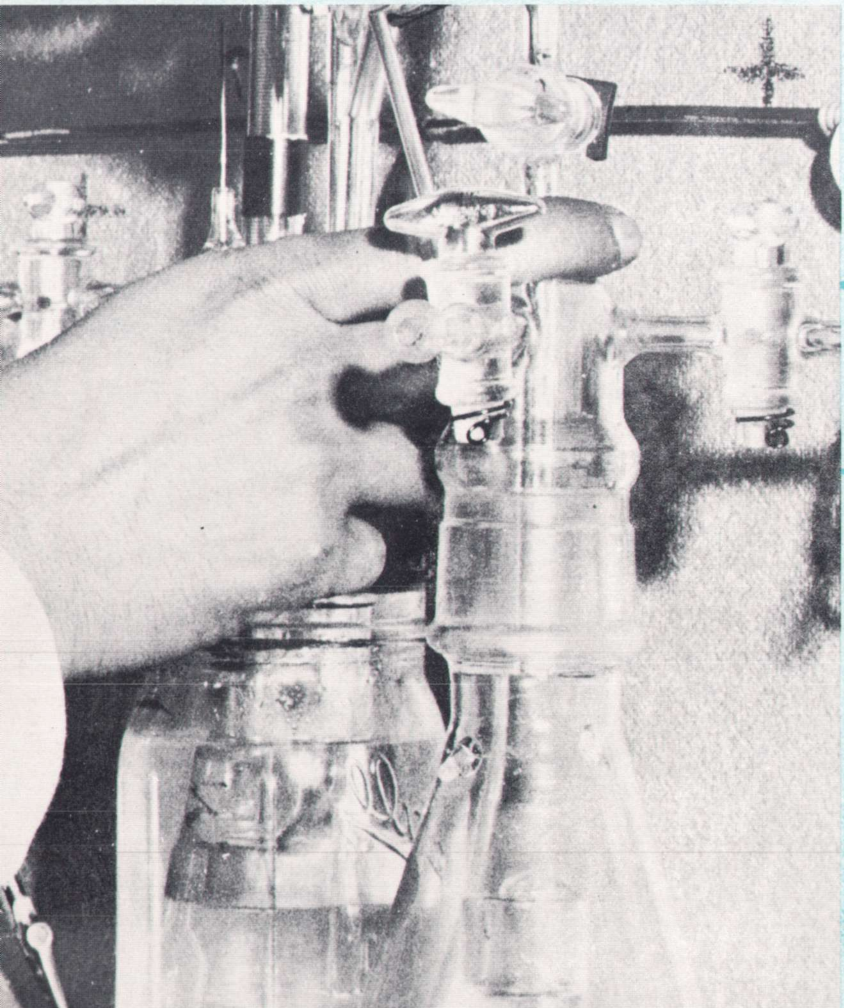
OSU LEARNS

....through research

Oregon State University . . . Corvallis . . . 1962

Both Basic and Applied Research

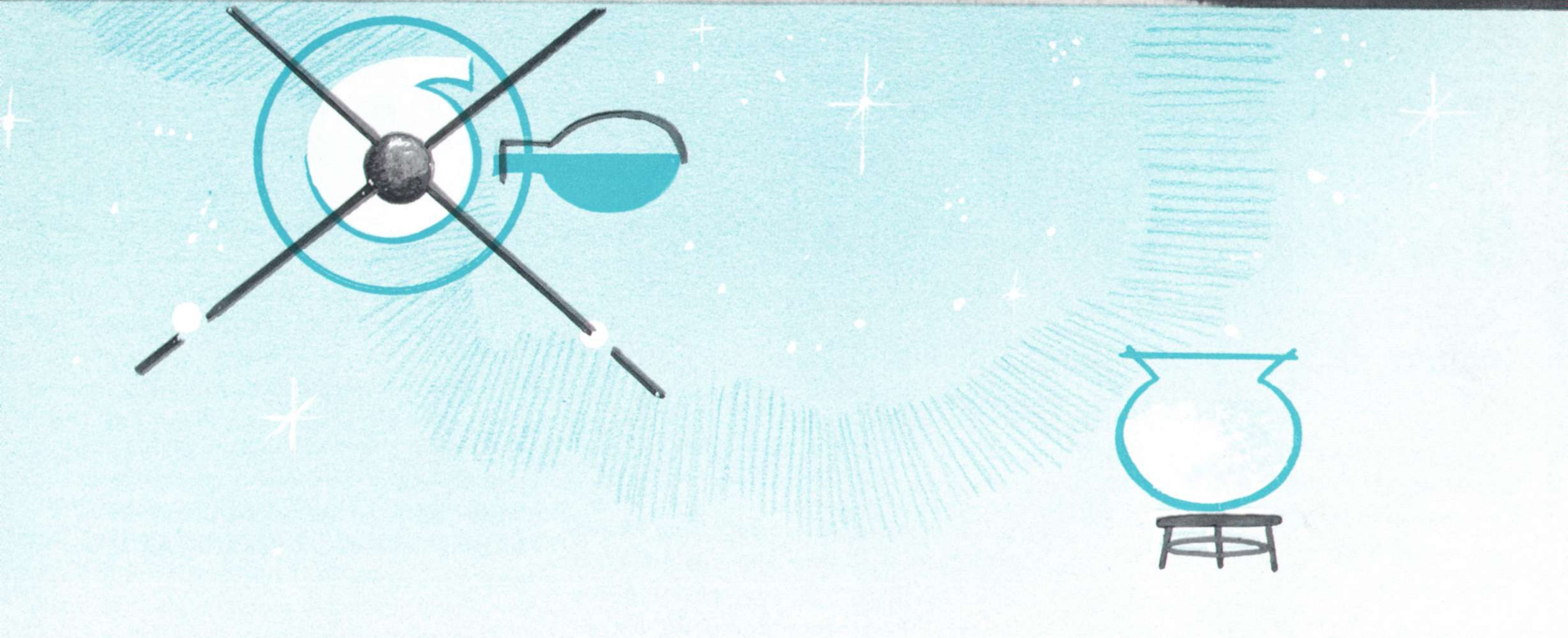


Oregon State not only teaches; it learns . . .

It continuously learns more about people . . . and, among other things, about animals and fish and insects. It learns more about earth, water, weather, and about trees, grass, cells, atoms . . . through research.

What for? To find out how things work, and then use these things for the benefit of all of us.

On the following pages only a few of the nearly 500 research projects underway at Oregon State are described to give some idea of how this "benefit for all of us" takes place.



To find out how things work just because you want to know — that is basic research.

To find out how things work so you can solve some practical problem — that is applied research.

At Oregon State University research workers do both. Some seek knowledge for others to apply, and others seek knowledge for immediate application.

New Way of Life

Indians, O S U Study Plans for Future

One-hundred and six years ago federal troops rounded up Indians near the Columbia River in the central part of Oregon and moved them to a desolate area between Madras and Mt. Hood.

These Indians, friendly toward the white settlers, for generations beyond recall had netted salmon at Celilo Falls, balancing on wooden scaffolds built out over swirling, splashing water.

Their way of life, their livelihood centered about the salmon.

The government granted them fishing rights, and each year when the great fish returned from the sea, heading for graveled-stream spawning beds, the Indians also returned, catching salmon to eat, to trade, and in later years, to sell.

Other times of the year these people lived on game, berries, roots, what crops and livestock they could raise, and—more recently—on a per capita income from timber sold off the comparatively small fringe of forest on one side of the 600,000-acre reservation.

They kept to themselves, these Confederated Tribes of Warm Springs, Wascos, and Paiutes, mixing little with outsiders. Their enormous feasts, served on mats on the longhouse floor; their parades of fine horses, decked out with brilliant beadwork bridles and trappings; their drum-accompanied ceremonial dances in elaborately fringed, intricately beaded buckskins—all are still a natural part of their life and have not been commercialized.

Unlike most Indian groups in the U. S. today, they remain almost pure Indian. A few have left the reservation for a time, some even getting degrees from the University of Oregon and Oregon State University; but they came back home, and have become administrative leaders on the reservation.

Today, however, thoughtful members of the tribes realize that, for several reasons, their isolation cannot continue. For one thing, their people will need more money. For another, the influence of the outside world is constantly becoming stronger.

What, ask the older ones, does the future hold for their young people? What happens to young people who are caught in the middle of a jumbled culture that has accepted television but still clings to ceremonies with age-old chants and drum-beat rhythms?

Adding to the problem of mixed cultures, a crisis was reached in their lives when the government built The Dalles dam and Celilo Falls were flooded.

The Indians were paid a considerable sum for the loss of their fishing grounds. They could have divided the money among all the reservation members. However, so the 11-man Tribal Council thought, this way the money would be spent quickly with no lasting benefit to anyone. Instead, the Council decided to invest some of the funds in the tribes' future.

One part of it, $100,000, was invested with OSU for specialists to make surveys of all the reservation resources, both human and physical. In a 5-volume report of the surveys, Oregon State has made broad, comprehensive recommendations for the development of the reservation in the future, and will help put them into effect.

An OSU executive committee of Dr. G. Burton Wood, chairman of agricultural economics; Joseph H. Berry, assistant to OSU president; and Dr. Hans H. Plambeck, chairman of sociology, hired Dr. Norman McKown, social psychologist from Stanford University, to direct the project.

Some of the problems were quickly evident. Per capita payments the previous year from timber income had been $900 a person; but timber income is dwindling, population (of about 1,500) is increasing rapidly, and job opportunities are limited.

Dr. McKown directed 19 specialists in 14 subject matter fields. They appraised both the existing situation and possible developments.

Surveys on human resources dealt with: wants, desires, abilities, skills, traditional interests; housing; health and welfare; educational facilities and services; sources of income, spending, credit needs; commercial and business services; population and its possible increase.

Surveys on physical resources dealt with: soils, water, power, range, agricultural economics, forests, minerals, buildings, roads, development of industries, and recreation areas.

Obviously, regardless of the action taken, dramatic changes will not take place immediately. Two things, however, are particularly unusual about the project; that Indian leaders saw serious problems ahead which could destroy or greatly damage their people; that OSU specialists considered human resources before recommending what might be done with physical resources.

The main problem is evident. It is not simply how the Indians are going to get money. It is how they are going to join together the mixture of two cultures—the new one they cannot possibly ignore, and the old one they cannot give up.

Witch Doctor to Scientist

New Uses Found for Ancient Medicinal Plants

A grotesquely painted witch doctor, chanting magic words and shaking ritualistic charm-rattles, hovers over a bubbling brew of selected herbs, preparatory to dosing a sick tribe member and driving the evil spirits out of him.

Several thousand years later a white-coated Ph.D. research worker, using chemistry symbols, a microscope, intricate glass tubes, and other complicated laboratory equipment, creates a medicine from selected herbs, preparatory to helping various sick people throughout the world.

It is entirely possible that the ancient witch doctor and the modern pharmacy research worker sometimes used the same herbs for their potions. Folklore has handed down many medicinal recipes, using some 600 plants, and modern scientists have found that about 90% of this folklore has some factual basis.

Today, with improved techniques and astounding new equipment, scientists are re-investigating many of the old medicinal plants for their therapeutic value.

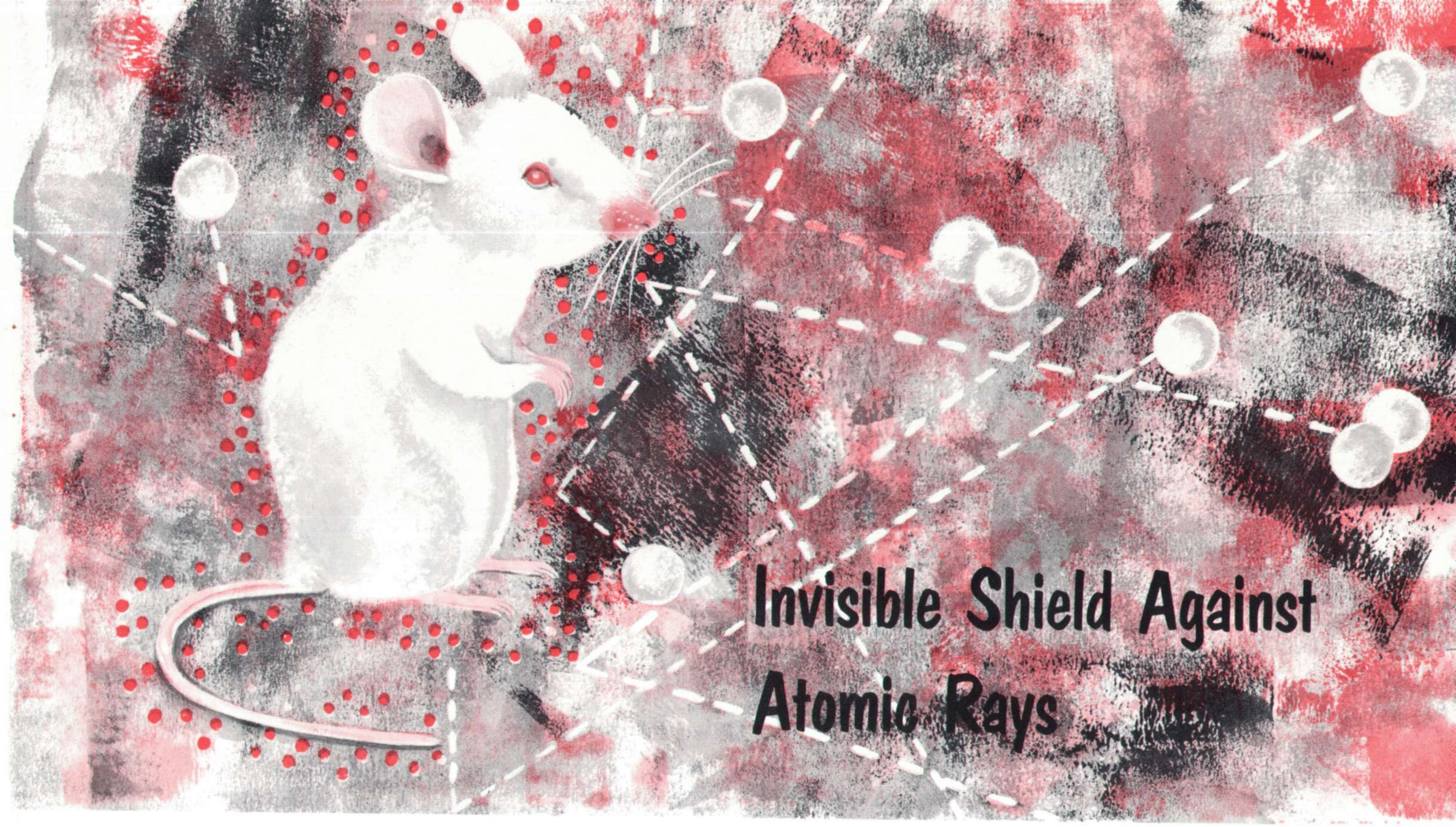
Dr. Leo A. Sciuchetti, OSU School of Pharmacy, is one of the pioneer workers in the U.S. in trying to get more medicinal compounds from plants by treating them with growth stimulants; and, going further, in trying to discover exactly how the medically-valuable compounds are formed within the plants. If scientists could know just how this process occurs they might be able to increase drug yields.

Dr. Sciuchetti has been working with belladonna and Jimson weed, applying gibberellic acid to increase growth by cell elongation, and applying kinetin to cause growth by increased cell division. He has both increased and decreased drug yields, depending on the concentration of growth stimulant used. Now he is adding radioactive materials to the stimulators so he can trace them in the plants.

Belladonna and Jimson weed yield atropine, used as a nerve gas antidote and in the treatment of ulcers and diarrhea. Jimson weed also yields hyoscine, used as a tranquilizer, motion-sickness drug, and eye dilator. Both plants are gathered wild in a few places in the U.S. and in other countries.

Three students who have assisted Dr. Sciuchetti — Arle Scott, Edward Caldwell, and Robert E. Brummett — have won top national awards for papers about this research. The awards were made by the American Foundation for Pharmaceutical Education and the American Pharmaceutical Association.

In addition to state funds, the research has been helped by National Science Foundation grants. Increased work in this field is expected at OSU soon when a new greenhouse is built. The School of Pharmacy and the department of botany are cooperating in some of the studies.



Resistant Bacteria May Contain Protective Substance

A small, white mouse in the microbiology laboratory is exposed to a big dose of radiation—enough to kill him; in fact, more than enough to kill a man.

The mouse is put back in his cage, and Dr. A. W. Anderson, bacteriologist, and his assistants at OSU await the first signs of damage — lack of energy, dull eyes, rough fur—that show up in less than two weeks when blood cells are dying and no new ones are being formed.

This little mouse, however, stays alert and perky. He scampers about his cage and up the wire sides. He eats well, his eyes remain bright, his coat smooth.

Shortly before his radiation exposure he had been given a hypodermic injection of a compound taken from a round, red, microscopic bacteria discovered at OSU. This strange bacteria is fantastically resistant, even to as many as 5 or 6 million roentgens of atomic radiation.

The mouse is one of many injected in laboratory experiments with substance from the bacteria, and is one of the approximate 50% injected that apparently will survive exposure to powerful radiation.

Research at OSU on radiation resistance in inoculated mice is comparatively new, and results are far from complete. The work has received a good-sized grant from the National Institutes of Health. Although it sounds like science fiction, the ultimate object is to find a substance to inject into human beings to increase their radiation resistance. Such resistance could be valuable to persons working with radioactive materials, and in time of possible war could mean the protection of millions of people.

Why some of the mice seem to be resistant while others are not is not yet understood. Frequent blood tests show that the ability to form white blood cells in all exposed mice is destroyed; but in some—about half—the damage is not permanent, and soon white cells reappear and function normally.

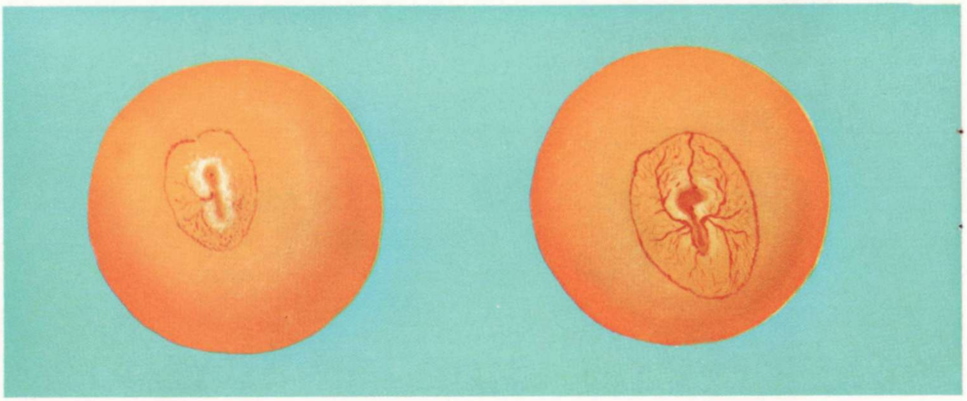
The bacteria itself was discovered by accident at OSU by Dr. Anderson and his associates.

Dr. Robert F. Cain, food technologist, was doing research on irradiation methods of food preservation. Various foods were sealed fresh in cans or in cellophane packages and then exposed to various amounts of radiation. In most cases all food-damaging bacteria inside were killed with relatively low exposures, and the food stayed perfectly preserved until the seal was broken. However, in batches of canned, irradiated beef some of the cans began to swell, indicating that all damaging bacteria had not been killed.

Microbiologists found a bacteria never before isolated. In further experiments the bacteria, recently named *Micrococcus radiodurans,* was exposed to radiation so powerful its container turned black; but when the bacteria were put back on a culture they busily went on living and reproducing.

Micrococcus radiodurans looks like a number of other roundish cells except that it grows in a clump of four. Photographs, taken by electron microscope and enlarged up to 100,000 times, show that the clump has tissuelike cell membrane between the bacteria. Researchers elsewhere are now investigating other aspects of this bacteria, including its mechanics of radiation resistance.

New equipment at OSU, a Cobalt 60 Irradiation Source, to be used in further food irradiation studies, also will be used in studies of *Micrococcus radiodurans.* Microbiologists at OSU will be able to investigate respiration and other functions of the bacteria during radiation exposure.



Chicken embryo,
48-hour development

Seventy-two hours

Man-Planned Chickens

Lay as Many Eggs with 35% Less Feed

When Oregon State University geneticists some years ago developed a type of hen that lays an egg nearly every day of the year it seemed that scientists had done all they could to improve poultry.

But now Dr. Paul Bernier, poultry geneticist, is developing a line of hens that not only will lay a large number of normal-sized eggs, but will do this with 35% less feed than necessary for normal hens.

This means that once more both farmers and consumers should profit as eggs cost less to produce on farms and sell for less in the stores.

In this research Dr. Bernier is using chickens that are only 65% of normal size. They are not Bantams. Through the years he has saved midget chickens as they appeared in the University Leghorn flocks. From these, and from Leghorn midgets contributed by a commercial poultry farmer, he has developed his line. All the midgets have much smaller frames than the normal birds, but their egg-laying organs are not smaller.

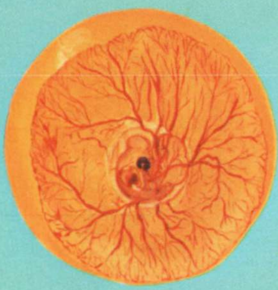
The midgets are not ready for commercial use, but research on them is highly promising, for there is no reason, says Dr. Bernier, why they should not lay as prolifically as the larger hens. With more nutritional research and continued breeding selection he believes their egg-laying output can be very high.

It's not the first time poultry research at OSU has brought benefit to both farmers and consumers. Back in 1912 staff member James Dryden developed a hen that set the world's record by laying 303 eggs a year—when the average of hens in the U. S. was only 86.

Dryden met bitter opposition from chicken "fanciers" who bred fowl for appearance rather than production. In fact, because of Dryden's work, a bill was introduced in the state legislature to try to do away with the university entirely because of its "harmful" activities.

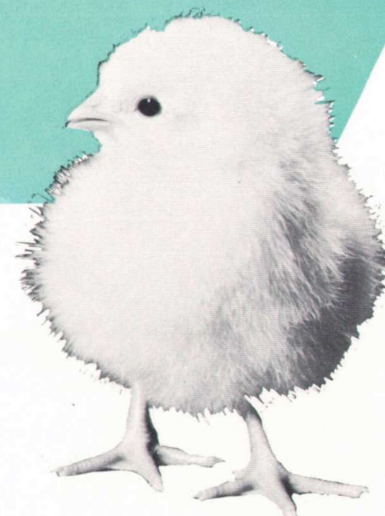
As time went on, however, Dryden's work met with approval. Farmers got high-laying stock from the institution, became commercial egg producers, and sold eggs at a profit for the first time. Also, egg prices went down in stores.

OSU geneticists can cross these midget chickens so all the males will be normal



Six days

Thirteen days

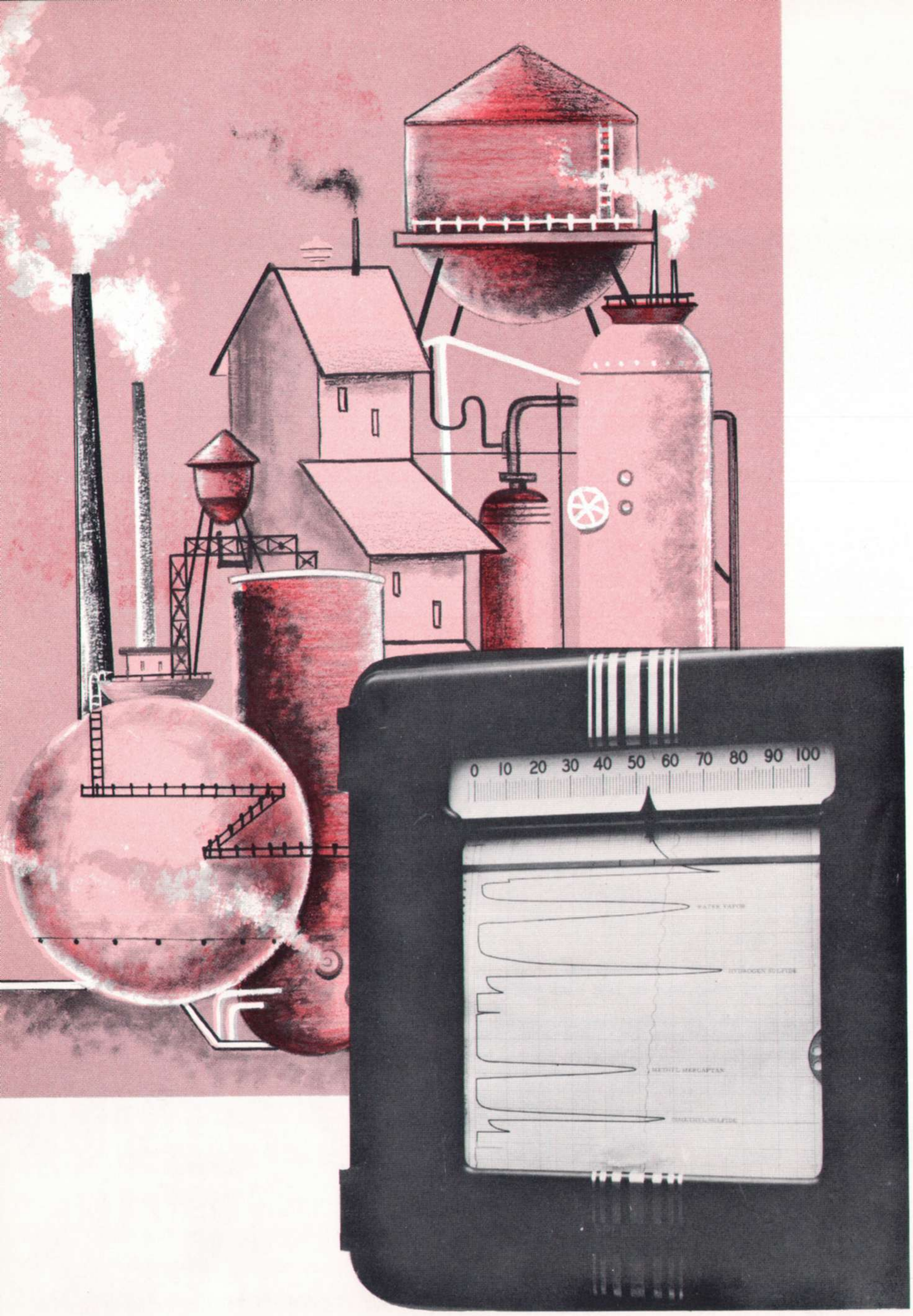


Normal-sized hen on left and midget on right lay the same size eggs

sized, to be sold for meat, and all the females will be midgets, to be used for egg production.

The midget characteristic comes from a sex-linked recessive gene. When a midget rooster and a normal hen are mated all males are normal and all females are midgets. Other crosses bring results that can be predicted.

Breeding for results has become a science. What will happen is known. But one of the big unknowns today is why some livestock uses feed more efficiently than others for producing eggs or flesh. Dr. Bernier hopes the study of midget chickens will give clues to solve this puzzle. If so, it could have a tremendous effect on growth patterns not only of chickens but of other animals as well.



Clean Air

Industry and Engine Fumes, Odors Reduced

As the machine makes scribbles and peaks on a graph it draws the picture of an odor — the particularly objectionable odor that pours out into the air from pulp mills in Oregon.

The position of each peak on the graph indicates what kind of gas is present in the sample being measured. The height and width give the quantity. This particular diagram tells that water vapor, hydrogen sulfide, methyl mercaptan, and dimethyl sulfide are present. Three of these gases happen to have very unpleasant odors even when present in minute amounts.

Making such a diagram is the first step Dr. C. E. Wicks, chemical engineer at OSU, takes in his research on air pollutants.

In a small, bomb-like container he catches a sample of gases coming from a pulp plant. He attaches the bomb to the machine—a gas chromatograph—and releases the gases into looped tubes, where they are absorbed on an inert granular material. Next, he adds an inert gas such as helium or nitrogen, in a process that removes each gaseous constituent from the others. As each passes certain instruments its characteristics cause specific reactions and produce lines on a graph.

Once he finds out exactly what is in this sample of air pollutant, Dr. Wicks is able to go ahead with research on processes to filter, burn, or in some other way use the materials, so the unwanted ones will not be released into the atmosphere.

Research at OSU has made it possible for pulp plants to cut the amount of the air pollutants in half. Now when the gas chromatrograph draws a picture of the pulp plant odor the peaks are only half as large as they originally were. Actually, it is physically and chemically possible for plants to eliminate all of the odor. It is not, however, financially possible for them to do so and stay in business. Therefore, OSU research is now concentrated on trying to find cheaper ways for pulp mills to get rid of air pollutants.

In research to reduce industry smoke and soot, R. W. Boubel, mechanical engineer, and M. E. Northcraft, civil engineer, have found that the manner of operation of wood waste burners determines the amount of smoke and soot thrown off. If correctly operated, these engineers report, the burners need not pollute the air at all.

Automobile engine fumes constitute a major source of air pollution. Recent investigations have shown that the Humphreys Constant Compression engine, not requiring high octane gasoline, produces less pollution than the conventional automobile engine. W. H. Paul, automotive engineer, J. G. Mingle and E. R. McClure, mechanical engineers, hope to develop an economical, reliable automobile engine that will not contribute to the smog problem.

Pure Water

Wastes Changed Into Harmless Liquid

Water in its liquid form is rare, apparently existing in large quantities only on earth among the sun's satellites; and even on earth it remains a liquid within only a narrow temperature range. Plant, animal, and human life, as we know it, is made up largely of water and is completely dependent on it. Yet we are polluting our main sources of water — rivers, streams, and oceans—with human and industrial waste, thereby creating a hazard to human health, damaging aquatic life, and making our most important resource—water—unusable.

At OSU, civil engineers F. J. Burgess and M. E. Northcraft are working on one phase of the water pollution problem—that of finding more economical means of waste disposal for small cities and industries in maritime climates (where the rainfall exceeds the evaporation).

Part of their experimental equipment consists of two 1-acre shallow lagoons built near the Corvallis sewage treatment plant along the Willamette River. In each pond raw sewage enters at one side. At the other side the treated waste, now an almost harmless liquid, flows out and into the river. In this form it does not cause harmful water pollution.

The seeming magic that takes place in the waste material between the inlet and outlet does not require expensive equipment or processes. Mainly, it takes human know-how in letting nature take its course. For nature will take care of waste if it has the chance. It provides a powerful, though invisible, force of microbial workers that literally eat the organic materials in the waste and bring about a chemical transformation.

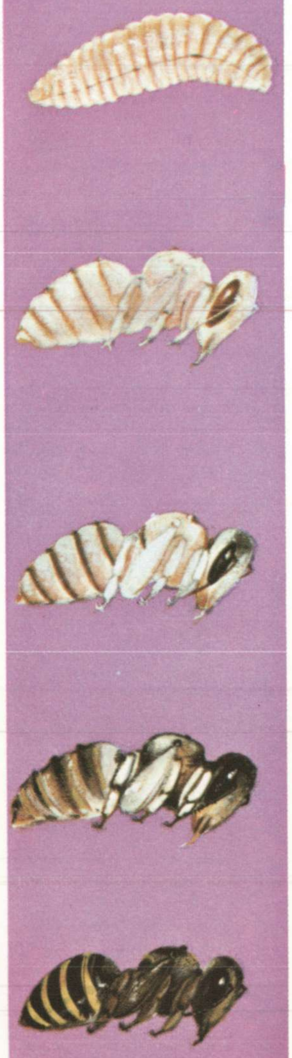
These microbes—round, rod, or corkscrew shaped bacteria—are so tiny that 100 million of them can be found in a gram of soil. Given the right conditions they double their numbers every 30 minutes.

Right conditions, the scientists have found, include plenty of light on the waste material and plenty of oxygen in the water. Light is insured because the ponds are kept shallow. Some oxygen is absorbed through the surface of the water, but more comes from algae in the water itself. These algae use carbon dioxide and some nutrients as food, and in the presence of sunlight they produce an excess of oxygen. With sufficient oxygen the bacteria can do their job efficiently, and as long as they are efficient the lagoons are odorless and blue-green in color.

To keep track of what is taking place in the ponds the engineers regularly measure the amount of sunlight reaching the water's surface. They count the number of oxygen-producing algae, test for the number of coliform bacteria, and measure the efficiency of the ponds in removing polluted organic matter in the waste.

In another experiment, also concerned with converting waste into a harmless liquid, Dr. C. M. Gilmour, bacteriologist, and F. J. Burgess are experimenting with a trickling filter. It works in much the same manner as a lagoon except that bacteria attack waste while it trickles down over a bed of rock. Both the microbiology and civil engineering departments are cooperating on this study.

This waste-water research started as a cooperative project of the city of Corvallis, Oregon State Sanitary Authority, and OSU. Since then a grant for the work has been given by the National Institutes of Health.



Man-Made Bee Beds

New System Boosts Seed Crops

The fuzzy honey bee on the sweet-smelling, purple alfalfa blossom has a problem.

It is tantalizingly tempted by the nectar down in the flower, but remembers that when it enters a blossom like this a tripper is released, scattering pollen, but also giving the bee a jolting knock on the head. But the honey bee is clever. Very carefully it creeps down the side of the flower, sips the nectar, and creeps out again without touching the part that releases the tripper.

But now the alfalfa blossom has a problem.

Its pollen remains in its closed container, unused. It did not pop out and shower itself on the fuzz of the bee as nature intended, to be carried to other alfalfa blossoms so that cross-pollination will occur. The result will be no seed on this plant.

Sometimes, however, an alfalfa blossom is more fortunate. An alkali bee comes along. This kind of bee, instead of living in a hive, digs a hole in the ground for its egg-laying chamber.

The alkali bee does not hesitate about entering the flower normally. The tripper pops out, bongs the insect on the head, and scatters its pollen. But for some reason, perhaps because it has a better protected head than the honey bee, the alkali bee does not mind the knock. It goes on to other blossoms, releases more trippers, cross-pollinating very efficiently. The result will be high seed yields on these plants, meaning more profits to growers and more prosperity to the state.

But now the alfalfa grower has a problem.

Very few alkali bees live in Oregon's alfalfa seed producing areas — near Milton-Freewater and Ontario. The reason is that the bees need nesting sites, or beds, in earth of a certain mixture of sand, silt, clay, salt, and moisture. Few such sites exist naturally near the alfalfa fields.

To solve that problem, Dr. William P. Stephen, OSU entomologist, found a way to make artificial bee beds. Growers, county agents, and even organized groups of town people have cooperated in building such beds—scooping out 3-foot-deep pits, lining them with heavy plastic, filling with the right earth mixture, and transplanting bee larvae from natural sites.

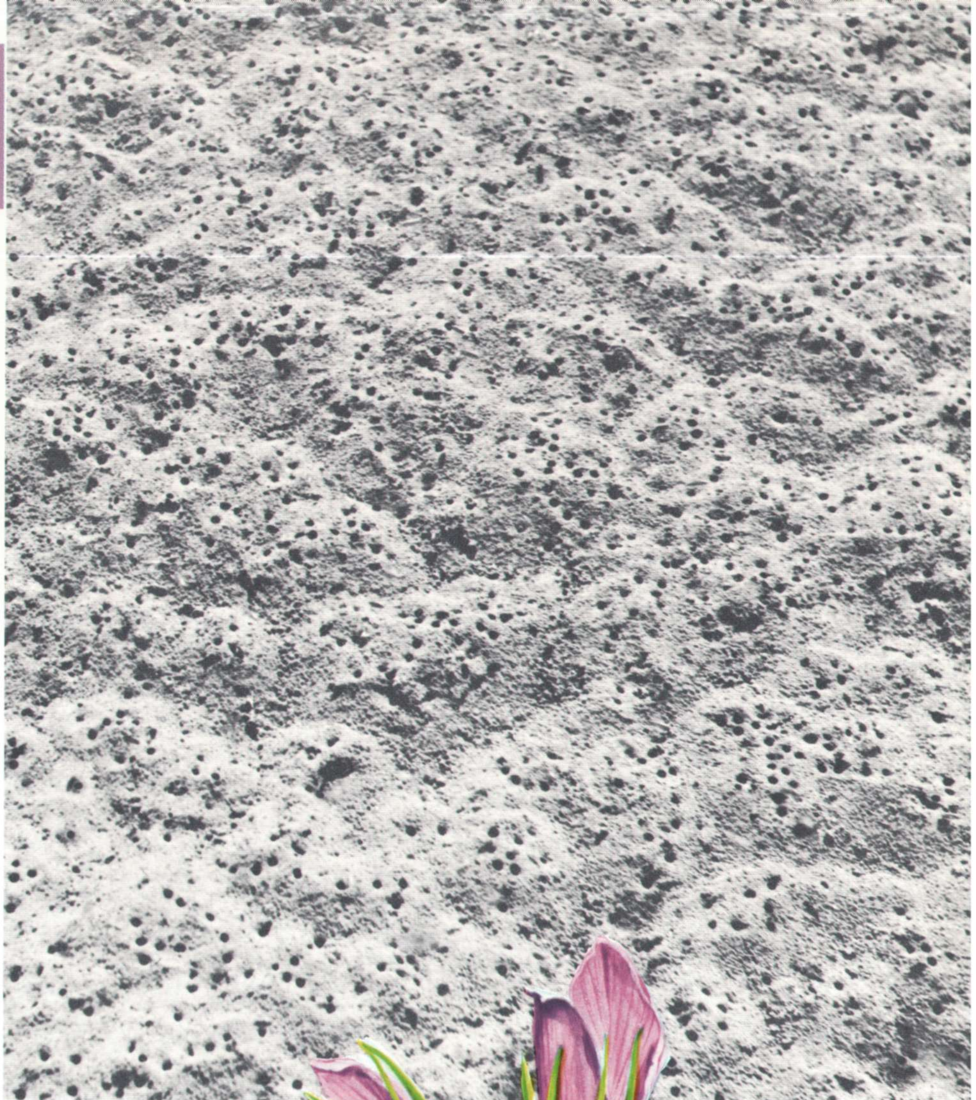
Such beds have brought yields of 1,200 pounds of alfalfa seed an acre—a 10-fold increase in some fields. The national average is about 175 pounds an acre. Already the bee beds have brought additional millions of dollars to Oregon.

Bee-bed builders use specially designed metal cylinders when transplanting larvae. They take out 10 to 20 cores of earth per bed, each core holding about 300 larvae. But the larvae in the cores are only part of the new colony, as bees are attracted to the artificial sites to lay eggs. A good nesting site, 30 by 60 feet, holds about 300,000 larvae. Many of these, however, are lost because of diseases and such natural enemies as other insects, mice, skunks, and birds.

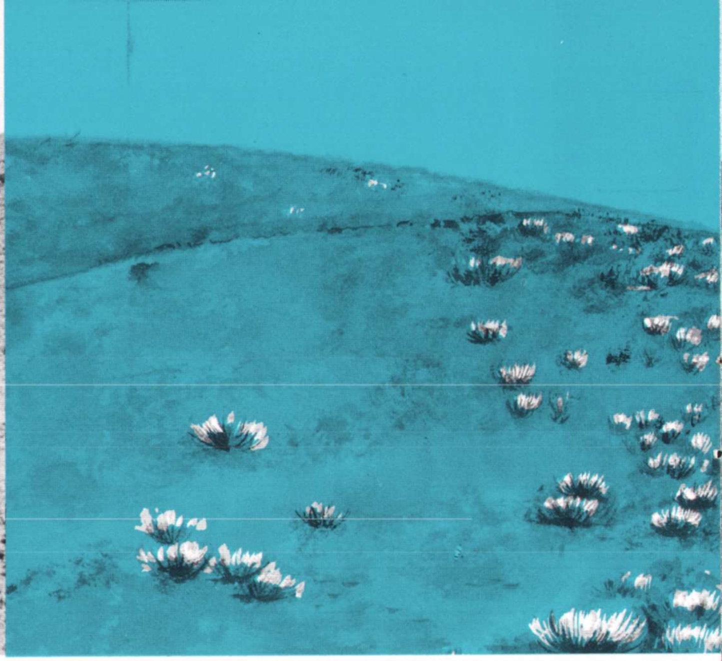
The female alkali bee mates in late June and spends several weeks gathering nectar and pollen and laying eggs before she dies. She digs a hole in the nesting site, digs down 6 to 10 inches, puts in a pollen ball, lays an egg on it, and plugs the cell with soil. From one entrance she digs branches into a number of individual egg-pollen chambers.

The eggs hatch into tiny, wormlike larvae, feed on the pollen, and spend the winter in their cells. In late May to late June, when the soil temperature and moisture are right, the larvae change into bees and dig their way out. This is the time when alfalfa is in bloom, and the females go through the cycle of gathering nectar and pollen and laying eggs.

Dr. Stephen is experimenting with improved ways of making new bee beds and reclaiming old ones. Also, he is studying the bees, trying to find more hardy individuals, and then hopes to develop an improved strain.



Alkali bee bed



Rescuing the Range —

Stubborn Sagebrush Gives Way to Lush Grass

In much of eastern Oregon all you can see in any direction is sagebrush—stretching on and on and on. In some places you see no other people, no houses, no livestock. And in the enormous silence you are likely to see nothing move but an occasional small dust devil, funneling greyish dust aimlessly here and there. You probably see a glaring sun, warming powdery soil that gets an average of only about 11 inches of rain a year, mostly in the winter months.

All this sagebrush is largely a waste, unfit for livestock feed. At one time an abundance of palatable grasses also grew on much of the rangeland like this, but overgrazing through the years caused many of the desirable plants to die out and more sagebrush and other such range robbers to crowd in. The palatable grasses have not completely disappeared, but they are becoming sparse.

Actually, 92% of Oregon is considered forest, range, and pasture and 40% of the entire U. S.—a total of 785 million acres. All of this is not sagebrush land, but all of it needs continued or improved scientific range management. Without it we eventually would have a shortage of beef, mutton, wool, water resources, timber, wildlife, and natural recreation areas.

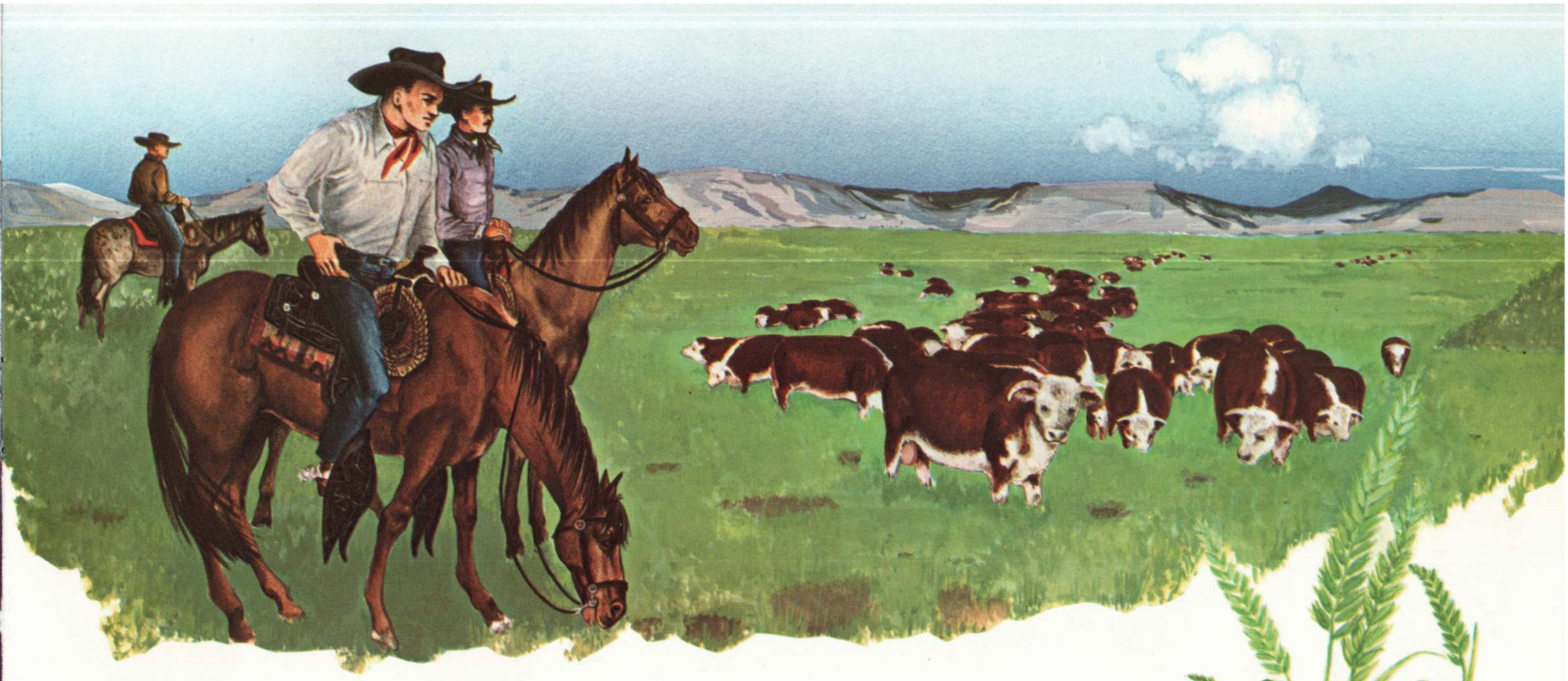
It is on these enormous western ranges—real cowboy country—that beef steak and lamb chops are born, long before cattle and sheep are rounded up to be sold to midwestern grain farmers and fed to a "finished" condition for market. Good range is essential to our economy.

Today, however, sheriffs and marshals are not galloping to the rescue of ailing rangeland. Help is coming from other sources — from teams of scientists concerned with soil, plants, chemicals, machinery, livestock.

The main setting in Oregon for range research is on 16,000 acres at OSU's Squaw Butte-Harney Branch Agricultural Experiment Station, 42 miles west of Burns. Headquarters are four miles off the main highway, through desolate, boulder-strewn, sagebrush country. W. A. Sawyer is station superintendent.

Here, scientists have found ways to change the face of their particular part of the earth, causing stubborn sagebrush to give way to lush grass.

First of all, range conservationists Dr. Donald N. Hyder and Forrest A. Sneva experimented with chemical sprays to learn what mixtures to use and what seasons were best to kill sagebrush, either by air or ground spraying.



Crested wheatgrass

In some areas when sagebrush is killed desirable native grasses increase, usually tripling forage production, and increasing beef production 10 pounds or more per acre a year.

In other areas, suitable for seeding, sagebrush and other vegetation is removed by plowing. Then the land is seeded, usually with seed of a remarkable plant—hardy, palatable, nutritious crested wheatgrass. This grass was imported in 1900 by U. S. plant scientists from a semi-arid region in Siberia, and was carefully tested in nursery and field plots before being released for general use.

Seeding is done with a revolutionary machine developed out of studies at Squaw Butte and designed by Dean E. Booster, OSU agricultural engineer.

Ordinary machines are of less value on land like that around Squaw Butte. Booster's machine, however, named the Oregon Press Seeder, is different. It proceeds over rocks, humps, hollows, and brush, sometimes seeding as many as 50 acres a day.

The seeder is 12 feet wide, has 12 broad wheels, and weighs 5,000 pounds. It is especially designed for rough ground, each wheel being individually suspended and each seed tube constructed of flexible springs. Ridges on the wheels make seed furrows into which seed is dropped. Chain drags cover the seed. The wheels pack the soil into a firm seed bed, to help chances of sprouting.

The seeder has been borrowed by various agencies for trial seedings and has proved so successful that now the first 15 models of it have been manufactured commerically for use both in Oregon and in other states.

How to manage crested wheatgrass plantings has been studied by Dr. Hyder, who wrote his doctoral thesis on the plant's growth characteristics in southeastern Oregon. He studied such things as the plant's root development, nutrients, and regrowth ability after cropping at various stages. Thus he determined when it is best to turn stock onto crested wheatgrass and for how long a period to allow grazing.

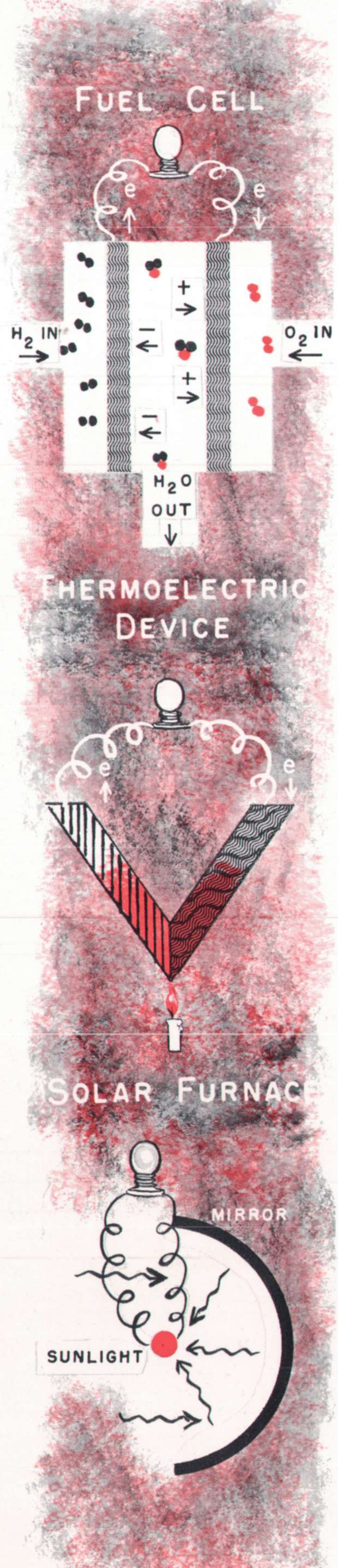
Other research at the station also has contributed to range improvement. Dr. C. B. Rumberg has worked with the use of fertilizers on meadow lands. Dr. Robert J. Raleigh and Joe D. Wallace work with livestock. In research concerning the effect of various diets they use a beef animal with a removable plug in its side and first stomach. Thus they actually can observe activity and can take samples to analyze from the stomach contents. They check feed quality by using stomach bacteria to digest feed samples in a test tube.

Because of research at Squaw Butte, today's seemingly endless stretches of sagebrush someday may be replaced with desirable forage plants. Some experts conservatively predict that income from Oregon's ranges may be doubled in the next 25 years.

Research at Squaw Butte-Harney Experiment Station is jointly operated and financed by Crops Research Division, Agricultural Research Service, USDA, and the Oregon Agricultural Experiment Station, Corvallis.

Exotic Sources of Energy

Electrical Power Directly from Chemicals



Because of their present research, engineers soon may turn the wheels of civilization, light the lights, and warm the shelters with an insignificant looking little apparatus called a fuel cell.

The cell lacks things usually associated with making wheels go around. It has no metallic, whirling, spinning cogs and rods. It does away with pistons, crankshaft, cooling system, transmission, spark plugs, and exhaust pipe. It also does away with engine noises and fumes, since it has no moving parts, no vibrations, no combustion.

It could even do away with central power stations that burn fuel—at only 15% to 35% of its total energy—to make steam that drives turbines.

It could cut present fuel costs in half or more. It is light in weight. It can be made of any size, even small enough for satellite instruments; and one no larger than a drawer of a filing cabinet can supply electricity and heat for the average home. It need not be grouped with other fuel cells for increase in power; instead, cells can be placed here and there in a building or automobile to suit the needs of space and weight distribution.

The fuel cell, however, still has one major disadvantage. It wears out too fast. Scientists have not yet found materials practical for its construction.

Attempts to solve fuel cell problems are being made at OSU by Dr. Robert E. Meredith, chemical engineer. He is being assisted by a grant from the U. S. Air Force, as well as by funds of the OSU Engineering Experiment Station. He is doing research on materials with which to build the cell so it will last for a long period; and he is trying to learn more about what actually happens in the fuel cell so it can be built to operate more efficiently, extracting as much energy as possible from the fuel used. The cell can use a wide variety of fuels, but Dr. Meredith is trying carbon, a refined form of coal, and hydrogen.

The fuel cell is much like a storage battery, points out Dr. Meredith, except that it never needs recharging as long as it is fed fuel and air. It is designed with a fuel intake on one side, and with an air intake and oxidation products output on the other. Inside, between two porous electrodes, is a solution of potassium hydroxide. The reaction of fuel and chemicals creates the electrical power.

Research on other exotic means of converting heat directly into electricity also is being done by OSU engineers. S. A. Stone, electrical engineer, is working on thermoelectric devices. When a junction between two different materials is heated, electricity is produced. Such a device, made up of many such junctures, is well suited for producing electricity directly from the heat available in nuclear reactors.

The tremendous heat produced in nuclear reactors may be used to produce power directly from a plasma device. In these, electrical charges are literally boiled off materials, with the resultant production of electricity. J. F. Engle is conducting research on this type of electricity production to find out more about the process and develop it into a more practical operation.

In other research, scientists are attempting to use the sun's energy. Dr. C. E. Wicks is using a solar furnace that can concentrate the sun's rays into a small area to produce extremely high temperatures at which chemical reactions may be studied. The solar furnace can be used also to produce electricity directly by means of the several exotic methods mentioned previously. ◆ ◆ ◆

The Living Cell

What Makes It Live? How Does It Reproduce?

A living cell and a nonliving atom have much in common. Both have movement, the cell's activity producing the energy of life in plants and animals, the atom's activity producing the energy of electricity in elements and compounds. The big difference between the two is that the cell is alive; that is, it eats and it reproduces.

But what is the mysterious process that keeps a cell alive? And why does it split in half, producing two daughter cells that in turn also split, and so carry on life?

In various laboratories at OSU, basic research is aimed at trying to answer these and other questions about the cell. Using recently developed equipment more intricate than any yet devised to run the most complicated manufacturing process, biochemists in the Science Research Institute are carefully putting together parts of the puzzle of what keeps a cell alive.

They know a cell is made up of thousands of organic substances called enzymes, or catalysts, and that these enzymes use the oxygen we breathe to burn (or oxidize) foodstuffs, changing them to carbon dioxide and energy. This energy, like the flames of thousands of small candles, is released in every cell throughout the body.

These scientists know, too, that cells carry out building processes, like tiny artisans, changing foodstuffs into the comparatively large molecules the body needs. Although it may take a long time for the researchers to gain complete knowledge of the chemical events that take place in the body of a human or animal, those in the Institute are constantly discovering new processes that may help lead to advances in the cure of major degenerative illnesses, such as heart disease or cancer.

In another laboratory on campus, zoologists Dr. Ernst Dornfeld, head of the department, and Dr. Alfred Owczarzak are trying to learn why a cell reproduces, what the requirements are for cell division, and how a cell maintains contact with its neighbor cells. They point out that if we knew more about what happens to normal cells we could better understand what happens when abnormal cell growths, such as cancer, occur.

They isolate pieces of tissue from various organs of living, unhatched chicks and culture them in specially constructed chambers, where the tissue — under optimum conditions of nutrition and temperature — can live and grow indefinitely. Requirements of this research are so rigorous that conditions for isolation equal those of a modern hospital surgery.

While the tissue is growing the zoologists can watch what takes place, for modern technological developments have made it possible for them to see clearly inside cells so tiny it takes 2,000,000,000,000 of them to make up a newborn child. While looking through the microscope they can, at the same time, record the activity on motion picture film. Using the technique of time-lapse photography, they speed up the record of living processes so that events that normally take hours to photograph are condensed into a few minutes when projected. In this way each change is emphasized and is easily detected and measured.

The cells, seen this way, seem to be floating in the culture medium. The transparent nucleus, taking up much of each cell, is quite evident. In a dividing cell the dark, threadlike chromosomes jiggle and swarm at the cell's equator in preparation for division (mitosis).

At the proper moment the chromosomes divide and their halves move apart, moving to the opposite poles of the cell. The cell elongates, pinches in at the middle, and pulls apart with a sort of explosion as the cell membranes bulge and bubble. Then the membranes smooth out again and the two cells prepare for another cycle of mitosis. In some tissues, such as bone marrow where red blood cells are formed, 4.3 billion cells are in division at any one moment.

In addition to making these live studies, Drs. Dornfeld and Owczarzak are studying structural and chemical changes in the nucleus, chromosomes, cytoplasm, membranes and intercellular materials. They use both the classical techniques of cytology and newer methods of cytochemistry and electron microscopy.

A number of grants have increased research at OSU on the living cell. The zoologists have grants from the American Cancer Society and the National Public Health Service. The Science Research Institute has received grants from these organizations also, plus the American Heart Association, Oregon Heart Association, Nutrition Foundation, National Science Foundation, Atomic Energy Commission, Office of Naval Research, Research Corporation, Frasch Foundation, Life Insurance Medical Research Fund.

The Science Research Institute, jointly with the department of zoology, is also conducting an advanced training program in cellular and molecular biology. This program, financially supported by the U. S. Public Health Service, is specifically designed to develop research workers who will devote their energies to the study of life on the cellular level.