually, an equivalent of $.08 per acre would be realized. Such a return exceeds the $.047 per acre realized from 1960 grazing fees reported in an earlier article (Utah Farm and Home Science 24:14-15, 24-25. 1963). It also undoubtedly is a conservative estimate of the potential selling price. Historic prices have been somewhat above this minimum, particularly in more recent years, and interest potentials may reasonably be expected to be somewhat above 3 percent. Higher rates of interest and higher sales prices would obviously generate still higher interest returns.

In addition to the interest revenue, benefits from the sale of the land would also include new tax sources.

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Fig. 4. Conversion of fruit juices into sponge-like material for rapid drying. Note bubble formation.

FRUIT JUICE POWDERS

Another outlet for Utah fruit

D. K. SALUNKHE, GLENN G. WATTERS, DORIS H. TAYLOR, and JOSEPH Y. DO

PROGRESSIVE expansion of the fruit juice industry during the last ten years is due to the recognition of the nutritive value of fruit products and also to the increased demands brought about by improvements in the quality of the products.

Acceptable quality is a key factor which determines the commercial success of a product. The quality attributes of fruit juices are color, flavor, body, and nutritive value. The detailed analyses for these attributes indicated that marketable qualities of reconstituted juice powder are similar to those of canned juices. In addition, juice powder has the following advantages:

1. It saves weight and space because more than 85 percent of the water is removed; hence, it is economical in transportation, storage, and handling to distant markets.

2. Juice powder can be preserved for extended periods without refrigeration.

3. Ease in handling and convenience and rapid reconstitution make it suitable for domestic and military requirements, especially for overseas use.

4. It has concentrated nutritive values.

5. It is stable at elevated storage temperatures and for extended periods of time.

6. It has high quality and nutritive value at the time of consumption.

During and since World War II investigations were undertaken to develop powdered fruit juices in the United States Department of Agriculture’s Western Utilization Research Laboratory, Albany, California. In spite of unpleasant memories of dehydrated foods of World War II, these dehydrated juices have found a

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FARM AND HOME SCIENCE
Fig. 1, 2, and 3 below: Fitzmill used to convert pitted apricots and peaches into nectars. Cider press used to squeeze juice from the pitted sour cherries. Precook of nectars and juices in steam jacketed kettles. Fig. 5, 6, and 7, right: Zahn viscosimeter used to study viscosity of the juices. Hunter color and color difference meter used to study comparative color changes. Refractometer and pH meter were used to study sugar and acids in the reconstructed juices.
As far as we know, apples were first reported growing in southwestern Asia, in the area from the Caspian to the Black Sea. From this area, they spread rapidly to Europe and India and have been in the cultivated and wild form for many centuries. A Greek writer, Theophrastus, mentions a number of varieties grown in Greece in the 4th century B.C., although they may have been present earlier than that.

Apple seeds and cuttings were brought to America by the early settlers. They were rapidly distributed along the Atlantic coast area and were later disseminated throughout America by explorers, travelers, missionaries, and early settlers. John Chapman, known as Johnny Appleseed, planted many apple seeds throughout Ohio and Indiana in the early 1800's. Apples were planted in the state of Washington as early as 1817. Seeds of fruit were brought to Utah with the pioneers. In 1850 standard varieties of fruit were brought to Utah and by 1860 there were a number of nurseries selling budded trees.

Origin of varieties

Most of the popular varieties of today were discovered in obscure places as chance seedling trees which had grown from seed that was scattered on the soil. As examples, the Red Delicious variety was first observed in Peru, Iowa, as a chance seedling under a Bellflower tree in 1881; Rome Beauty was observed in Lawrence County, Ohio, in 1848; Golden Delicious in Porter, West Virginia, in 1916; Jonathan in the Hudson Valley area of New York about 1820; and McIntosh was introduced by John McIntosh about 1870. McIntosh was clearing land in Ontario, Canada when he discovered what is now known as the McIntosh apple.

The trees that developed from the large number of seeds which were distributed since the first settlers arrived in America have been gradually evaluated. Many people made selections from their seedling trees, propagated them, and introduced them as new varieties through a nursery. It is reported that in 1869, there was a list of 1856 varieties under cultivation in America. Some varieties of apples were far superior to others, hence nurserymen concentrated on the better varieties.
Their origin and importance for Utah growers

Professor Anson Call, extension horticulturist, and Dr. J. LaMar Anderson, assistant professor of horticulture, are observing a five year old Starking Delicious apple tree planted on a dwarf rootstock.

Dwarf apple tree six feet tall and six years old producing Golden Delicious apples

and propagated them on seedling trees, resulting in more trees of fewer varieties. At the present time there are still many varieties, but ten or less account for 90 percent of the apples grown. The important varieties still have many disadvantages which experiment stations are now trying to correct through controlled breeding programs.

Controlled breeding is the second method in which new varieties are obtained. Breeding apples is a long range project since it takes so long for them to fruit, be evaluated, and the promising selections grown under a number of varied climatic and cultural management conditions before they are named and released. Although a number of apple varieties have been released, only a few have been planted widely. The Cortland variety, which was introduced by the New York Agricultural Experiment Station in 1915, has been planted by growers more than any of the other varieties that have originated through controlled crosses. It is the only variety obtained through controlled breeding that is one of the top ten. Cortland is a result of a cross between Ben Davis and Mc-

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The following mutations or sports of the commercially important varieties are recommended for Utah plantings:

1. Red Delicious
   - Standard growth
     a. Red Queen
     b. Top Red
     c. Hi Early
     d. Red Prince

2. Golden Delicious
   - Standard growth
     a. Standard Golden Delicious

3. McIntosh
   - McIntosh

4. Rome Beauty
   - Nero Red Rome
   - Barkley Rome Beauty
   - Gollin Beauty

5. Jonathan
   - Jonathan
   - Jonared
   - Valnur Double Red Jonathan

Spur growth
- Starkrimson
- Red Spur
- Wellspr

Spur growth (available, but not tested in Utah)
- Gold spur
- Stark spur

FOR SEPTEMBER 1963
Each locality through the world has its own peculiar weather, and areas within Utah are no exception. This article is the first of a series that will define what causes Utah's weather and explore possibilities her citizens have of modifying the undesirable forms. But weather is only secondarily localized in origin. Throughout the world the weather of the moment is the result of interaction: first of global forces, second of hemispheric factors, and then of local elements.

Looking only at Utah weather, therefore would be somewhat like taking one piece of a jigsaw puzzle and trying to visualize the finished picture. The piece is but a small part of the whole. It makes sense only after the puzzle is assembled, and it can be seen in proper perspective. In turn, each piece of the puzzle is important to the final effect. To be meaningful, then, Utah weather must be viewed in relation to the global picture, and the localized climates within Utah must be seen relative to the entire state.

Utah weather is particularly hard to discuss in general terms because most of the climates known to occur in temperature zones of the world can be experienced within her borders. This is largely due to the extreme variations in topography. Precipitation records for areas of the state range from less than 5 to 40 inches a year. Temperatures have ranged from -50 to 116 F. Winds have reached hurricane force and tornadoes have been observed.

This series begins, therefore, with a discussion of the general circulation of the atmosphere, how storms are formed, and how they move, the characteristics by which various fronts can be identified, and how geographic features affect weather. The more specific causes of Utah's wide range of climates and extremes will be explained later. Other articles will consider weather forecasts, their limitations, and how a general forecast can be adapted to specific areas in Utah. The ways in which we, as individuals, can adapt to the vagaries of our local weather will also receive attention.
Weather not only is one of the most popular topics of everyday conversation, it is one of the factors which most affect our daily lives. To understand weather (or climate, which is the average weather in a given locality for a long period of time), one must be concerned with heat, pressure, wind, and moisture.

*Global considerations*

The distribution of weather or climate over the surface of the earth is the direct reflection of the motion or circulation of the atmosphere. This circulation results from the motions of the earth in relation to the sun and from the consequent variations in heat and moisture content of the atmosphere. As the earth revolves around the sun, more solar energy reaches the tropical regions than the polar areas. Equatorial air, thus heated, expands upwards and flows toward the poles. This continuous inflow increases the amount of air in the polar regions. The buildup at the poles causes a return flow toward the equator in the lower levels of the atmosphere. Since the earth is rotating continually on its own axis, the air does not follow a direct line between the poles and equator; rather, the winds are deflected toward the right in the northern hemisphere and toward the left in the southern. The resulting general pattern of circulation for the northern hemisphere is shown in simplified form in fig. 1.

The global circulation of air is modified by hemispheric arrangements of land and water surfaces, and the differences among these surfaces in heat absorption and resistance to airflow. Large bodies of water, for example, will absorb 60 to 96 percent of incoming solar insolation, depending upon the angle at which the sunlight strikes the water surface. Fresh snow absorbs only 15 to 30 percent of incident solar energy, while older snow may absorb 60 percent. Dry sand absorbs about 75 percent. Absorption by a plowed field will range from 75 to 95 percent, depending upon the soil structure and its moisture content. A grassy field generally absorbs between 80 and 90 percent of the incoming insolation. Dense forests may retain as much as 95 percent.

The air itself absorbs little incident solar energy directly. Instead, it is modified both in temperature and in moisture content by the surfaces over which it moves. Air is cooled by passage over snow and ice, while passage over warmed land or water surfaces results in the air being warmed. The air will also pick up moisture as it moves over water. The moisture that the air picks up is eventually deposited back on earth as precipitation. This is vividly illustrated by the drenching rains that characterize equatorial zones (fig. 1).

So far you've been introduced to some basic meteorological facts about the sun's radiation (heat), air circulation (wind), and moisture (precipitation). A basic knowledge about pressure variations is also fundamental to understanding weather processes.

*Air masses and fronts*

Pressure in the language of the meteorologist is a relative thing. High pressure signifies the presence of more air in one place than in the surround-

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**Fig. 1. The general pattern of air circulation for the northern hemisphere**

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E. ARLO RICHARDSON is climatologist of the U.S. Weather Bureau in Salt Lake City. GAYLEN L. ASHCROFT is assistant professor of agronomy, and LOIS M. COX is technical writer for the Division of University Research.

FOR SEPTEMBER 1963
Fig. 2. Air masses which develop in high pressure regions take on the properties of surfaces over which they lie. When contrasting air masses meet, intense weather activity occurs.

There are also two zones in the general circulation pattern where air tends to rise. These zones, at the equator and near 60 degrees latitude, are the regions most conducive to the development of low pressure.

In the vicinity of a high pressure system, air moves quite slowly (circulation is weak). This slow moving air tends to take on the characteristics of the underlying global surfaces and becomes uniform. Air with uniform characteristics is called an air mass.

Zones of high pressure thus become source regions for air mass development. For example, the North American continent, being large at the top and narrow at the south, is an ideal location for the development of contrasting air masses. During the winter the air in contact with the vast snow-covered plains of northern Canada becomes extremely cold and dry. Similarly in the south, air over the Gulf of Mexico and adjacent warm oceans takes on the characteristics of the surface and becomes warm and moist (fig. 2).

As the major circulation changes, these two air masses begin to move. The cold air pushes southward and the warm air moves northward. A battle ensues where these contrasting air masses meet, and the zone of contact is called a front. It is in this frontal zone that our most intense weather activity occurs. Winds, clouds, and precipitation, as well as temperature contrasts are greatest in this region.

As the battle between the contrasting air masses develops, the fronts are strengthened. In the region where the colder air is advancing, the frontal zone is called a cold front (fig. 3), while in the area of a victorious warm mass, the zone is classified as a warm front. At times the opposing masses may remain relatively quiescent, and the meteorologists then call the boundary zone a stationary front. In any case, the denser cold air remains beneath the warmer, more moist air mass; and the lifting action produces the intense weather activity characteristic of fronts.

One of the prime areas for development of frontal systems is near 60 degrees latitude. This band, which extends around the earth in both hemispheres, forms an almost permanent boundary called the polar front. The cold air north of this front occasionally breaks out and pushes far to the south. The extremely cold air which
Fig. 3. Fronts develop where contrasting air masses meet
took such a great toll of citrus fruit in 1962 was this type of outbreak.

Narrowing the view

On the basis of terrain alone, the continental United States can be divided into several climatic zones (fig. 2). The weather of the coastal regions on each side of the nation is modified by the close proximity of the oceans. The weather of the great central plains is characterized by their minimal opposition to the storm systems that move across them. The mountains on each side of the plains enjoy distinctive climates because of the modifying influence of the mountain barriers.

To be even more specific about Utah, both the general terrain of the Rockies and Sierras, and their localized hills and canyons, modify the state’s air circulation. Only the degree and range of impact are different. The towering Rockies usually prevent westward intrusion of the cold surges which sweep southward across the plains. This cold air occasionally is of sufficient depth, however, to cross the continental divide into the intermountain area. When this happens, temperatures in the Great Basin are apt to remain cold for some time because the heavy cold air tends to accumulate in the valley bottoms.

The Sierras on the west tend to milk moisture from Pacific storms and often leave only a dry and windy skeleton to sweep across the higher plateaus of the Great Basin. Thus, rainfall in the high Sierras and higher Rockies may be 40 to 60 inches a year, while the valleys between the ranges receive only a few inches and are virtual deserts.

Within Utah, the basin of old Lake Bonneville traps cold air just as efficiently as it used to hold the waters of

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The long ears of the jackrabbit provide a good base for applying markers so that animals may be recognized in the field and their movements followed. A colored, numbered plastic marker has been designed which can be attached to the ear with a numbered, metal tag (left ear of rabbit above). The average litter size found in the Utah studies was 5.4. Jacks have several litters a year. This high reproductive rate probably contributes to the violent population fluctuations which occur. All photographs in this article were taken by Jack E. Gross and Robert M. Rumsey.

FREDERIC H. WAGNER

From the time the earliest settlers chopped clearings in the eastern forests to grow crops, chased clouds of passenger pigeons from ripening grain on the prairies, or carved the first irrigation canals in the western landscape, the battle with the natural elements has been a major chapter in the history of American agriculture and livestock husbandry. The vagaries of weather and disease organisms, suitability of soil and topography, and competition with weeds, insects, and wild mammals and birds all take space in the chapter. And to a large extent, the productivity of our system is a measure of the degree of control we have achieved over Nature.

A natural adversary of the rancher and farmer

One of the many natural adversaries of the farmer and stockman in the western half of the country has been the black-tailed jackrabbit. This is one of the more abundant, conspicuous, and widely distributed wild mammals in western United States. Since the first farming operations were begun in the West, farmers have periodically been plagued with concentrations of rabbits that move into fields and wipe out many if not all of their crops. Entire grain and alfalfa fields have been clipped off, while vegetables have been ruined and fruit trees barked. Losses over the years undoubtedly have added up to many millions of dollars.

Jackrabbit competition with livestock for range forage is less evident and spectacular than heavy crop damage, but is probably a more general and persistent liability. Arizona studies of jackrabbit forage consumption found that somewhere between 12 and 30 rabbits eat as much forage as one sheep, while 60 to 148 jacks may be equivalent to one cow. Jackrabbit densities commonly run one to the acre, and such populations may eat as much as 4 to 10 cattle, or 20 to 50 sheep, per section. Recent studies at Utah State University suggest that rabbit populations, when high, may

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FARM AND HOME SCIENCE
The age of rabbits can be determined by the condition of the epiphyseal (growth) cartilage in the leg bones. Young rabbits have open lines filled with cartilage (see the wavy, horizontal line just below the head of the bones at left). This gradually fills in with bony tissue as the rabbit gets older until no opening remains in a one year old animal (see bones at right of picture).

Eye lens weight is another means for determining the age of mammals. The eye lens grows continuously throughout the life of the animal. When oven-dried, (as above) the weight provides a clue to the animal's age.

From 50 to 150 jackrabbits are collected and autopsied each month in the laboratory. Each animal is sexed, aged, weighed and measured, the reproductive status recorded, and a number of internal organs removed and preserved for future measurement and analysis.
RESEARCH FOR UTAH’S FAMILIES

PHYLLIS SNOW

Research is not dry facts. Research is people. Research is adventure of high order. It is the pioneering mind seeking answers to the riddles of the universe. It is creative scholarship. The inquiring mind coupled with the creative spirit lays the foundation for tomorrow.

In the College of Family life all staff members are given time and opportunity to do research if they wish. The principle requirements are that there be stimulating ideas, a minimum of restrictions in using research funds, and no interference in research procedures. Those who demonstrate capacity for productive research are encouraged to continue and every effort is made to provide them with needed facilities and support.

Family life as a discipline is the study of the development of the individual in the context of the family. At the core is an understanding of (1) human growth and development, (2) the functions of the family, and (3) decision making. Research is directed towards greater understanding of the decision making process and of the resources available to families. It is consumer oriented and seeks to provide the help that families need in selecting and using goods and services for daily living, in managing money and time, and in developing and conserving human resources.

By nature, family life is a field of applied knowledge, as contrasted to abstract or theoretical disciplines, but significant research inquires into underlying principles and basic truths.

Until 1955 the College of Family Life was the School of Home Economics. The change in title and philosophy was made to accommodate more readily management and family and child development in the traditional home economics program and to encourage men to participate professionally.

"Domestic art" was first mentioned in the biennial reports of the College and Experiment Station in 1896, home economics research in 1925, and a graduate student program in 1930. Mrs. Carrie C. Dozier, on the resident teaching staff, and Mrs. Almeda Perry Brown, with the Experiment Station, were USU's first home economics researchers. Both began in nutrition though Mrs. Dozier soon became interested in a study of the penetration of ultraviolet rays through clothing materials. Samples of artificial and real silk, cotton, and wool were inter-
posed between a source of ultraviolet light and cottonseed oil which was to be irradiated. The ability of the oil to prevent rickets was measured by feeding to albino rats and taking micrographs of the rat bones for study. The effects of weave and weight of materials were investigated.

Over the years, problems studied have been many and diverse. Often they have overlapped traditional academic boundaries and included persons from more than one discipline. Work with graduate students is part of the work of each of the five departments making up the college.

Clothing and textiles

Clothing. Research in this area is consumer-oriented. It copes with the individual’s role as chooser, user, and demander in the market. Early studies focused on design, health, comfort, and service. During the depression years emphasis shifted from skills to intelligent selection. During World War II conservation became the key phrase and research was concerned with care, renovation, and home sewing. Women entered defense industries and design was concerned with safe and serviceable work clothes. In the postwar inflation period, when real income was rising, research concentrated on the social character of clothing behavior and there was an exchange of ideas and views by psychologists, sociologists, marketing people, and home economists. For the first time research focused on the needs of older and of disabled women. The why of consumer behavior received much attention.

Now, in a society where material goods are plentiful and more people than ever before can afford them, clothing choice provides a means of self-expression and of transmitting culture. Research is concerned with the interrelation of taste, fashion, and behavior.

As an illustration of these new directions, studies are now under way to investigate (1) possible contribu-
tions of fashion therapists in rehabilitation of neuro-psychiatric patients and the implications for clothing for normal persons, and (2) clothing of junior high and high school students as it relates to their behavior and achievement.

Textiles. The question which is constantly asked of textile research workers is whether an investigation can be conducted better by industry than by home economists in a university. Industry may have excellent research personnel, laboratory facilities, libraries, and adequate funds. However, there is need for impartial agencies to conduct research directly in the interest of consumers.

Research in the department is presently concerned with problems of home laundering of fabrics made from fiber blends, and achievement of greater crease retention of wools for trousers and pleated skirts through home application of chemicals.

Also underway is a survey of employment opportunities for professionally trained women in the production of clothing and textiles in Utah.

Family and child development

Child development. The concern of those in this discipline is to study problems of personality growth. Emphasis is on parent-child relations, the role of the home and family life in healthy child growth, the impact of individual infants on their families as well as the impact of families on children, and the concept of the child as a dynamic being, acted upon by the persons and objects in his world and in turn acting upon his world as he moves forward in time, maturity, and experience.

Work with preschool children has centered on frustration reactions, attitude changes of parents and student teachers resulting from participation in nursery school programs, and creative expressions of pre-schoolers in a creative atmosphere.

Family relations. Three studies have just been completed dealing with early marriage: a self-evaluation of a group of young mothers who had married early, parent and teen attitudes toward early marriage and school policies dealing with young married students, and the association between early physical maturation and age at marriage. In other studies the adjustment of married couples in terms of church activity and the marital role expectations of single and married students have been investigated.

Future research will center upon marriage, preparation for marriage, various dimensions of family life, problems of aging, and upon the child as a member of his family and in relation to his peers and the community.

Household economics and management

Home management. Research in home management is delineated as the study of the management process itself — and the interrelations involved in the use of resources. In addition the overall uses of time, energy, and money by the family have come to be considered the special responsibility of home management.

One of the interesting studies is an attempt to describe some areas of difficulty in human relations, deficiencies in technical skills, and the carry-over from classroom for girls in the home management house. In the sample studied, non-majors did as well as majors, mainly because the house was used as a laboratory to teach management and decision making in a group situation — not as a place to try out skills; also because the non-majors made an extra effort to learn what was needed. As a result of the study one session each year is now reserved for non-majors and a curriculum developed specially for them.

We are now beginning to know how families spend their money but we know little about how they spend their time and about the philosophies and values that are important in deciding how time shall be used. To investigate use of time among families in Western United States, a regional project on the meaningful activities which women do is in the planning stage. Homemakers' time was selected because women are one of the chief influences in determining what families do and are, in turn, influenced by the needs of families.

Family economics. The concern of those in family economics is defined as that of "investigations of all those conditions which make homes economically sound." At present no research is being done in this area. Questions of concern for future research are: information on family living expenditures, information on money and time management practices of families, and adjustments made as family situations change, use of consumer credit by families, replacement rates for clothing and household textiles, quantitative information on the use of homemaker time in view of the many facets of her job and the multiplicity of decisions she must make.

The departments of Family and Child Development and Household Economics and Management have much in common and certain major areas of family life research require a cooperative approach, including: studies on the homemaker and her role as a family member; descriptive studies of household activities and the effect of different patterns of activity on family living; basic control patterns in families and how they reveal themselves; studies of the house, its equipment, and surroundings as they influence family living; and the growing child as he functions in the home.

That there is considerable interest in these problems from other disciplines is apparent from the work of Mrs. Carmen Fredrickson (sociology). Her research on the changing
role of women in our culture, particularly in Utah, has contributed much to our understanding of today's homemakers. She has accumulated evidence that women are assuming increased responsibility generally, but have a long way to go to reach full partnership with men. She has asked questions such as: How does women's working outside the home affect family life? Should post-marriage education be subsidized? Should academic requirements for the mature woman who did not finish work for a degree earlier be changed to help her complete her schooling later in life? Why are dropouts so numerous among college women?

Food and nutrition

Nutrition. Recent research in this area has included: studies of the nutritional status of children with a history of rheumatic fever as compared with those who do not; ascorbic acid and incidence of gingivitis in the Navajo; the effect of school lunch and other meals on total adolescent nutritional intake; the interrelations between leucine, isoleucine, and fat as measured by biological utilization in the rat; the effect of various levels of calcium and phosphorus upon utilization of carotene and vitamin A; the effect of kind and amount of fat on flavor of ground venison; field care, age of animal, month obtained, and aging of carcass on flavor of venison; the effect of feeding sucrose to beef cattle, swine, and poultry on the dressing percentage and quality of meat; effect of method of cooling on tenderness of turkey; and quality appraisal and nutritive changes in gamma irradiated fruits and vegetables.

Development of a device for measuring heat at the surface of meat during broiling is one of the latest projects. It is hoped that this device will help take the guesswork out of charcoal broiling much as the use of meat thermometers has done for roasting meats.

Problems of overweight and diabetic individuals have prompted researchers to investigate quality of canned fruits, jellies, and syrups of selected fruits prepared with several concentrations and combinations of natural and artificial sweeteners. Syrups of 10 percent sucrose and noncaloric sweeteners were preferred and low calorie jellies and syrups were acceptable.

A study of rapid aging of venison when a broad spectrum antibiotic is used to control mold growth, and studies on the underlying components of venison flavor are under way.

Research in this department will continue to stress human studies in nutrition though animal studies will be used to supplement or extend the studies and determine what is happening in cells or organs. Work on lipid metabolism will continue with emphasis on various interrelations of the individual lipids and on the effect of other nutrients on lipid metabolism. Other areas of interest are: factors affecting utilization of amino acids when these are fed as common foods in customary diets; expansion of food guides for nutrition education to include plans for different cost levels; characteristics of raw, cooked, and processed meat that determine household methods of storage and preparation and affect yield, convenience, and price; principles of heat transfer in relation to food and the effects of variation in rate of transfer; utilization of one nutrient when the supply of others is varied; flavor, texture, and color of foods as affected by physical structure, chemical composition, and interactions with other constituents.

Homemaking education

This department is primarily concerned with organization for and methods of teaching Family Life subject matter. Research includes determination of objectives and curricula for elementary college courses in food and nutrition and for higher education units in other countries, evaluation of home economics programs for junior colleges, and methods of promoting family life adult education.

Typical of the research of this department is a study resulting in the recommendation of a co-educational course in home management to meet the needs of the non-majors in the Sarah Hamilton Fleishmann School of Home Economics in Nevada. Existing courses were examined, time available for elective work determined, college catalogs reviewed, and personal and group interviews were conducted with department heads, students, and deans of other colleges.

Another study indicated that effective development of student teachers in homemaking education required

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A chalcid wasp parasite of the alfalfa leaf-cutting bee

P. F. TORCHIO

Since its accidental introduction on the East Coast of the United States about 30 years ago, the alfalfa leaf cutting bee, *Megachile rotundata*, has rapidly extended its range westward. By 1959, it reached the interior valleys of California to the west, the Canadian border to the north, and approximately the Mason-Dixon line to the south. When this bee arrived in the Intermountain states and the Pacific Northwest, its numbers increased rapidly because its preferred host plants (alfalfa and sweetclover) and suitable nesting cavities (nail holes, beetle burrows, and spaces between shingles) were in abundance. Its obvious potential as an alfalfa pollinator was soon recognized and programs of intensive research were begun to increase its populations within seed growing areas. Today, an increasing number of seed growers in western America are using it on their farms.

P. F. TORCHIO is a very recent arrival on the campus. He came here from Oregon State College and is replacing E. R. Jaycox as a member of the staff of the Bee Culture Laboratory.
and the species is rapidly increasing in importance as an alfalfa pollinator.

Either the original introduction of the leaf cutting bee to this country did not include its native parasites or they failed to become established. During the few years in which this bee has been studied, several native parasites, predators, and scavenger insects have been recorded. In 1962, however, the writer found a chalcid wasp, *Melittobia chalybi* Ashmead, infesting leaf cells in California. This wasp is well known as a serious parasite of other aculeate Hymoptera and some Diptera. It develops a great number of adults on a single host and parasitizes all larvae and pupae within its available micro niche. *M. chalybi* already occurs in Utah, where it has been found as a parasite of bumble bees (Bohart, *in lit*) and it represents a serious potential threat to our efforts to establish leaf cutting bees in economic numbers throughout western America. The following description of the wasp and its biology should help others working with leaf cutting bees to recognize it in its various stages and appreciate its menace.

**Description of adults:**

*Melittobia chalybi* is sexually dimorphic. The male is brachypterous with rounded wing stumps carried perpendicular to the thorax. It lacks compound eyes, its ocelli are minute, and its antennae have the first segment strongly expanded, the ventroapical third hollowed out. The females are macropterous with the wings crossing one another and held in typical Hymenoptera fashion horizontally over their backs. The compound eyes and ocelli are normal, and the first antennal segment is not expanded. The females are dark brown and measure 1.11 millimeters in length while the males are lighter in color and average slightly longer.

**Biology:**

Each egg is deposited directly on the host larva or pupa and is slightly curved, opaque white in color, and circular in cross-section. Eclosion occurs in 3 to 4 days, whereupon the first instar larva imbeds its mouthparts into the host larva and begins feeding. The mature larva disengages its mouthparts from the host after 10 to 14 days and begins extruding a long, heavily pigmented string of fecal pellets, each pellet resembling the parasite egg in shape and dimension. Mating takes place 2 to 3 days after defecation and males begin appearing 7 to 10 days later followed by the females in 5 to 8 days.

Mating occurs following a "courtship" pattern during which the male positions himself on the female's back with his mandibles lying across the vertex of her head pointing posteriorly. His front legs are placed on her neck and push against the back of her head. His middle legs grasp her thorax and his posterior legs are positioned along the sides of her abdomen. He then covers and clasps her first antennal segment with the hollowed apical portion of his. His antenna are then moved rapidly in an alternate manner so that only the expanded first segment taps the female's antennae and face. During this period she spreads her mandibles and tucks her antennae down over the sternal regions. This behavior continues for nearly 5 minutes after which the male moves back on the female and copulation takes place, lasting for 3 to 5 seconds. Females mate only once, but males mate a number of times.

After mating, the female begins inserting her ovipositor into the host larva or pupa and upon its withdrawal drinks the drop of juice exuding from the puncture. After the droplet dries, she sometimes chews the remaining solids with her mandibles. Feeding in this manner continues for a day or two until the abdomen is expanded and the first eggs are mature. During oviposition the female stands on the host grub with her legs nearly straight and the ovipositor resting on the integument of the host. The egg travels down the ovipositor as a thin ribbon but swells out from the lower third of the ovipositor until its diameter is 6 times greater than the ovipositor. The eggs are scattered singly and in small groups on the surface of the host until the female wasp expires.

Successive generations are completed within the same cell until the host is completely devoured, whereupon 1 adult female chews a cylindrical hole through the partition between the cells and infests a second cell. At the same time other females leave by the same exit to enter the next cell. This activity continues until every cell in the immediate nesting environment is parasitized.

Females were never observed flying but instead chose to hop and run. This behavior guaranteed complete parasitism of every cell within the spectrum of their migration. Because they are so small and confined most of their activities to a single cell series, they are not readily noticed around a nesting site. Their presence can be detected by carefully searching for adults crawling about the nest plugs, by critically examining individual leaf plugs for small exit holes, and by periodically slicing open the cocoons of cell series.

**NEW PUBLICATION**


This statistical abstract brings together in one convenient volume many facts about Utah's agriculture. It has been prepared for those engaged in agriculture in Utah to assist them in their managerial planning and decision making. The 171 tables include data on characteristics of farms and use of land, farm employment and tenure, livestock and crop production, farm income, expenses and debt, economic trends, population, and industrial employment.
Winter takes its toll of MOUNTAIN SHRUB

ARTHUR H. HOLMGREN

Severe winter damage to snowbrush or deerbrush (Ceanothus velutinus Dougl.) during last winter has prompted many questions. Motorists traveling through Logan Canyon or other high canyons in the northern Wasatch have observed many brown and apparently dead patches of browse. This much-branched shrub is perhaps better known as deerbrush in Utah.

Deerbrush is a broad-leaved evergreen with leathery leaves that appear to be varnished above and with three prominent veins that run the full length of the blade. Most of the shrubs reach a height of three feet, and dense thickets of nearly pure stands are formed on open mountain slopes.

Many close observations were made on the brown patches in early June of 1963. It was concluded then that deerbrush had practically disappeared from the mountains of northern Utah. On July 15, six weeks later, an occasional patch could be found with new growth sprouting from roots that were still alive. Most of the patches, however, showed no life at this later date and newly dug roots in these areas were all without any visible signs of life. So a shrub species that was a common sight at higher elevations may be difficult to find in a few years.

What happened to deerbrush during the winter of 1962-63? No insect damage or signs of a plant disease have been found. The mountain areas inhabited by deerbrush were exceedingly dry during the fall months and also through most of the winter. The drought was accompanied by abnormally low temperatures. These environmental factors are more than an evergreen species with broad leaves can tolerate. Evergreen plants lose water at all times of the year. After several months of drought these plants are more vulnerable than ever to subzero temperatures. It will take another year before the actual losses of deerbrush can be determined.

FEDERAL GRANT LANDS

(Continued from page 55)

since previously tax-exempt lands would be placed on their respective county tax rolls. Almost without exception, the grant lands are under county jurisdiction and, therefore, would be subject to county tax levies only. Based on 1960 mill levies and appraised evaluations, the sale of all state land would increase total county tax revenues by approximately $152,500. This is equivalent to approximately $.06 per acre of grant land.
Returns from interest and taxes at any of the hypothesized levels of land values and rates of return would exceed the returns from 1960 grazing fees. Returns could range from a low of $1.14 per acre (taxes plus 3 percent interest on invested funds received from land sales at $2.50 per acre) to a high of $6.66 per acre (taxes plus 6 percent interest on invested funds received from land sales at $10.00 per acre). This range amounts to an increase of approximately 3 to 15 times the 1960 returns from grazing fees charged on state lands.

Framework for comparing alternative benefits

Analysis of the economic results that could be realized through a sale program suggests that surface revenues would be increased. Such an analysis, however, does not insure that maximum returns will be realized nor does it include an analytical framework which furnishes a statement of the important relations to be considered. Maximizing economic returns requires recognition of all available alternatives and an appropriate selection after careful analysis. In most cases this necessitates consideration of individual situations and units of land smaller than the total area held by the state.

What are the possible sources of benefits from the sale and hold alternatives for state lands?

Alternative one can be defined as selling state land at current sale prices and investing the proceeds in acceptable securities. The sale proceeds become a permanent fund which when invested earns annual interest returns. Only these interest returns can be expended. The expected appreciation or depreciation in the permanent fund, plus expected interest returns on investment, plus expected taxes paid on previously tax exempt land represent the expected benefits from alternative one. The estimated value of such expected benefits must be compared with those accruing to alternative two. The second alternative involves keeping the land. Under this alternative, the current value of the land would be kept invested in the land. Expected benefits from this alternative consist of the expected appreciation or depreciation in land values plus the expected returns from all types of surface leases. Sub-surface revenues are excluded from consideration since they cannot be sold with the surface rights and are retained by the state.

These alternatives may be stated more formally as follows:

\[
\text{Total present value of benefits expected from selling the land} = \text{expected, net capital gains or losses per acre equivalent} + \text{discount factor} + \text{expected interest returns per acre} + \text{discount factor} + \text{expected tax returns per acre} + \text{discount factor}
\]

\[
\text{Total present value of benefits expected from holding the land} = \text{expected increase or decrease in land value} + \text{discount factor} + \text{expected fees from all surface uses} + \text{discount factor}
\]

A basic assumption of this analysis is that the goal of the Utah Land Board is to obtain maximum economic returns from surface uses. The above elements represent the sources of monetary benefits available from each alternative for a given year. In analyzing the alternatives, a planning or decision period involving several years should be used to permit consideration of future potentials which may influence the revenues to be realized. The annual revenues from each year of the planning period should be "discounted" and summed for the full planning period to provide a statement of the present value of the various streams of benefits.

The "discount factor" is a mathematical entity. Based on an assumed rate of interest, it provides a means for calculating the present value of each source of revenue. The factor permits the values of the two alternatives to be compared for equivalent points in time. (It would be invalid to compare the sale benefits as of today and the hold benefits as of 1969.) By determining the present value, both alternatives are compared as of the "present."

What span of years has to be considered to have proper planning is difficult to determine. This problem must be resolved by the individual decision maker or the State Land Board. However, in making such decisions, it is essential to realize that the present value of revenues received in future years becomes increasingly less important the further into the future we go. For example, at 5 percent annual interest, the present value of $1.00 expected 50 years from now is only $.09. At the same rate of interest the present value of $1.00 expected 100 years from now is only $.008. In other words, $.09 invested today at 5 percent will be worth $1.00 in 50 years or $.008 invested at 5 per-

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Table 1. Potential annual returns per acre from interest resulting from investment of funds received from sale of all state lands, Utah 1960

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Note: Tax returns of $0.06 per acre are assumed to be constant at all levels of land evaluation. Returns from investments plus taxes for various rates of interest and land valuation can be computed by adding $0.06 to the various interest returns.

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For September 1963
cent today will have a value of $1.00 in 100 years. Thus, the value added to present income by incomes expected in distant future years, particularly in years beyond 100, becomes increasingly less important.

The decision on whether to sell or to hold a particular section of state land is necessarily concerned with the relative present value of the two alternatives. If the present value of the expected benefits to be derived over time from holding the land exceeds the present value of the expected stream of benefits from selling the land, then the decision must be to retain the land at present. Of course, the reverse would be true should the present value of the expected stream of income from selling the land be the greater.

It will be noted that considerable reliance is placed upon the use of “expected” values in this analysis. Expectations are vital to decisions whose ramifications extend into far distant years. In relation to our state lands, the expectations of the decision maker for the future and the probability of his expectations being realized are a rational basis upon which sound judgment can be made. Other processes such as projecting current trends to the future, can facilitate his appraisal of the future. But in the final analysis, the expectations of those making the decisions are the basis for their ultimate choice among alternatives.

Use of the decision framework

The logic and use of the decision framework can be demonstrated by an hypothetical example.

Suppose the state holds title to a section of land in Kane County. The section is located near the Wauwee recreation development of the Glen Canyon Dam project and is currently unleased. The recreational area is expected to be developed within about three years, however, and then the land can be leased for commercial use. The returns from leasing would probably be $6.00 per acre during the first five years and $8.00 per acre during subsequent years as business improves. Purchase offers of up to $125 per acre have been received for this land, and the land is presumed to have a potential for appreciating $275 per acre in value during the next 20 years. In other words, by 1983 it should be worth $400 per acre. If sold for the $125 per acre currently offered, investment at 4 percent would yield the equivalent of $6.00 per acre annually. Taxes are estimated to average $90 per acre per year for the 20 year planning period. Capital gains on the investment portfolio are not expected to exceed $0.02 per acre per year equivalent. The question is: should the land be sold now or held and leased in anticipation of the expected increase in fee rental and land value?

The alternatives of this hypothetical situation can be substituted into the previously presented formulas as follows:

\[
\text{Total present value of benefits from sale of land} = \begin{array}{c}
\text{(Capital gains)*} \\
\text{($0.02, $0.02^0) + ($0.02^0, $0.02) = $0.25} \\
\text{($0.02, $0.02^0, $0.02) + ($0.02^0, $0.02) = 74.77} \\
\text{($0.02^0, $0.02) + ($0.02, $0.02) = 11.22} \\
\text{Total} = $86.24
\end{array}
\]

*Subscript numbers refer to individual years in the planning period.

Thus, if the land is sold now, the state would realize a present value of $86.24 per acre from the stream of income from various sources expected over the next 20 years. Alternatively, if the land is held, the expected streams of income over the same period would yield the state a present value of $180.63 per acre. If these projections are realized, the state would benefit by approximately $94.00 per acre if the land were retained for 20 years.

A decision to retain the land should not be irrevocable. It should still be possible to sell the land during the 20 years or hold it beyond 20 years. Conditions and expectations may change with time. Appraisal of the property at a later date may suggest the advisability of selling before the end of 20 years, or it may reaffirm the decision to hold the property even beyond the 20-year analysis period. (The 20-year planning period used in this analysis is not intended to be suggestive as an appropriate period for state land planning. It is used only to demonstrate the application of the analysis.)

FRUIT JUICE POWDERS

(Continued from page 56)

place on the American market because of their present high qualities.

A cooperative study was undertaken with the laboratory to determine the feasibility of using Utah grown fruits for juice powders. It was thought that this might open another outlet for the utilization of our fruits.

Preparation of peach and apricot nectars

Mature fruits (Elberta peaches and Chinese apricots) were picked and allowed to ripen at 70° F and 90 percent relative humidity. The fruits were then washed, sorted, halved, pitted, and steamed for three minutes at ten pounds pressure in a retort. This heat-

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ing inactivated enzyme systems in the fruits and also loosened the skin. The peach halves were then immediately placed in tap water and skins removed. Fruit was heated in a steam jacketed kettle with an equal quantity of water at 160°F and passed through a Fitzmill with 0.04 inch sieve and in an atmosphere of nitrogen. The resulting nectars were sweetened with sucrose to 40 degrees brix (concentration in percent of sugar by weight according to the brix scale).

**Preparation of cherry juice**

Montmorency sour cherries were picked without stems, washed, sorted, pitted in an Elliott pitter, heated to 160°F and pressed in a cider mill. The juice was filtered in a sparkler laboratory filter. Cherry juice was sweetened with sucrose to 30 brix.

Samples of peach and apricot nectars and cherry juice were shipped in frozen state to the Western Utilization Research Laboratory, Albany, California, for conversion into powders.

**Preparation of fruit juice powders**

Fruit juice powders were made by a process developed there and popularly called "puff" drying. This process removes water from the fruit juice in such a manner that a porous structure is formed. The open sponge-like material aids rapid drying and, also, rapid reconstitution.

The control of the viscosity of the feed material is the key to the process. It must be low enough to permit bubble formation at full vacuum, but high enough so that the formed bubbles will not collapse after breaking. Proper viscosity is achieved either by concentrating the juice or by adding enough sugar to make a soluble solids content of approximately 50 percent before puff drying.

Drying procedure: For best results, the viscous juice containing at least 50 percent soluble solids is allowed to flow on to metal trays. These are placed in a vacuum chamber which is equipped with tubes or hollow shelves to support the trays. Steam or water is circulated through the shelves or tubes to heat or cool the fruit product rapidly. A tray load of 0.5 pound per square foot is used with a maximum shelf temperature of 100°F. Before heat is applied, the pressure is reduced to 2 millimeters of mercury and maintained at this level for the 18 hour drying period. At the end of the drying cycle, the product is cooled by circulating cold water through the shelves before the vacuum is broken and the dryer is opened.

The friable, puffed material, easily removed from the trays, is ground to pass through a 6 mesh screen. Detraying, crushing, screening, and packaging are carried out in a room with humidity below 10 percent to prevent the hygroscopic powders from picking up moisture and becoming sticky. All lots of powder for each variety of fruit are mixed together for uniformity, placed in appropriate size cans, and sealed under half an atmosphere of air pressure.

The moisture content of the powder is usually between 3 and 5 percent when packaged. For maximum storage stability and to prevent caking, the moisture content of the fruit powders should not exceed 1 percent. This is accomplished by incorporating in the hermetically sealed container sufficient in-package desiccant (CaO) to reduce the moisture content of the powder to 1 percent and below. The desiccant is enclosed in a sift-proof moisture-permeable package which allows the moisture to transfer from the product to the desiccant. The drying cycle is shortened several hours by use of the in-package desiccant.

**Quality evaluation**

Juice powders of peach, apricot, and sour cherries were reconstituted in cold water. The resultant juices had 15 degrees brix (equivalent to commercially canned juices) and were evaluated by several persons for their acceptability. Some of the samples were compared with canned juices available either in the market or prepared in our laboratories. The juices made from the powders tasted like standard canned fruit juices. Quality was also evaluated objectively by using a viscosimeter, a pH meter, a refractometer, and also a Hunter color and color difference meter.

**APPLE VARIETIES**

(Continued from page 59)

Intosh. Another good apple which originated through breeding is Idared, a cross between Jonathan and Wager.

The third method of obtaining new varieties is from a sudden change referred to as a bud mutation, occurring within the chromosomes of a cell which results in a different type of fruit. This mutation may appear on only one limb of a tree or on a whole tree. Growers are continually observing their trees in hopes of locating a desirable mutation. Many mutations of our main varieties have been observed during the past decade. Mutations may provide better or poorer fruit and/or tree characteristics from those of the parent. Fruit color and type of tree growth have been the most important apple mutations noted. Earlier formation and more intense red color development, as a result of a mutation, on the important varieties has resulted in a great number of new varieties being named. In addition to the earlier and darker red color mutations, some of the trees have mutated to shorter type growth and are referred to as spur type trees. These trees are two-thirds to three-fourths the size of a standard tree and tend to bear
occurred among the other leading
76
The large majority of these have mu­
tations from the Starking Delicious since
1950. Mutations from the Rich­
ared Delicious and Shotwell Delicious
apples are other examples of Red
Delicious mutations. There are at
least 35 other named varieties that
have occurred from Red Delicious
mutations. Some have been planted
rather extensively while others may not
have been as good varieties or the
parent rights were not purchased by
a nursery who advertised them ex­
tensively.

Many promising bud mutations
have occurred more recently from the
Starking Delicious. A few have also
arisen from the Richared and Shot­
well Delicious varieties. One of the better
examples of these mutations is that
which occurred in the Roy A. Bis­
bee orchard in 1952 at Hood River, Ore­
gon. Bisbee noticed a 12-year old
Starking Delicious tree that had spur­
type tree growth and whose apples
developed red color earlier and were
darker than Starking. The tree was
observed for a few years and the stock
eventually purchased by the Stark
nursery for $25,000 and was named
Starkrison. Mutations from the
double Red Delicious varieties have
been referred to as triple Red Deli­
cious varieties. There were over 50
triple red sports on record in 1960.
The large majority of these have mu­
tated from the Starking Delicious since
1950. The triple Red Delicious sports
have been planted extensively.

Similar type mutations have also
occurred among the other leading
apple varieties. Many Golden Deli­
cious, Rome Beauty, Jonathan, and
McIntosh bud mutations have resulted
in new varieties, although these mu­
tations have not received as much
attention because they were not as
important as Red Delicious to the
apple industry.

Nurseries purchase the patent rights
of a mutation from individual growers
and then apply for a plant patent. A
distinct new variety that can be
sexually reproduced and was not
found in an uncul­tivated state may be
patented for 17 years, during which
time exclusive right is retained
throughout the United States and its
territories. During this time it is
unlawful to propagate a patented tree
without permission. This allows nur­
series to sell their new varieties at a
premium to pay for the initial pur­
chase of a promising mutation.

Commercial varieties for Utah

Although there have been an ex­
tremely large number of apple varieties
described and named, there are rela­
tively few which are extensively
planted on a commercial scale. The
housewife at the supermarkets deter­
mines the varieties growers should
plant. Some varieties consistently sell
for a dollar or more per bushel than
other varieties of equal quality dis­
played attractively next to each other.
The dessert quality apples are the
important ones now. People do not
buy apples as much now for cooking
when ready-to-serve pies and sauce
are available at a comparatively low
price. Nor do they purchase large
quantities of apple varieties in the fall
which will store well until spring as
they did years ago. With modern
refrigeration and controlled atmos­
phere storages, good dessert quality
apples can be maintained throughout
the year.

A triple Red Delicious variety is
recommended for large commercial
plantings. Golden Delicious is also
a good variety and is usually used as
a pollinator in the Red Delicious
orchards. Golden Delicious is not
grown as widely as Red Delicious
because it is more difficult to grow
without the skin russetting. Russetting,
formation of rough brown skin, may
be caused by chemical sprays, or the
wind. This variety also tends to bear
biennially, bruises rather easily, and
does not store as well as other varieties.

McIntosh is increasing in impor­
tance in Utah. This variety ripens
the first part of September, is round in
shape with attractive red color and
white flesh. It is tender, juicy, medium
acid, aromatic, and is good for eating
fresh or cooking.

The demand for Rome Beauty and
Jonathan has decreased somewhat,
although they are still good varieties.
Rome Beauty stores well and is good
for cooking, but most people do not
think it is as good a dessert apple as
the first three mentioned. Vigorous
Rome Beauty trees have also been
increasingly harder to grow because
they are susceptible to a stem pitting
virus disorder which markedly curtails
tree growth.

Jonathan apples are characteristically
smaller and do not store well. They
develop a physiological storage dis­
order called Jonathan spot which
forms a number of small black spots
on the calyx end of the fruit resulting
in cull fruit. However, they are one of
the earliest winter varieties, tart,
and enjoyed by many. They do require
eye thinning to increase their size.

Most of the mutations of the main
varieties have fruited and been evalu­
ated under Utah conditions during the
past three years. A definite difference
in extent of red color is evident among
the varieties. Some varieties even
develop too much color and turn an
undesirable purple before they are ripe.
Some varieties have tended to revert
back to the color of the standard Red
Delicious; others have produced fruit
ranging from poorly colored green to
desirable red color, maturing on the same tree at the same time.

Varieties for summer

One of the better summer apples is Lodi. This variety has largely replaced Yellow Transparent. It resulted from a cross of Montgomery and Yellow Transparent. It ripens a little later, and is much larger than Yellow Transparent. It does not become mealy nor soften like Yellow Transparent.

Other good summer apples include Patricia, Snow, Strawberry, Red Astarachan, and Early McIntosh. Snow, Strawberry, and Early McIntosh apples are naturally small, but with proper early thinning can become medium sized. Snow is juicy, mild tasting, and sweet. Strawberry and Patricia are quite similar to Snow, except they have more red color. Red Astarachans are medium to large, bright red over yellow, and sweet. They do become mushy when overripe. Early McIntosh tastes and appears similar to the regular McIntosh. It ripens about three to four weeks before McIntosh.

For people desiring to grow a number of varieties on a small scale for a roadside market or personal use there are some varieties that appear promising for planting. Jonadel (Jonathan x Red Delicious cross) has large fruit, reddish-pink color with white flesh. It has the tree growth and deep calyx characteristics of the Jonathan and the larger size and about the same flavor as the Red Delicious. It is an attractive and good tasting variety.

Redgold is another promising variety. It is a result of a cross of Golden Delicious and Richared Delicious. It is a solid red fruit maturing fairly early and with fine flavor.

Dwarf apple trees

Within the past 10 to 15 years there has been much interest in dwarf apple trees. The trees are "dwarfed" by special rootstocks or interstocks. The desired variety is grafted on the dwarf stock. A large number of dwarf stocks are being evaluated at the Howell Horticultural Experimental Research Station at Ogden. At the present time, most commercial dwarf apple orchards consist of East Malling II, VII, or IX trees. The II and VII's are semi-dwarf stocks which produce trees about two-thirds the size of a standard size tree. The II often produces a larger tree than the VII reaching three-fourths to four-fifths the size of a standard size tree.

The IX trees do not grow as large as trees on the II or VII stocks. They are true dwarfs which commonly produce a tree 6 to 8 feet tall with a spread of 3 to 6 feet. They have been classified as one-tenth to one-eighth the size of a standard size tree. These trees have small root systems and require staking to protect them from falling over during strong winds or heavy irrigations.

Dwarf trees usually bear earlier than the standard trees. The IX's may produce the second or third year in the orchard; VII's produce the third or fourth year; II's produce the fourth to fifth year; and the standard trees the fifth to eighth year. The age of bearing is shortened by reduced pruning, nitrogen fertilizer, ample water, and good insect and disease control.

The size, color, and quality of the fruit from dwarf trees are generally the same as fruit from standard trees. Fruit on dwarf trees may ripen a few days earlier.

Dwarf trees are more expensive to purchase than standard trees because an extra grafting is necessary. These trees are also placed closer together in the orchard, requiring more trees per acre, however they start to produce a few years earlier, require less ladder work, and are being planted in large quantities.

The spur type standard trees, about two-thirds to three-fourths the size of a standard tree, also may be planted closer together and come into bearing about the time of the larger dwarfs.

Fig. 4. Stagnant air plus a natural basin may add up to smog or fog in the valley with sunshine on the higher slopes

OUR ENIGMATIC WEATHER
(Continued from page 63)

the lake. As cold air accumulates in the valley bottom, it traps smoke and other pollutants in addition to moisture. These elements gradually decrease the effectiveness of the sun's radiation (fig. 4) and eventually fog or smog forms, and may persist for weeks. Temperatures in the valley then remain below freezing, while a few miles away on the mountain slopes skiers bask in a spring-like temperature. This stagnant condition generally is broken by the passage of an active cold front from the west or by the intrusion of fresh cold air from east of the Rockies.

Even the limited information presented in this introductory article emphasizes that we cannot control the major features of the atmospheric circulation that produces our weather and climate. We can, however, modify circulation on a microscale and achieve a more comfortable environment in which to live. Such modifications can be created by planting trees and shrubs or building walls and fences in strategic locations. Much can be done along these lines in both farm and urban areas of Utah to make living with our local weather easier and more enjoyable.

FOR SEPTEMBER 1963
apply more pressure to the vegetation than livestock. Efforts at artificial range reseeding are sometimes thwarted by rabbit concentrations which crop off seedling grasses as fast as they sprout.

**A role in the transmission of disease**

Although jacks probably play a role in the transmission of diseases to which humans and livestock are susceptible, the extent and details are not fully understood. Jackrabbits are commonly infected with tularemia, a disease which occurs in humans in Utah. One outbreak occurred in the 1930's among men in a Civilian Conservation Corps camp near Kelton, Utah, which forced closure of the camp. This area has long been jackrabbit habitat and supports high populations. Jacks are also known to be infected with Rocky Mountain spotted fever, western viral encephalitis, and Q fever, all diseases which humans contract.

**Their positive value**

The ink is not all red on the rabbit ledger, however; jacks are not without some positive values. Before settlement they were an important source of food and clothing to a number of Indian tribes. And in the decades following settlement, they provided food for wagon trains, surveying and railroad crews, and were available in large numbers in the markets of many cities. Today there is a general prejudice against eating them, but mink ranchers use many thousands for mink food.

Some ranchers contend that their losses of lambs to coyotes are nominal as long as jackrabbits are abundant. But when rabbit populations decline, coyotes may turn more to sheep flocks in search of food. Jacks are staple food for the medium-sized predatory mammals and the larger birds of prey.

In recent years jacks have been useful for monitoring radioactive fallout resulting from atomic-weapons testing. One study in Washington showed a clear-cut build-up in the radioactive iodine content of rabbit thyroids following test periods.

Jacks have become increasingly popular game animals and provide many man-hours of recreation for hunters during times of the year when other hunting seasons are closed.

**A need to know the animal**

Because of the practical importance of this animal, we need to understand its habits and biology thoroughly. The possibilities of controlling its numbers and damages, either artificially or naturally, or at least of understanding and predicting its behavior, depend on detailed knowledge of the animal. What are its breeding characteristics, natural enemies, typical birth and death rates, patterns of movement and other behavior, food, and cover needs, and many other aspects of its biology? Technology and solution of practical problems are always preceded by the acquisition of basic knowledge such as this which can then be applied to the problems at hand.

Although a great deal has been published on the related European rabbit (scourge of Australia and New Zealand), and the North American snowshoe hare and cottontail, the black-tailed jackrabbit is not as well known. Its general habits and characteristics are understood from the results of several studies including ones in California, Kansas, Utah, and Arizona. But other more basic and fundamental questions on the animal await long-term study.

The general family of animals to which rabbits belong is subdivided into two groups according to the condition of the young at birth and the type of home they use. The true rabbits, to which our cottontail and the European rabbit belong, are born with eyes closed, naked, and helpless. Most of them dig or use burrows in the ground and build fur-lined, enclosed nests in which to rear the young.

**The life history**

The hares, to which the snowshoe and Arctic hares, and our jackrabbits belong, are born fully furred. Eyes of the young are open immediately after birth, and they are able to move about and jump short distances almost from the time they are dry. They use no nests or burrows; as a rule, the young are left in shallow, saucer-shaped "forms" in the ground under bushes or other cover. So if we hew to the line with our terminology, our jackrabbit is not actually a true rabbit, but a hare.

At birth young black-tailed jacks weigh 2 to 4 ounces. They grow quite fast, but remain secretive and inactive for the first month or two of life. They reach adult size somewhere around 5 to 6 months which means about 4½ pounds for males and 5 pounds or more for females.

At this age, young of the year can only be distinguished from adults by the condition of the epiphyseal cartilage of the growing animal, but somewhere between 8 months and a year of age it fills in with bony tissue, and the bone becomes solid. Recent studies here suggest that the weight of the dried eye lens may disclose the age more accurately than the epiphyseal cartilage. The eye lens, an organ that grows throughout the life of all mammals, has been successfully used to tell the age of the cottontail and European rabbit.

In Utah, breeding first begins with a few animals in January and February, but the majority of the population does not reproduce until March. April, May, and June are the really heavy production months, and by late summer, activity wanes. At the Utah lati-
tude, virtually no breeding occurs between September and December, but in southern Arizona some young are born every month of the year.

Jacks raise several litters a year in Utah. The first litters at the beginning of the season average 1 or 2 young, but those in spring and early summer run from 4 to 6, on the average. Toward late summer, the number tapers off once again.

This high reproductive rate accounts in part for the violent population changes in local areas which jackrabbits experience in Utah and elsewhere. At times they are quite scarce, while a few years hence they may build up to tremendous densities.

**Rabbit drives**

It is these rapid build-ups to huge concentrations which have made the black-tailed jack infamous. Over the years, one of the traditional ways of combating such concentrations has been drives by large groups of men. Two, long mesh-wire fences are built beforehand which spread out into the brush, and converge on a small catching pen. The drivers fan out, form a line facing into the funnel formed by the two fences, and march toward it. All rabbits are chased ahead of the line of drivers and into the area between the two fences. The drivers gradually converge in the funnel, drive the animals into the pen, and move in to club to death a jumping, seething mass of hares.

The writings on the jackrabbits are full of descriptions of such drives. Areas ranging from a few hundred acres to 50 to 60 square miles have been systematically purged of jacks. Some of the most spectacular have been held in California. In 1888, some 8,000 rabbits were killed in drives covering a 9-day period near Bakersfield. One of the most famous was the Grand Army of the Republic drive near Fresno in 1892. Some 8,000 people participated, and 20,000 to 30,000 rabbits were killed in a single drive. Utah has had its share with kills of 1,000 to 3,000 rabbits not uncommon.

**Population fluctuations**

The causes and circumstances surrounding these population fluctuations are among the less understood aspects of jackrabbit biology. Yet it is this characteristic of the beast which is responsible for the heavy economic losses. And it is population problems, such as these, which are among the more interesting and challenging research areas to the animal ecologist and wildlife biologist who are interested in the factors which limit populations of desirable animals such as game species, or which fail to limit nuisance species such as jackrabbits.

To get at some of the unknowns in the population ecology and behavior of black-tailed jacks in northern Utah, long-term studies were begun in the spring of 1962 at Utah State University. Their long-range objectives are to study the changes in population make-up and behavior which are associated with the pronounced ups and downs in numbers in any given area, with differences in numbers between different areas, and the factors responsible.

One of the first steps was initiation of a study to learn about the internal workings of a population through the year, and how these vary as a population waxes and wanes. This involves a study of birth rates, death rates, and the extent of change in numbers during the year, and between years.

How many young are born each year? How many animals die and at what stage of their life: before birth in the womb, between birth and the age when they are able to fend for themselves, and after they have reached adult size? How much does the population increase between spring when the first young are born, and at the end of summer when the last young appear? And how much does the population decline from death between the end of the breeding season and the beginning of the next? How do these characteristics vary in years of population increase and decrease, and between areas of different rabbit densities?

**Sampling populations**

Getting the answers to these questions involves sampling populations at regular intervals. The percentages of males and females, and young and adults, are determined. Females are autopsied during the breeding season to determine when and how many young they are bearing. The populations are censused periodically to measure the extent and rates of change. And rabbits are caught alive in traps, are marked with metal ear tags, and are released to determine the rate at which they die off. These studies are being carried on in Box Elder County in three different areas.

**Movement as it affects populations**

Another problem with jackrabbit population behavior is the question of movement. To what extent does movement affect the ups and downs in numbers within localized areas, and to what extent are these population changes due to variations in the birth rate or death rate? There is a widespread impression among farmers and ranchers in Utah that the animals immigrate long distances to form the large concentrations which plague their fields and ranges. Studies in Arizona and Kansas tend to agree with this belief. Yet other studies in Idaho, California, and Utah show a strong degree of site attachment and limited movement by these hares. The question is not settled. It plainly has practical importance, and at the same time is a question of fundamental interest to the population and behavior student.
Consequently a second phase of the Box Elder County studies involves research on movement. What is the characteristic movement pattern of males and females, of young and adults? How does it vary through the day, between seasons, and at different rabbit population densities?

Rabbits are being caught in live traps and colored, plastic markers are attached to their ears. These markers have large numbers painted on them which can be read at some distance with the use of binoculars. In this way, individual rabbits can be followed over a period of time, and their movement patterns learned.

Tiny, battery-powered radio transmitters are being built which can be attached with harnesses to the hares. The animals are then released, and research men can pick up the signals emanating from them with the aid of receivers. By using two sets separated at some distance, and by triangulating, the locations of the animals can be pin-pointed. Their movements can then be followed day after day at a distance without ever actually seeing or otherwise contacting them. This radio-telemetry technique is one of the recent, significant break-throughs in the study of wild-animal behavior, and it is now being used on deer, antelope, ruffed grouse, geese, grizzly bear, and other wild animals in different parts of the country.

These are some of the approaches now being used in the jackrabbit studies, and the background and reasons for them. Their objective is to gain basic knowledge on the characteristics of this animal. Conceivably, this information could have practical value in the natural or artificial control of jackrabbit numbers. But as in all sciences, the knowledge must first be available from research effort before it can be applied.

Both professionally competent supervisors who could accept student teachers easily, give constructive criticism, and build up the student, and socially competent students with adequate backgrounds and ability to express themselves.

Except for experiment station appointments in food and nutrition and family and child development, staff assignments in the College of Family Life are teaching ones and research has resulted from theses problems for the M. S. degree. This tends toward research in unrelated fragments. Cooperative research and in-service training have been used to help obtain more significant results. These ideas can be carried further. For example, groups of students might develop research methods and carry out a sound sampling plan. Assembling and interpreting the findings on one or two significant questions of the study and writing a report on that part could be an individual matter. Also, in some departments research might well be on one major problem under the direction of one person, with staff members on part-time research assignments carrying out individual projects as a part of the whole. All could be in on the original planning but individually responsible for one phase. Group guidance would be a time-saving and rewarding technique on the part of the advisor.

The number of qualified research persons available might be increased by establishing special training centers for the development of research leaders in two or three institutions having strong research programs. Such centers should have available pertinent courses in research methods and statistics and carry on several programs making it possible for students to register for credit in research procedures. Qualified students, staff members, and homemakers wishing to return to their professions after their children are grown could go for a time for first-hand experience with a variety of the more common types of studies in each field.

Research designed to safeguard the human resources of the nation through concern for the quality of family living belongs in the forefront of public interest. Efforts to assure that families benefit from all sources of knowledge are efforts on behalf of national well-being. Individual families cannot be expected to provide the research basic to the solution of their problems. Therefore an expanded program of research for all of our families should be carried forward with initiative and foresight.

Pelleted seed for range seeding

All large-scale seedings made on rangelands in the western United States showed that compressed or coated seed pellets were no better, and in most cases not as good in establishing seeded stands as unpelleted or normal seed.

One-half inch was found to be the best depth to plant seeds of cheatgrass and three wheatgrasses.

A. C. Hull Jr. and A. T. Bleak

Fertilizers on dry lands

The use of low rates of nitrogen and phosphorus applied with the seed is a new approach to the fertilizers program on the drylands of Utah and seems to be the most practical method. Yields were increased from six to 10 bushels an acre where 50 pounds of 16-20-0 fertilizer was used during the past year.

Rex F. Nielsen and Arden Christiansen
The Morrison Award was presented to Dr. Lorin E. Harris (right) by Dr. L. E. Hanson, president of the American Society of Animal Science

Dr. Lorin E. Harris Receives Morrison Award

Dr. Lorin E. Harris of the Utah Station staff was presented the Morrison Award at the annual meeting of the American Society of Animal Science held at Corvallis, Oregon, August 14, 1963. The award consisted of a gold watch and $2000. It is made annually to the person who has contributed most to the field of animal science during his lifetime in research work.

The award is made possible through a trust fund established by the author of a widely used text on feeds and feeding, the late Frank B. Morrison, and his wife.

Dr. Harris received the bachelor of science degree from Utah State University and the master of science and doctor of philosophy degrees from the University of Illinois. He has served on the staff of the United States Department of Agriculture, University of Hawaii, University of Arkansas, United States Department of Interior, Cornell University, and Utah State University. He came to the latter institution in 1945. He received his professorship in animal husbandry and was named chairman of the Institute of Nutrition in 1950.

Dr. Harris received the American Feed Manufacturers’ Association Award in 1951 for outstanding research in animal nutrition. In 1953 he received the Hoblitzelle National Award in cooperation with Dr. C. Wayne Cook, professor of Range Management, for the most outstanding research in the United States in the field of agriculture. This award was based on range nutrition research with sheep.

Dr. Harris attributes his success in winning these awards to the untiring efforts of his colleagues and their fine cooperation in carrying out research work. His productivity and leadership are attested by 145 publications during the years 1940 to 1963 dealing with nutrition of range sheep, the nutrient requirements of fur animals, the use of urea by sheep and cattle, the effects of fluorine and insecticides on farm and laboratory animals, and the composition of feeds.

His research on the techniques of conducting range nutritional studies with sheep has influenced experimental designs throughout the United States and foreign countries. Research in this area has a potential of increasing wool production from the sheep in Utah by 1,200,000 pounds and the number of lambs weaned by 120,000.

His experiments in establishing the protein, calcium, phosphorus, vitamin D, and thiamine requirements of foxes and the calcium, phosphorus, and vitamin D requirements of mink, suggest models of experimental design for establishing nutrient requirements of other animals. His controlled experiments using large numbers of animals have established many facts concerning the influence of insecticides on lambs, dairy cows, dairy calves, swine, poultry, and rats. The results of these ex-
periments were reported before the House of Representatives Committee in an investigation on the use of chemicals on food products.

The ultimate goal desired in constructive research is to assist the man raising livestock on the farm. Dr. Harris has written many popular articles for newspapers and magazines and has given generously of his time in responding to invitations to speak on practical feeding of livestock. He helped to organize and was secretary of the Utah Feed Dealers and Manufacturers Association for many years.

He helps his students to grasp the fundamentals of research and spends his time unselfishly in counseling them. From a meager beginning he and his associates have built and equipped a large metabolism building, and a modern chemical and small animal laboratory.

He believes in a spirit of cooperation. He was the second chairman of the Utah State University Institute of Nutrition. While in this capacity he correlated nutrition teaching, research, and extension work in the departments of Animal Husbandry; Chemistry; Dairy Industry; Foods and Nutrition; Poultry Husbandry; Range Management; Veterinary Science; and Zoology, Entomology, and Physiology.

Dr. Harris has traveled extensively. In 1956 he received a Fulbright Award to study with H. R. Marston of the Commonwealth Scientific and Industrial Research Organization, University of Adelaide, Adelaide, South Australia. In 1960 he spent five months at the Rowett Research Institute, Aberdeen, Scotland, studying with Dr. A. T. Phillipson. While there he did research in the area of ruminant physiology, particularly on the reactions that go on within the digestive tract of sheep.

In September 1962, thirty days were spent in Brazil. While there work was done cooperatively with the IBEC Research Institute and the Animal Production Department of the state of Sao Paulo. The IBEC Research Institute (IBI) is a division of AIA, a privately established non-profit membership corporation of New York State, USA. The main purpose of the trip was to advise the IBEC Research Institute on projects which could be instituted for Brazil through the Alliance for Progress Funds. While there advice was given on the design of a feed plant, a metabolism building for large animals, individual feeding facilities for cattle and sheep, and recommendations on a program of animal nutrition research for Sao Paulo. A three-day nutrition short course was given for scientists.

He is a member of Alpha Zeta, Phi Kappa Phi, Gamma Sigma Delta, Sigma Xi; the American Society of Animal Production; American Institute of Nutrition; the American Association for Advancement of Science; Utah Academy of Sciences, Arts, and Letters; and the Society of Range Management. Dr. Harris has been president of the Western Section of the Society of Animal Production and secretary of the Society of Sigma Xi.

In his capacity as a member of the Committee on Feed Composition of the National Research Council, he developed a new method for naming feedstuffs and compiling their average composition on International Business Machines. His research in this area was presented to the 6th International Nutrition Conference which was held in Edinburgh, Scotland, in August 1963.

At the present time he is serving a third three-year term as a member of the Animal Nutrition Committee of the National Research Council. He is chairman of the Fur Animal Subcommittee, and a member of the Subcommittee on Feed Composition of the Animal Nutrition Committee. During this past year he has prepared a "glossary of definitions of energy terms" for the Committee on Animal Nutrition.
DR. VEARL R. SMITH

Dr. Vearl R. Smith, a native of Idaho, and formerly head of the Dairy Department of the University of Arizona, became the new dean of agriculture at Utah State July 1. He replaces David A. Burgoyne, acting dean since last summer, when the former dean, Dr. William H. Bennett, was appointed director of the USU Extension Service.

The new dean has been professor and head of the department of dairy science at the University of Arizona since 1957. Before that time his professional experience has included research assistant at Oregon State College, and professor of dairy husbandry at the University of Wisconsin.

Born at Elba, Idaho, he received his bachelor's degree from the University of Idaho in 1939, a master's degree at Oregon State in 1941, and the Ph. D. at the University of Minnesota in 1944.

He has a wife and six children.

DR. H. J. VENEKAMP

Dr. J. H. Venekamp, associate professor of plant pathology, joined the staff in the spring on a one year assignment to work with Dr. George W. Cochran in the plant virus studies. Dr. Venekamp is on leave from the Institute of Plant Disease Investigations in Wageningen, Netherlands. Dr. Venekamp has had 10 or more years of experience in studying viruses and has developed new methods of isolating them. He has his doctor's degree from the University of Amsterdam and worked in the Institute of Veterinary Pathology in Amsterdam before going to Wageningen.

CENTER FOR SOCIAL SCIENCE RESEARCH

A University-wide Center for Social Science Research on Natural Resources has been established on the Logan campus. It will be headed by Dr. N. Keith Roberts, professor of agricultural economics. The center will act as a clearing house for ideas and methods related to social science research on land, water, and air use problems.

UTHAH TOMATO PARENT OF NEW VARIETY

UTHAH T 1-1, a verticillium wilt-resistant tomato developed at the Utah Station, is one of the parents of a new high yielding, wilt-resistant tomato released on the East Coast for home and market gardens.

CONTRIBUTIONS TO RESEARCH

May 1, to August 1, 1963

<table>
<thead>
<tr>
<th>Organization</th>
<th>Funding</th>
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</thead>
<tbody>
<tr>
<td>Dugway Proving Ground</td>
<td>$44,649 for meteorological diffusion studies</td>
</tr>
<tr>
<td>U. S. Army Research Office</td>
<td>$40,753 for the study of thermochemistry of organic molecules</td>
</tr>
<tr>
<td>National Science Foundation</td>
<td>$30,800 for a study of the simultaneous movement of material and energy through soil and plant systems</td>
</tr>
<tr>
<td>Atomic Energy Commission</td>
<td>$19,496 for a study of alkaloid biosynthesis and metabolism in the plant</td>
</tr>
<tr>
<td>Kennecott Copper Company</td>
<td>$18,277 for purchase of scientific equipment</td>
</tr>
<tr>
<td>American Cancer Society</td>
<td>$15,000 for support of the undergraduate instructional scientific equipment program</td>
</tr>
<tr>
<td>Utah Power &amp; Light Company</td>
<td>$12,500 for a study of the ethology of North American quail</td>
</tr>
<tr>
<td>California Pacific Utilities</td>
<td>$5,950 for support of an in-service institute in chemistry for secondary school teachers of general science and chemistry</td>
</tr>
<tr>
<td>Esso Company</td>
<td>$17,420 for a study of the effects of x-irradiation on the embryos of invertebrate animals</td>
</tr>
<tr>
<td>Merck &amp; Company</td>
<td>$12,294 for studies on the effect of radium on aquatic organisms</td>
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<tr>
<td>American Cyanamid Company</td>
<td>$12,500 for weather studies</td>
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<tr>
<td>Stanford Research Institute</td>
<td>$5,000 for investigations of maternal effect associated with tumorous head phenotype in Drosophila melanogaster</td>
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<tr>
<td>James A. Boswell Foundation</td>
<td>$11,000 for farm electrification studies</td>
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<tr>
<td>Squibb Division of Olin</td>
<td>$500 for canal lining studies</td>
</tr>
<tr>
<td>Mathieson Company</td>
<td>$5,950 for study of trichomioniasis, coccidiosis, and other protozoan diseases of livestock in Utah</td>
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<tr>
<td>Geigy Agricultural Chemicals</td>
<td>$3,570 for a study of the function of molybdenum in biological nitrate reduction</td>
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<tr>
<td>Thomson Hayward Chemical Co.</td>
<td>$500 for study of effects of certain chemicals and packing films on the storage life and chemical quality of refrigerated fruits and vegetables</td>
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</table>

(For other contributions see page 84)
CONTRIBUTIONS TO RESEARCH
May 1, to August 1, 1963

National Institutes of Health

- $210,066 for graduate training in speech pathology and audiology
- $167,525 to train students in basic science and toxicology
- $73,236 for a study of flavor and aroma synthesis and degradation in fruits
- $52,284 for a study of the pathogenesis of enzootic abortion of ewes
- $35,935 for study of behavior and dispersal in a squirrel population
- $35,325 for study of the effects of radium on stream biota below uranium mills
- $35,000 for compilation of data on feed composition
- $31,629 for a study of mammalian metabolism of chlorinated hydrocarbon insecticides
- $27,000 for study of factors influencing tissue storage of certain pesticide chemical in animals
- $13,080 for study of infiltration of unsteady open-channel fluid flow
- $12,529 for a study of poisons from Astragalus miser and other range plants
- $11,280 for study of protoplasmic ion distribution
- $10,379 for study of structure, biosynthesis, and mode of action of physically active natural products
- $8,979 for a study of the genetics and diet in serum cholesterol diosynthesis
- $6,173 for the experimental study of tissue eosinophil transformation

(For other contributions see page 83)