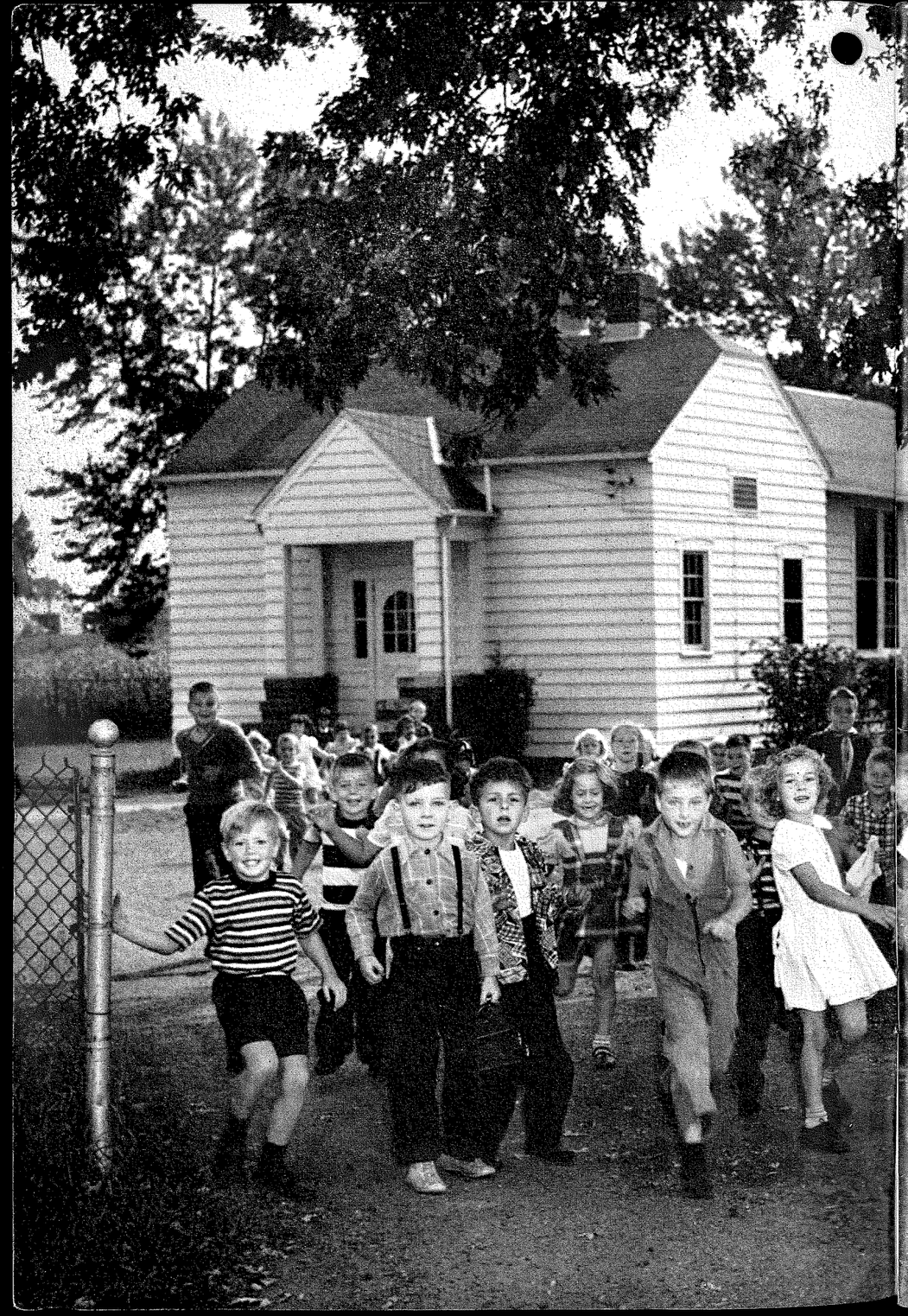
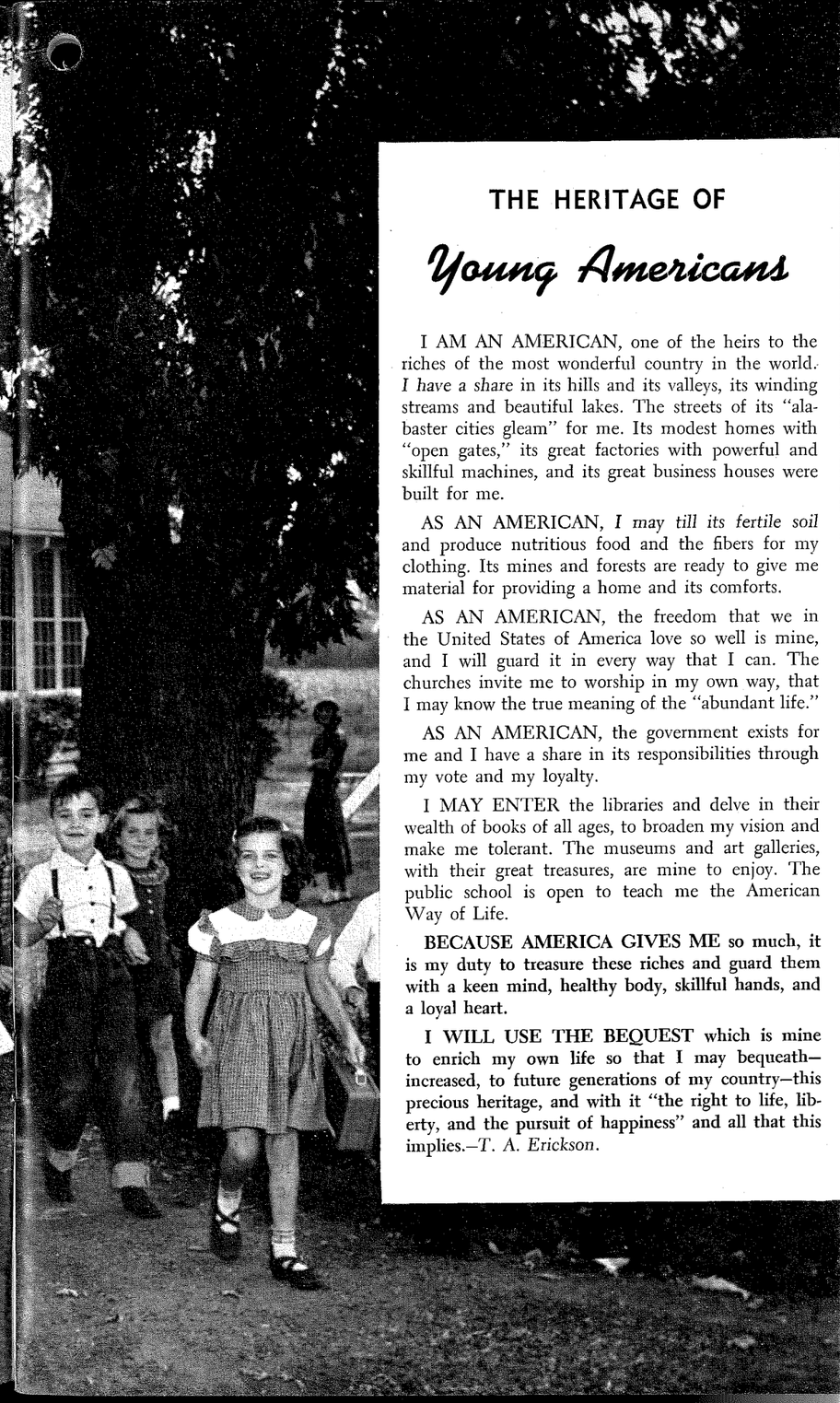
Extension Bulletin 260
Reprinted June 1954

Our soil to use...

UNIVERSITY OF MINNESOTA
Agricultural Extension Service
U. S. DEPARTMENT OF AGRICULTURE





THE HERITAGE OF

Young Americans

I AM AN AMERICAN, one of the heirs to the riches of the most wonderful country in the world. *I have a share* in its hills and its valleys, its winding streams and beautiful lakes. The streets of its "alabaster cities gleam" for me. Its modest homes with "open gates," its great factories with powerful and skillful machines, and its great business houses were built for me.

AS AN AMERICAN, *I may till its fertile soil* and produce nutritious food and the fibers for my clothing. Its mines and forests are ready to give me material for providing a home and its comforts.

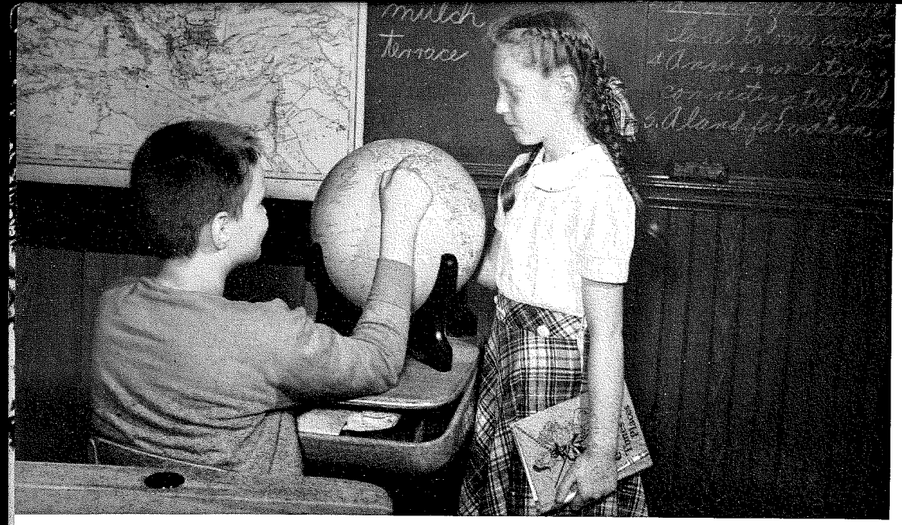
AS AN AMERICAN, the freedom that we in the United States of America love so well is mine, and I will guard it in every way that I can. The churches invite me to worship in my own way, that I may know the true meaning of the "abundant life."

AS AN AMERICAN, the government exists for me and I have a share in its responsibilities through my vote and my loyalty.

I MAY ENTER the libraries and delve in their wealth of books of all ages, to broaden my vision and make me tolerant. The museums and art galleries, with their great treasures, are mine to enjoy. The public school is open to teach me the American Way of Life.

BECAUSE AMERICA GIVES ME so much, it is my duty to treasure these riches and guard them with a keen mind, healthy body, skillful hands, and a loyal heart.

I WILL USE THE BEQUEST which is mine to enrich my own life so that I may bequeath—increased, to future generations of my country—this precious heritage, and with it "the right to life, liberty, and the pursuit of happiness" and all that this implies.—*T. A. Erickson.*



Even our 36 billion acres of land will not feed the world tomorrow unless we save our soil today.

We Have Billions of Acres of Land

THIRTY-SIX BILLION acres of land—this has been given to all the people of the world. Surely this is enough to grow food for us all. But much of this land is on deserts or mountains, in places too dry, too hot, too high, or too steep to grow food. Our scientists tell us that only one acre of seven will grow crops. This leaves only two acres to produce food for each human being.

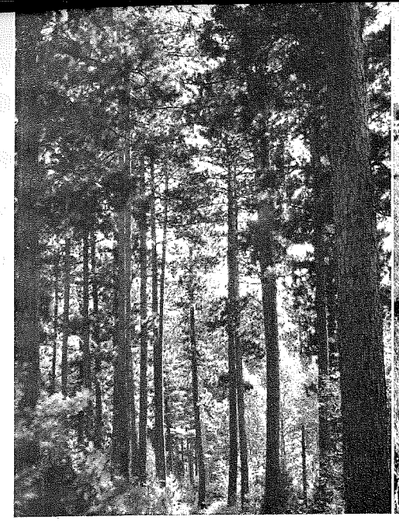
Today, our land must grow food for twice as many people as it did 100 years ago. In another century there will be twice as many people to feed as there are today. Food is now being grown in every possible place. We must do all we can to keep our precious soil and make it fertile for growing food for us, our neighbors, and our children.

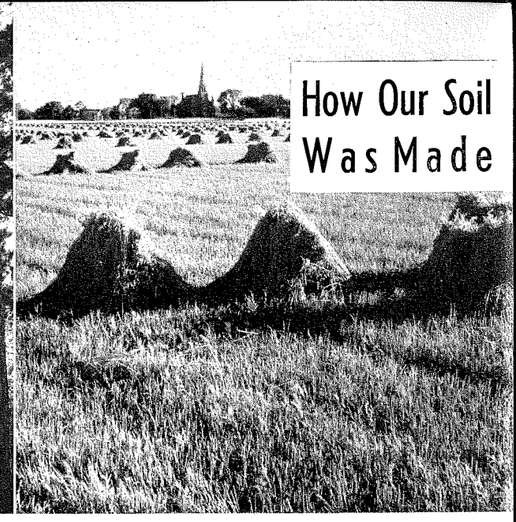
Saving and caring for soil is not a new problem. George Washington and Thomas Jefferson worried about it. Many other famous men also have worked hard trying to keep our soil rich and productive. Even today, however, the need for saving our land is not understood.

The top of our soil (topsoil) produces more than the soil below (subsoil). We must keep this topsoil from blowing and washing away. This is what we call erosion. At the same time, we must keep topsoil from wearing out so it can continue to grow good crops.

Actually, with all our modern inventions and knowledge, we can make the soil produce more today than it did in the "old days." Finding new and better crops, discovering better ways of managing this land, and finding new uses for the crops we grow—all call for hard work and keen wits.

Why not join the scientists in exploring this new frontier—a frontier that will save our land and provide more and better food for us and our children and our grandchildren?





How Our Soil Was Made

Land once covered with woods is different today from land which was covered with prairie grasses.

Our Soil Was Made from Rocks

MOTHER NATURE worked thousands of years to make our soils. She ground up rock-like material to do the job. Most Minnesota soil was formed by glaciers. Thousands of years ago great sheets of ice spread over our state. They scraped down hills, filled in valleys, and ground rocks to sand and dust. Large areas were leveled, others were pushed up into hills. In some places big patches of sand were left; in others, lakes, ponds, and swamps.

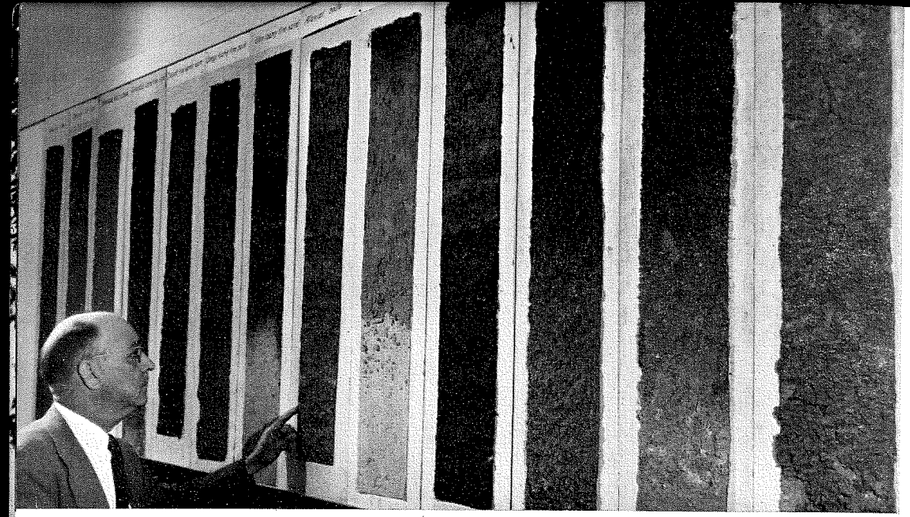
The famous Red River Valley was formed by these glaciers. Once it was a great glacial lake called Lake Agassiz. There now is Minnesota's largest area of "lake-laid" soil.

Near the end of one of the glacial periods, severe dust storms carried fine soil from the flood plains of streams upland to some of our southeastern and southwestern counties. This coating of wind-formed, pebbleless soil ranges from 1 to 15 feet deep.

Soils also were made and changed by the plants growing on the land and the climate (temperature, rain, and snow).

The plants covering the land influenced our soil greatly. In some places tall grasses grew, in others trees, and in still others both. Where tall grasses grew, *prairie soils* developed. Grasses produced large quantities of organic matter (decaying animal and plant life). This made a storehouse supplied with plant food to grow crops. Our prairie soils in southern and western Minnesota have a dark-colored surface rich in organic matter and nitrogen.

Where trees grew *wooded soils* were formed. The forested part of Minnesota at one time supported magnificent stands of pine trees, but most of this timber was cut years ago. Now this area, called cutover country, has a second growth of hardwood. Timbered soils in eastern and northern Minnesota are generally light colored, lower in organic matter and nitrogen than prairie soils.



This University of Minnesota exhibit shows only a few of the hundreds of different kinds of soil in Minnesota.

There Are Many Kinds of Soil

HAVE YOU ever seen a purple cow? Of course not, because the purple cow exists only in the imagination of a writer of nonsense jingles. We do know though that there are red cows and black cows and brown cows. We tell cattle apart by their color, size, shape, and other things. Soils are different in many ways, and so we can tell them apart, too. We have told you about the two main groups of soils, prairie and wooded soils. In Minnesota we actually have over one hundred different kinds or sub-groups of soils. Let's take a look at some of these.

Some soils are good, some are poor! Some good soils will produce more of certain kinds of crops and less of others. The same is true of the poor soils. All of our soils, whether good or poor, will produce if the proper crop is planted. Choosing the right crop is called good land use. Some soils are poor because people have not followed good land use. For example, soils that would produce excellent timber would be of little value in producing corn and grain.

Strange as it may seem, the topsoil for two different soils may be similar. Underneath they may be entirely different. This difference may make one soil excellent for farming and another poor.

Just as we name different types or breeds of livestock, we name different soil types. You can tell different livestock breeds apart by such things as color, size, production, and growth. Some cattle are best for producing beef; some are best for producing milk. Some soils are best for producing corn, grains, hay, and pasture; others are best for producing timber.

We tell soil types apart by such things as color, texture, and the slope of land. Many counties now have soil maps which show the different soil types in a county or on a farm. Studying these maps helps the farmer plant the best crops on his land.

These profiles show how soils differ. Notice the timber soil on the left and the prairie soil on the right.

Profiles Tell of Underground Wealth

MAPS MEAN ADVENTURE. In pirate days they often pointed to buried treasures and hidden wealth. Today, maps of our soil tell us of our wealth below the surface. These maps are made from *soil profiles*.

A soil profile really is a side view of the soil from the surface down to 40 inches or more. You can see such a side view in road cuts or ditches. You will notice the difference in the various layers such as the depth of the black topsoil and the color depth of the various layers.

Let's look at some typical soil profiles and see how they differ.

A sandy soil profile often shows a topsoil of a fine sandy loam up to 12 inches deep. The color may be a dark grayish brown. Below the topsoil there may be 18 inches of a brown to a dark brown fine sandy loam. Below this may be loose, coarse sand and gravel, light brown to yellowish-brown or even yellow down to a depth of three feet. The land itself may be gently sloping. If you see this soil in a road cut, you would know that crop yields would be low unless there was a lot of rain in the spring and summer.

A profile of a *medium* or *heavy soil* tells a different story. The very dark grayish brown to black surface soil may range from 8 to 12 inches deep. This surface soil may not be this deep because this soil is usually gently rolling and often erodes. The subsurface soil to a depth of 24 inches may be brown to yellowish brown. The heavy subsoil to a depth of about three feet is yellowish-brown to yellow. There may also be some rusty brown and gray streaks. Immediately you see the difference between these two soils. This last soil is one of the best in the State.

Other profiles tell us other stories about our soil and tell us again how important it is to use our soil properly.

If you were to look at soil through a microscope you would see many fine roots. Some are dead, some alive.

The Soil Is Full of Living Things

IF YOU were to look at our soil through a microscope, you would be surprised at all the living things in it. We call these living things bacteria and fungi, and they help plants to grow better in soil.

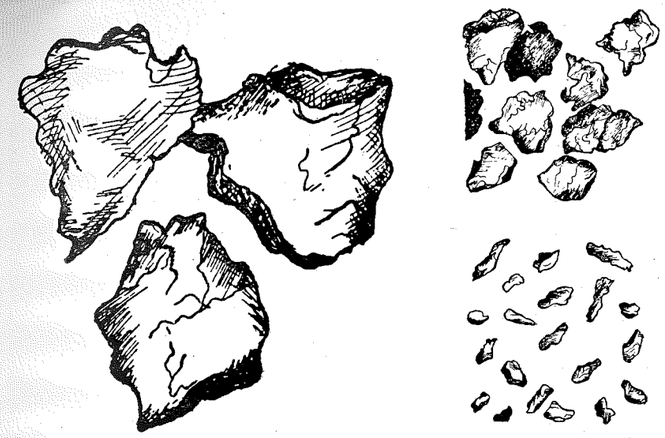
Plants live and grow on the food that the soil and the air provide. Air supplies the oxygen and carbon dioxide needed for all plant growth. The soil provides water and plant food.

All through the soil there are the roots of plants. The smaller roots are covered with hundreds of very fine fibers called root hairs. These root hairs are searching everywhere for food and water in our soil. Among these roots are also dead roots and stems. Looking at these through a microscope, we probably would find them covered with bacteria and fungi. These little organisms digest or rot the dead roots and stems (organic matter) and form plant food.

The soil, of course, provides plants with many things they need—nitrogen, phosphorus, potassium, and calcium. Nitrogen, for example, is furnished largely by organic matter in the soil. In addition, legumes like alfalfa and clover take nitrogen from the air. The phosphorus, potassium, and calcium are supplied in other ways.

Most Minnesota soils once had plenty of these foods. Now, however, many are showing signs of wear after nearly a century or more of use. Many of the elements we mentioned are being lost. Without them our land will not produce all the things we want. This is especially true of phosphorus, and, in some cases, nitrogen and potassium. On the sloping lands, where valuable topsoil is washing away and is being poorly used, the loss of organic matter and nitrogen is most serious.

Lack of enough grass and legume crops to hold the soil in place on most farms has been one of the other serious causes of our soils wearing out.



Soil comes in many sizes. The larger the particles, the more space between the particles and the quicker water is lost. Here we have, magnified many hundred times, fine sand (left), silt (upper right), and clay (lower right).

The Soil Stores Water for the Future

ALL LIFE, from tiny creatures within the soil to humans like us, must have water to live and grow. But water can also destroy!

Let's see how water works with soil in many ways. Soil stores water. When rain and snow fall, they become a part of the soil. When some soils become dry, they are hard to plow and cultivate. When moist, they are soft and crumbly and even sticky. When soil that is too wet is plowed, it looks shiny because it has run together. This soil will hold only a little additional water.

Why do some soils store or hold water better than others? If we look at soil closely, we can tell that soil is actually a network of small particles of soil separated by tiny spaces. These spaces are connected. Thus, when the soil is wet, each piece is surrounded by water. Sandy soils (coarse) have only a few large spaces. Clay soils (heavy) have many very tiny spaces. Loams, a combination of the two, have more medium-sized spaces.

The size of these spaces determines how much water a soil can hold. Water in the large spaces (sandy soils) drains out rapidly and helps crops very little. Water in the medium-sized spaces (loam soils) moves fairly easily but stays in the soil. Crops can use this water. The more medium-sized spaces soil has, the more water it can hold for plant growth. Soils with tiny spaces (clay) cannot hold much water for plant growth. If clay soils have plenty of organic matter, they have medium-size spaces.

When it rains, water moves into the soil the fastest if there are some large spaces present. During droughts, water moves up from the moist subsoil. Put one end of a straw in a glass of water and see how the water rises higher inside the straw than it is in the glass. Water moves in the soil much the same way. This is an important way plant roots keep well supplied with water and plant foods.

This field of corn was ruined by the lack of water during one of our worst drouths.

Plants Get Thirsty for Water

ONE CORN PLANT can drink nearly a barrel of water during a growing season. Some 400 years ago people believed that plants used this water as food. Later scientists found that the green color (chlorophyll) in leaves uses sunlight to change carbon dioxide in air and water in soil to food for plants. Now we know, too, that soils help carry food from the soil up to the leaves of plants.

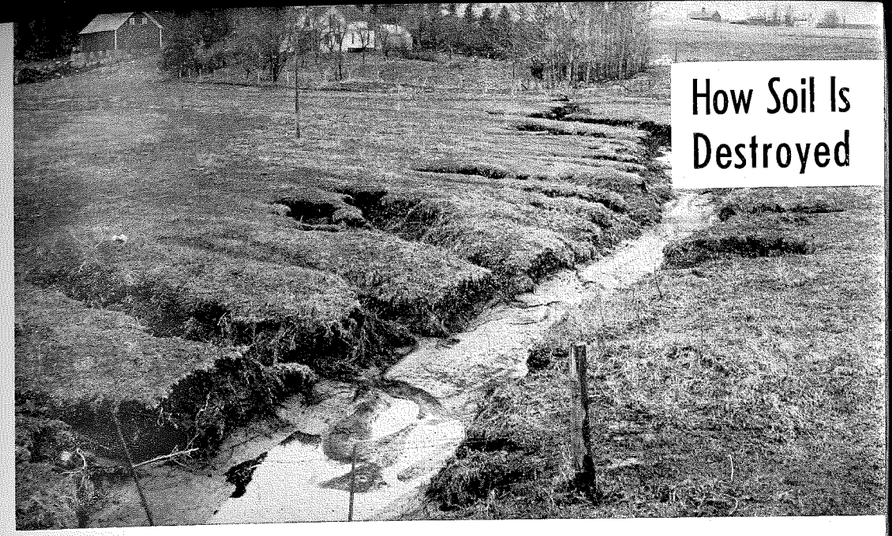
Plants, like people, also need protection from the sun's heat. Plants keep cool by losing water through tiny pores in their leaves. This is called transpiration and is much like our sweating. A field of corn may give off as much as 15 inches of water during the growing season.

Counting the water lost by plants "sweating" and by evaporation from the soil, we need 20 inches of rainfall to raise a bumper crop of corn. A heavy soil can store 6 to 8 inches of water while a very sandy soil can store only one inch. Dry spells, therefore, are harder on sandy soils than on heavier soils.

Not only does water protect plants against heat, but also it helps to change food in the soil, such as nitrogen, phosphorus, and potassium, into forms plants can use. Here's how it is done. Soil water is filled with tiny living things. Most of these digest the organic matter and break it down so that plant foods are released. Others live on the roots of plants. All need water if they are to live and work.

When the soil has a lot of water, some moves down, carrying away plant foods. In heavier soils this movement is slow, but in sandy soils it is fast. When soil is too dry, plant foods do not move to the roots fast enough to take care of the plant needs. For example, during dry seasons, it is the lack of the plant food, nitrogen, not the lack of water, that causes injury to plants.

How Soil Is Destroyed



Water running downhill with nothing to stop it makes gullies or big ditches like these.

Water Is Both a Friend and an Enemy

WATER IS one of the best friends both men and soil have. But it also destroys the soil we are trying to save.

The force of rain drops falling on bare soil breaks up and dislodges soil particles. These small pieces fill in the large spaces in the soil and seal the surface so that water cannot get into the soil.

As the water collects, it runs off the land, carrying with it the small pieces of soil which have been loosened. We scarcely notice that soil is lost until we begin to turn up light-colored subsoil when we plow. This is called sheet erosion. It is especially dangerous because we do not notice it until too late. This is the first stage of soil loss or water erosion.

After sheet erosion removes the topsoil, gullies start to form. Usually the water running off the field will follow low places like the track of a wagon or tractor. Tiny ditches are formed which are easy to see after a rain but disappear the next time the field is cultivated. The little ditches soon deepen with more rains into gullies too big to cross with machinery. The final result is a field so robbed of its good topsoil and so cut up with gullies that it cannot be farmed.

Nearly one out of every four acres of crop land in the United States has been damaged or destroyed by water erosion. In addition there have been untold losses from floods. Reservoirs have been filled with silt, homes ruined, and lives taken by runaway water.

Valuable plant foods are lost along with this soil. But we lose more than just the plant food. Erosion also removes organic matter which gives the soil its ability to hold water. Less water enters the soil during rains and more runs off, thus increasing erosion. Because less and less water remains in the soil, there is very little left for crops in dry seasons.

If there is nothing to stop the force of the wind, it blows some soils into drifts.

Wind Blows Our Valuable Soil Away

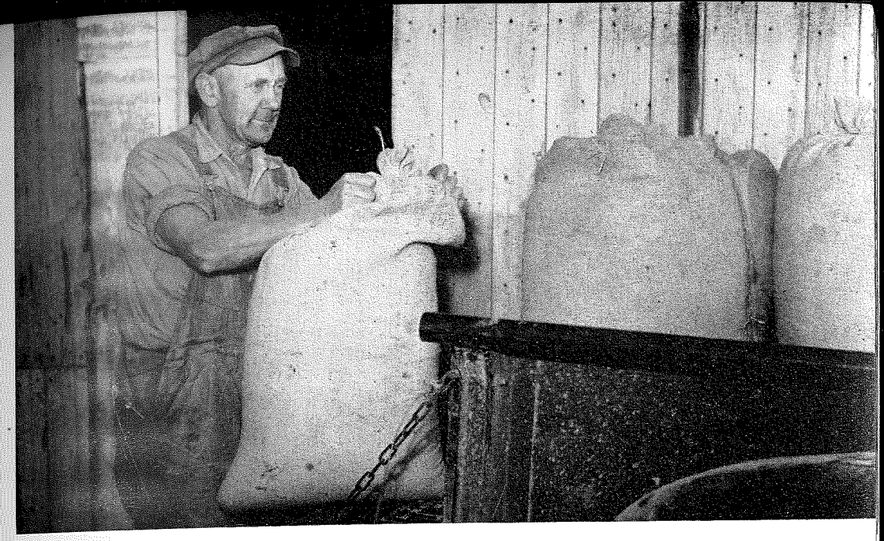
DRIFTS OF SAND, like snowdrifts, can stop a train. This happened once in Minnesota. If drifting can do this to trains, imagine what it can do to our farms. Of course, like water, wind can be both good and bad for soil. Thousands of years ago wind helped build soils. It blew small pieces of soil against larger ones, breaking them into smaller and smaller pieces. Thus, we got sand particles and silt. Some of our very good loam soils in southeastern and southwestern Minnesota are these wind-made soils.

Wind can also be bad for soil. Loose, dry, bare soil drifts like snow when strong winds blow. The less crops or stubble the soil has, the more it drifts. This drifting, of course, is worse in the open country where there are no trees or hills to slow down the wind. This drifting of soil is called wind erosion. Soils low in organic matter blow more than soils well supplied with organic matter.

Wind erosion has already damaged over five million acres of farm land in Minnesota. Some is badly drifted. Most of the damage is caused by finer parts of the soil blowing away. The coarser sand particles are left. In this way, the topsoil gradually becomes poorer.

Many times, sand and soil are piled in drifts along fence lines and highways. The drifting sand skimming along the surface cuts tender young plants and kills or seriously injures them. This means less food for all of us.

When wind erosion becomes really bad, we have dust storms. The dust may be blown hundreds of miles. Farm machinery and fences may be buried. Orchards and farm shelterbelts as well as farm crops may be smothered. All the topsoil may be blown away. When this happens, farmers cannot make a living on the subsoil. They move away just as they did in the dust bowl of the western plains in 1934 or 1936.



When a farmer sells grain or corn or livestock off his farm he sells plant food from his soil. This plant food must be replaced.

Man Wears Out and Sells the Soil

CAN WE MAKE our soils last for thousands of years or will we let them wear out in a few hundred years? Our answer to that question, even more than the atom bomb, will determine how long our civilization will last.

Here in Minnesota we have used our soil for only a hundred years. Each year, though, crops use up huge quantities of plant foods—nitrogen, phosphorus, potassium, lime, etc. from this soil. To replace all of this, we would have to apply between one and two million tons of commercial fertilizers to our fields each year. Luckily, we don't have to return *all* of these plant foods now since the soil has a large reserve. Even now we should be returning much more than we are.

Everything that leaves the farm takes food and fertility with it. Livestock, of course, return much of the food they eat on farms to the land in the form of manure. Many of our crops, however, are sold off the farm. When these crops leave, the plant foods they contain leave with them. Plant food also leaves the farm when livestock, such as cows, pigs, and sheep, and livestock products, such as eggs and milk, are sold.

Minnesota soils, when they were first plowed, were very fertile. Most of our land is still fertile, but the removal of plant food by crops has cut down yields greatly. That is why the use of fertilizers and other soil building practices are increasing rapidly.

Before 1940, we never used more than 17,000 tons of commercial fertilizers a year in Minnesota. Today, nearly 275,000 tons are spread on the land each year.

To get the most from our land and still conserve it for future generations requires careful land use. Later in this bulletin we will tell you some ways to save soil and stop it from wearing out.

When the soil is worn out it produces poor corn (left). The cow is unhealthy because her hay and feed came from soil lacking proper food.

Plants and Animals Can Talk!

HOW ARE WE to know that our soil is wearing out? The answer is easy. Plants and animals can talk! We have to learn to understand their sign language.

For example, the leaves of a plant which needs nitrogen badly turn yellow or a light yellow-green down the center. On the other hand, leaves of healthy plants getting plenty of nitrogen are very dark green and glossy.

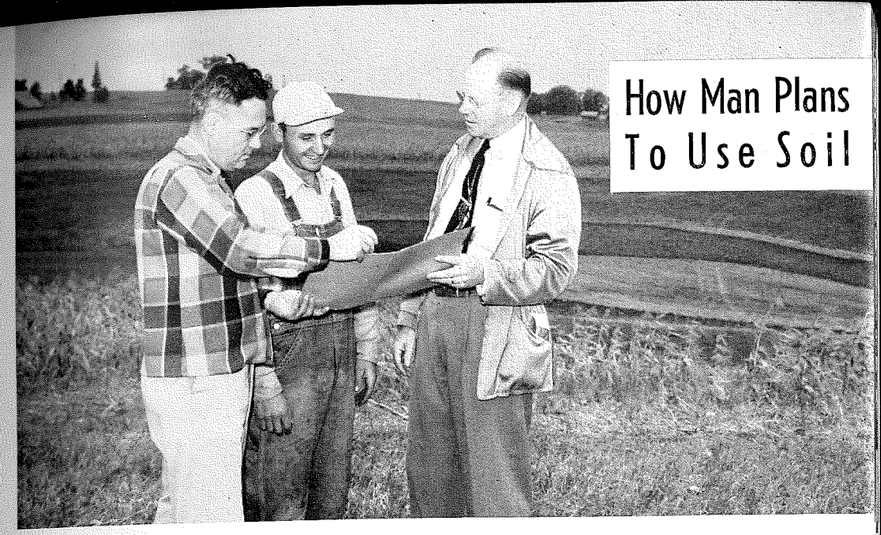
When the soil is low in potash, first the lower and then the higher leaves turn yellow and brown along the edges. Plants also tell us, by their signs, if they don't have enough phosphorus, calcium, and other elements they need to grow up healthy and normal. We can learn to recognize these and other hunger signs. Good books have been written for us on this subject.

Animals live mainly on crops grown on the farm. If the land and, as a result, its crop are low in plant foods, the animals often develop "deficiency diseases." We can recognize these easily, too. A cow without enough phosphorus in her diet cannot grow normally and be healthy. She will be small, her coat (skin and hair) rough, and her joints large. She will chew bones and wood to get some of the phosphorus she craves.

In this way, animals show that there is not enough plant food in the soil. In fact, even humans who eat the grain and fruit grown on these soils suffer. Poor teeth, for example, may be caused by low calcium and phosphorus foods. Poor soils then mean poor crops, poor livestock, and undernourished people.

Keeping the soil fertile and productive by using crop rotations, farm manure, and commercial fertilizer, and lime where needed, will insure healthy, well-nourished crops. These in turn will make better feed for our livestock and better food for humans.

How Man Plans To Use Soil



It takes planning to use soil wisely. Here a county agricultural agent and a soil conservationist plan with a farmer.

Man Must Use Soil Wisely

WHEN OUR FOREFATHERS came to America, they found a continent rich in virgin forests, prairies, clear waters, and productive soils. They managed the land as they did in the "old country" where erosion was not a serious problem. Then erosion ruined lands because farmers did not understand our climate. Today, they know they must farm differently.

Every farmer needs a land-use program of his own. He should put every acre to its best use. To do this he must consider what *kind* of soil he has, whether it is hilly or level *(topography)*, how serious the *erosion* is, and how satisfactory *crop production* is.

In the sections of this bulletin that follow we will tell, first, about permanent changes that should be made to save soil and, second, about changes that farmers can make from year to year.

Here are some of the steps they might take:

1. Place some steep hilly land in a timber and wildlife area and some in permanent pasture.
2. Drain land if necessary so it will grow bigger and better crops and at the same time cease heavy farming of other land.
3. Use lime and fertilizer where necessary. The University of Minnesota soil testing laboratory will test soil.
4. Seed legumes and grasses and change crops (crop rotation).
5. Plow under legumes, grasses, manure, cornstalks, and straw to build up organic matter.
6. Use other erosion control such as grassed waterways, contour cultivating, strip cropping, or terracing, if necessary.

Not all of these practices are needed on every farm. Some are more necessary on one farm than on another. If this land-use program is properly applied on every farm, Minnesota soils will be kept productive permanently.

How Trees Help Conservation

Trees hold and protect the soil on steep hills. On level land they keep soil from blowing away.

Trees Protect Land in Many Ways

FOR MORE THAN 200 years following the settlement of Plymouth Colony, pioneers had to push back the forests. Everywhere trees clothed the land. Trees were considered more of a bother than a help.

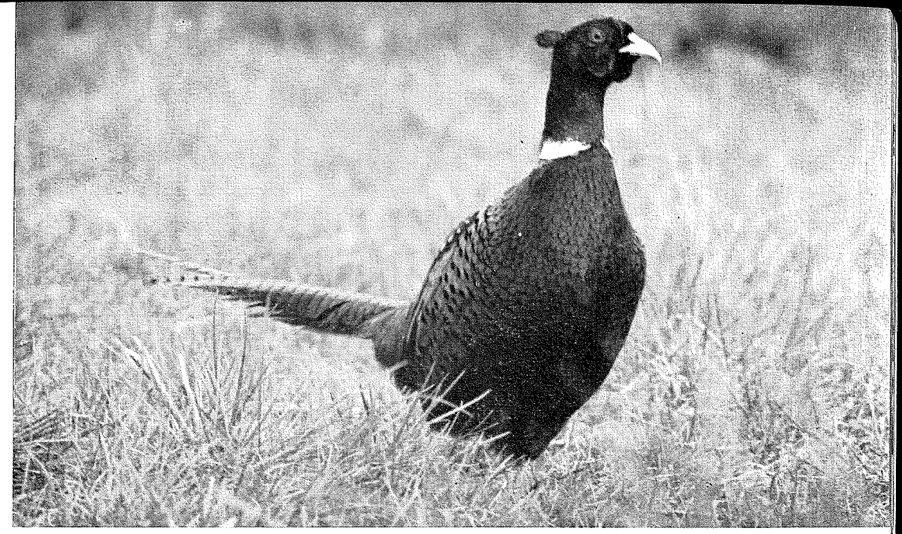
After westward migration reached the Great Plains, though, pioneers realized that trees protected the soil, themselves, and their livestock. Thereafter, there were men who planted trees.

Planting trees around the farmstead or narrow strip plantings across fields, for example, breaks the force of the wind. Thus, soil blowing is cut down. Crops are not cut off by drifting sand or covered by drifting soil. Tree belts also protect growing crops from scorching winds that cause both leaves and soil moisture to dry up. In the winter these same tree belts trap snow and hold it on cropland. Some years this can make the difference between a good and poor crop.

Many livestock farmers find that shelter furnished by trees reduces feed bills and saves livestock. Fuel needs for heating the farm home can be cut almost 30 per cent when trees shelter the home from winter's icy blasts. Tree belts protect orchards, too, when trees are in bloom and later when fruit is ripe.

Hillsides too steep to pasture should be in trees. Using these areas for pasture or field crops causes floods, severe gullying, and deposit of silt on good fields below. Wooded slopes, on the other hand, have very little water runoff and offer no erosion problem.

A permanent forest cover breaks each rain drop into tiny particles and lets it fall gently to the soil. Like a huge blotter, the partly decayed layer of fallen leaves and twigs on the soil soaks up this water. Gradually, the water seeps downward into the soil. Then, instead of running, it walks to the nearest stream.



Land protected from erosion provides wild game with a good place to live.

Good Land Use Saves Wildlife

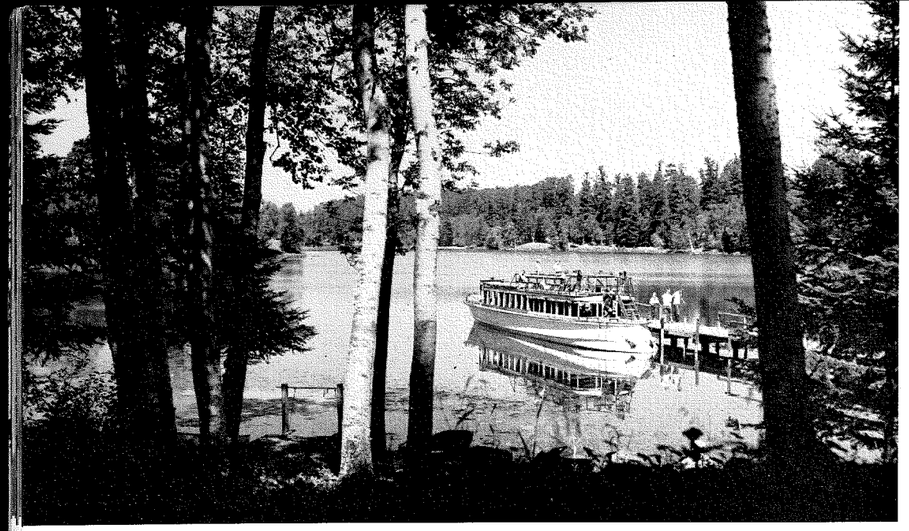
WHEN EARLY French and English explorers were dreaming of finding a "Northwest Passage" from Hudson Bay to the Pacific Ocean and for more than a century afterwards, fur-trading was the important business in the Northwest.

Today, wildlife is less important in our everyday living, but it still benefits us all. Even today fur animals bring a part-time income to many farm boys. We all recognize how ably our feathered friends help to control insect and weed pests. Are we aware, too, that the mole, ground squirrel, and even the skunk and fox feed upon our insect enemies? The contribution wildlife makes toward our increased enjoyment of the out-of-doors is hard to measure, but we do know that it adds to human happiness.

Wildlife is, first of all, a product of the soil. It will live or die according to what is done with the land and its plant cover. In other words, to increase wild birds and animals, the most important step of all is to *use the land wisely*. Where the land is fertile and healthy, wildlife will be abundant.

Proper crop rotations and strip-cropping (explained later) furnish different types of vegetation favorable to wildlife. On steeper slopes, trees hold the soil as well as provide excellent protective cover for birds and animals. Livestock, though, should be kept out of the woodland.

Planting shrub borders around the timber area helps both timber and wildlife. Trees and shrubs planted along rivers, ponds, and gully banks, where it is important to stop soil washing, provide wonderful cover and food for upland game birds and animals. Brushy fence lines furnish good wildlife cover. Fence rows grown up to brush and sod slow the flow of water, break the force of the wind, and thus help to prevent wind erosion and loss of soil moisture.



Soil, water, and wildlife conservation protect vacation spots like Lake Itasca.

Conservation Provides Vacation Spots

EVERY MINNESOTAN enjoys the great out-of-doors. Shorter working hours in the city and better machinery and equipment in the country have given people more time for leisure. People's tastes are different, but most people are attracted to places where the landscape boasts of beautiful trees and lakes. Our forests and woodlands give us clean wholesome living, conserving our bodies as well as our land.

Trees enrich our enjoyment of a few hours amidst nature's splendors in different ways for different people. For every visitor, the forest offers a new interest, idea, or experience.

Trees represent the highest form of development in the entire plant kingdom. This may account for the fact they appeal so strongly to human emotions. We experience a real feeling of peace when relaxing in a tree-shaded picnic spot.

Though it is easy to ignore the spiritual benefits of the forest, we cannot fail to appreciate the shelter from a hot sun and scorching, dry summer winds that trees provide.

Whether it be a tree-rimmed lakeshore, forested glade, or a spot in the yard where the family gathers in the late afternoon or evening, trees play an important part in making it pleasant and attractive.

Outdoor living is important to our physical well-being, and where our pleasure is increased by the majesty of trees, we are certain to benefit.

What is more relaxing from the day to day work than to hide away for a few hours in a properly protected timbered area full of birds and wildlife surrounding a lake of clear blue water free from mud, and full of all kinds of fish? Proper land use will provide you with this opportunity.

Farmers who plant steep hills to pasture crops find these crops protect the soil and save water.

Pasture Crops Hold the Soil

STEEP HILLS and rolling land need a special coat to keep their soil from washing away. Not all hillsides need to be clothed in trees, of course. If the hills are steep, trees should be planted. However, on rolling land not quite as steep, pastures will protect the soil and its fertility.

Many people think that pastures are not as profitable as other crops. The truth is that, used in the right way, pasture gives the farmer as much income as other crops. Don't forget that to put more hilly land to pasture makes the farmer change his plans. He has to raise less wheat, oats, and corn and more cattle, sheep, and other livestock. Then he must sell the animals as milk, butter, wool, and the like instead of crops.

The farmer can have either a permanent pasture or a rotation pasture.

Permanent pastures are left in grass and legumes all the time. They are usually put on land too hilly to plow for cultivated crops.

Rotation pastures are grown on cropland and are used a year or more for grazing and then are plowed and planted to a cultivated crop. This kind of pasture is a part of a crop rotation.

All pasture grasses grow best when they are planted with a legume like clover and alfalfa. The legume feeds the grass because it takes nitrogen from the air which helps the grass to grow. The grass in turn helps the legume by keeping the soil bound together by its fine roots so the soil won't wash away. Grass and legumes mixed, moreover, make better feed for livestock than either alone. The nitrogen in the legumes forms protein which makes the animals grow and produce meat, milk, butter, and wool. All pastures need good soil the same as other crops. Pastures should be treated with limestone and commercial fertilizers if needed.

How Farmers Can Save Soil

Good farmers change from grain (left) to legume sod (center) to corn or cultivated crops (right).

Changing Crops Keeps Soil Healthy

AS WE drive down a quiet country road, all the land may look alike to us. Looking a little closer we might see fine crops growing in one field and poor crops in another field nearby. The soil on a farm is a food factory. Where you see good crops, you know the farmer is keeping his factory running at top speed. When you see poor crops, you know the farmer is not doing some of the things he should.

One thing many good farmers do is to change crops. Just as we change clothes from one day to another, farmers have to change crops on one field to another from year to year (called crop rotation). Crop rotation can prevent erosion, improve the soil, and help grow better crops.

Here's how one rotation works. A farmer might grow a row crop like corn the first year, a small grain like oats the second year, and hay or pasture the third year. This is a three-year rotation. A good rotation must include a mixture of grass and clover or alfalfa because the hay crop is the most important crop in the rotation.

Changing the kind of crops every year or two means that the land is covered by soil-conserving crops at least part of the time. This prevents wind and water erosion. The grass and legume crops add organic matter to the soil. Organic matter binds the soil together and helps to prevent water and soil from washing away.

When a farmer grows corn, potatoes, or sugar beets, more organic matter is used up than with grain and hay. Working the soil too much is like opening the draft on a stove—the fire burns more rapidly because there is more oxygen available. The soil bacteria then digest the organic matter. When air, moisture, and temperature are favorable, working the soil increases the air supply and "burns up" organic matter faster.

Plowing under a crop of legumes, as this farmer is doing, helps keep soil healthy and productive and prevents erosion.

Legumes Put Fertility in the Soil

THE BIBLE tells us that Joseph, in the days of the Egyptians, helped store grain to save people from starving in time of famine. From this "storehouse," countless people were fed. The land, too, is a storehouse of fertility. This storehouse is organic matter, the decaying remains of plant and animal life. Without it, crops can make very little growth.

We have told you how important it is to change crops and get organic matter back into the soil. Have you ever noticed that some soils are light and others are dark or almost black? Here's why. Usually, the darker the soil, the more organic matter it has. Legumes are among the most important crops helping us put organic matter back into the soil.

Organic matter contains a lot of nitrogen and some other plant foods such as phosphorus and potassium. Soils high in organic matter soak up water readily, acting like a sponge. Soils well supplied in organic matter drain better in wet times and hold water for plants to use during dry weather.

Organic matter also keeps soil from washing or blowing away. We know now why farmers should always use a good crop rotation, seed legume and grass mixtures each year, and save and plow under all of the crop residues and manure.

Crops use up a part of the organic matter each year. So we must keep putting back organic matter each year. Plowing under a good crop of sweet clover, for example, will add a fresh supply of organic matter and nitrogen. We call this a green manure crop.

Small growths called nodules (beads) on the roots are the home of the bacteria which help the legume plants store the nitrogen. Grass roots do not have these nodules and cannot take nitrogen from the air, but these roots do add organic matter to the soil.

Farmers who haul manure out to the fields return valuable plant food to their soil.

Manure Is a Valuable Soil Builder

ORDINARY barnyard manure is one of the farmer's most valuable possessions. Manure keeps the soil fertile by adding organic matter and plant foods. It provides plants with two plant foods they must have—nitrogen and potassium. It also adds some phosphorus. Actually about half of the plant food in livestock feed may be returned to the soil in manure.

Manure must be taken care of properly. It should be hauled to the fields when it is fresh. Manure left around the farm buildings in piles may lose a large part of its plant food or nutrients when it rains. Where manure is available, it should be applied on each field at least every three or four years.

Unfortunately, some people think it is easier to burn cornstalks, straw, manure, and other crop residues than to work them into the soil. If these materials are plowed under, they will feed many millions of helpful bacteria. These small living things cause the stalks, straw, manure, and other residues to decay and make food available to the growing crops. As we have said before, all this organic matter material helps the soil to hold more water and makes it work easier, produce better crops. It helps prevent erosion by slowing up the flow of water and action of the wind. The stalks, straw, and other material protect the soil from beating rains and prevent it from being washed away.

Burning Harms Soil

Some people burn the woodlands and prairies to kill weeds and remove dead grass and leaves to make new grass grow. This does more harm than good. The fire kills the young trees and young grass, injures the old trees, sets back the growth of old grasses, and kills wildlife and game besides destroying valuable organic matter.

Farmers need to spread fertilizer on their fields to supply their soil with needed plant foods.

Fertilizers Return Lost Plant Foods

PLANTS ARE LIKE people. To grow and thrive, they need the right kind of food. Our soils have already lost huge amounts of this food by feeding crops and by erosion. To keep producing all the food we need, we must feed our crops properly.

First, though, farmers should test their soils before "feeding" their land limestone and commercial fertilizers. In this way, they can be sure they are using the right kind and the right amounts. Here are some of the most important foods the soil needs:

Lime is one of the most important rock materials in our soil. From it comes a mineral called calcium which plants need to make a good growth. Limestone keeps the soil sweet. Unfortunately, some of the limestone in the soil is removed by crops and by water. Only soils in the eastern one-third of the state need lime. The thing to do is to test soil to see if it needs limestone.

Nitrogen is a gas that helps plants to grow big and fast. It is always present in the air. Legumes (alfalfa and clovers) can take it out of the air and change it into a form of food plants can use. So you see alfalfa and clover plants are really small nitrogen factories. Manure, decaying leaves, and other organic material also contain lots of nitrogen.

Phosphorus makes plump seeds and strong roots and hastens ripening. When there is not enough phosphorus in the soil for good plant growth, the farmer applies commercial fertilizers called phosphates. Practically all soils in Minnesota need phosphate fertilizer.

Potassium gives plants "pep" and improves their quality. Plants like potatoes, sugar beets, alfalfa, and corn use large amounts of potassium. For these crops a farmer buys a commercial fertilizer containing potash. Minnesota soils so far are fairly well supplied with potash but for certain crops it should be used.

The rows of corn in this field are planted on the contour.

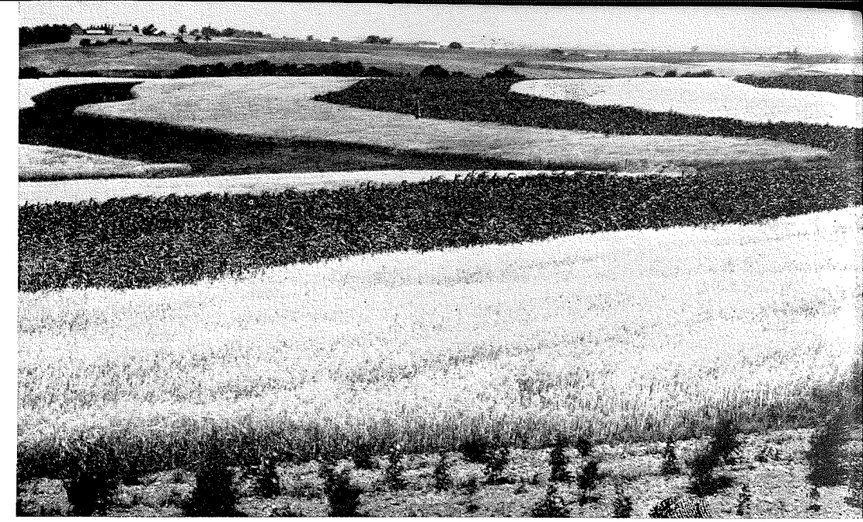
Contoured Rows Reduce Soil Losses

YOUR DOCTOR will tell you there are many things you must do to keep healthy. You must eat the right food, and you must take care of yourself. Soils experts, who really are land doctors, say the same thing about soil. Soil must be fed correctly. We do that by crop rotation, keeping organic matter high, and feeding fertilizers. At the same time we must do other things to keep our soil in shape. On level or slightly rolling land, good rotations and keeping organic matter high will be enough to control water erosion. However, if soils are sloping enough for water to run off and are several hundred feet long, we may need to take other steps. Some of these steps include: grassed waterways, contouring, contour strip cropping, field strip cropping, wind strip cropping, terracing, field windbreaks, and tillage.

Working the field on the level around the hill is called contour cultivation. It includes plowing, planting, and even cultivating the row crops. Every little furrow, drill mark, or row helps hold water so less of it flows down hill. This gives it a chance to soak into the soil, saves more water for the crops, and saves soil.

Up-and-down hill furrows or rows let the water run off fast. It has less chance to soak into the soil. It carries away more soil. Much more soil is lost even on gentle slopes with up-and-down hill cultivation than with contour cultivation.

It pays the farmer to plant his crop this way. Minnesota farmers have found they get about five to six more bushels of corn per acre by planting and cultivating on the contour. This is because less water is lost and because less soil and plant food is washed away. Farmers also have found it costs less to run the tractor on the level and is easier on all farm machinery.



Arranging fields in strips on the contour around hills and slopes helps save the soil from washing.

Strip Cropping Keeps Soil from Washing

STRIP CROPPING on the contour was first used in Minnesota way back in 1877 on the Von Arx farm near Houston. It is the most spectacular of soil conservation practices. The narrow fields winding around the hills can be seen for miles.

Strip cropping must combine crop rotation and contouring. Every other strip is in hay. The other strips are usually in corn and grain. All cultivation, planting, and harvesting is on the contour.

Contour strips are laid out as nearly on the level as possible. They are from 50 to 100 feet wide depending on the soil and the steepness of the slope. The steeper the slope, the narrower the strip.

The usual plan with a rotation lasting four years is to have one field in strips of hay and corn. Another field of the same size is in strips of hay and grain. These hay strips slow up the water so more of it soaks into the soil. As a result, less water flows from above into the corn or grain strips.

Experiments have shown that contour strip cropping reduces soil losses from 60 to 75 per cent. How much loss depends on the kind of soil, steepness of slope, width of strips, and the crop grown.

Field Strip Cropping

Some slopes are too irregular for contour strip cropping. Then we use field strip cropping. The contour is followed as closely as possible, but on the most irregular parts of the slope the strips are run straight across. This is not as good as contour strip cropping.

The strips should be narrower as the water sometimes does not flow straight across them. The hay strips help protect the corn and grain strips. With tillage not quite on the contour, there is more run off and more soil lost.

Terraces check the speed of excess water and lead it slowly to grassed outlets.

Terracing Saves Soil and Water

THOUSANDS OF YEARS ago, man invented the idea of terraces. He knew that these "ridges across slopes" would help stop soil erosion and would save water.

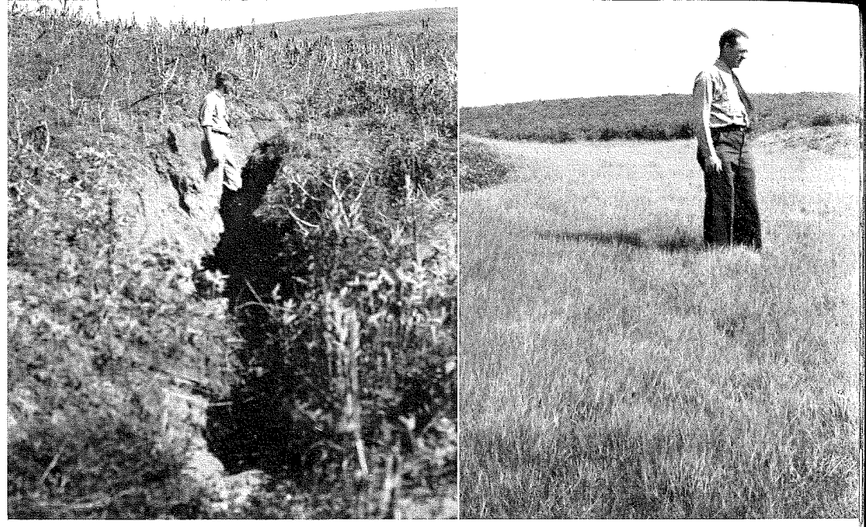
The modern terrace is a channel with a ridge below. There are two kinds of modern terraces—graded and level. The **graded** terrace is the most common. It has a small slope, like a river, that forces the water to flow gently to outlet waterways. This runoff water soon finds its way to creeks, rivers, and lakes without washing away soil.

The **level** terrace is built on the contour with both ends closed. The water collects in the terrace like a pond and then seeps into the soil. A level terrace only works when it is built on land where the water can quickly sink into the soil.

Some farmers build their own terraces with moldboard plows on disks. Some terraces are built by using big road graders. Terraces should not be built on steep slopes. Terraces are usually placed about 75 to 100 feet apart. Farm machinery can operate over the terrace. Terraces may be planted to any field crop.

The purposes of the terrace are to check the speed of the water and divide long slopes into many short slopes. The use of the terraces reduces soil erosion, permits shorter crop rotations, and provides larger fields. Terraces are sometimes built to take the water away from big gullies.

Terraces are not used on land where more simple and cheaper methods like contour tillage or good soil management practices will do the job. Terraces, however, should be used where other practices will not protect the land and also on badly eroded hillsides where they will give protection until tree plantings or pastures are started.



Gullies are formed by water running down hills. The gully on the left was filled in and planted to grass. The result is shown on the right.

Grassed Waterways Prevent Gullies

AS WATER FLOWS down hill, it gathers in little "rivers." If the soil is bare, gullies or big long ditches may start. By seeding these little rivers to grass, we can stop gullies from forming and have grassed waterways instead.

Grassed waterways should be saucer-shaped and wide enough to carry the water that naturally flows through them. Brome grass and Kentucky blue grass are most commonly used in Minnesota. Some alfalfa or clover should be used in the mixture to make better hay or pasture. Oats are used in the spring and winter rye in the early fall to give protection until the grasses and legumes get started.

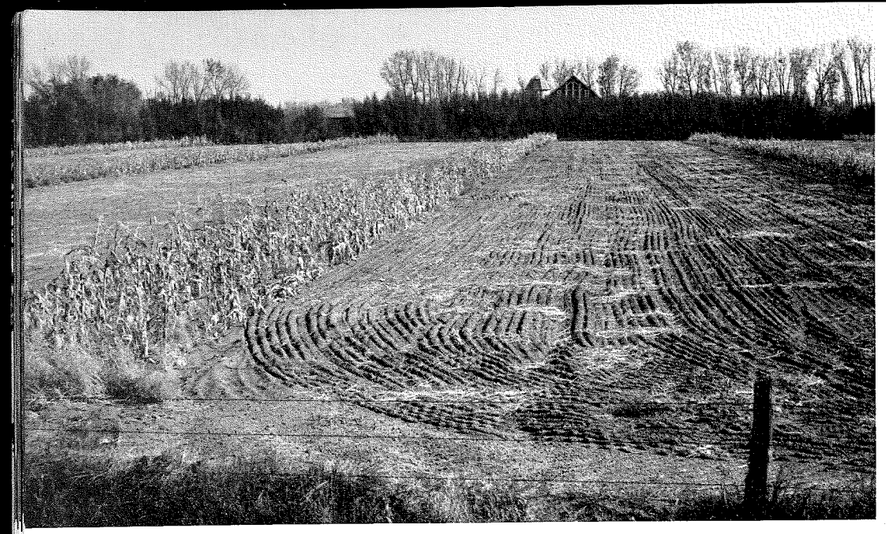
Grassed waterways do many things to save our soil. They prevent gullies and keep valuable soil where it belongs by carrying off the runoff water without any damage. They provide hay and pasture and they make farming operations easier. They must be used with a contouring, strip cropping, and terracing program on a farm.

Rough Tillage Leaves Surface Cloddy

Rough tillage means leaving a cloddy surface. This helps check both wind and water erosion. Rough tillage has two main advantages:

1. The machinery marks, uneven surface, and crop stubble slow up the wind and keep the soil from breaking up into fine particles that blow away easily.
2. It gives the water more chance to soak into the soil.

Subsurface packers can be used both to pack and to ridge the soil. Basin listers or basin tillers or similar implements are effective in stopping blowing in summer fallow or fall-plowed fields. Press drills help pack the soil and at the same time leave ridges to prevent blowing until the grain is up.



On this level potato field buffer strips of corn keep soil from blowing away.

Strips Keep Soil from Blowing

BLOWING DUST in huge clouds has often spelled disaster and even failure to many farmers. There are things farmers can do to avoid such wind erosion. Wind strip cropping and field wind breaks are two such steps.

Wind strips are usually straight narrow fields, 10 to 20 rods wide. They often run the full length of the farm. On sloping lands they may be built on the contour to protect against both wind and water erosion.

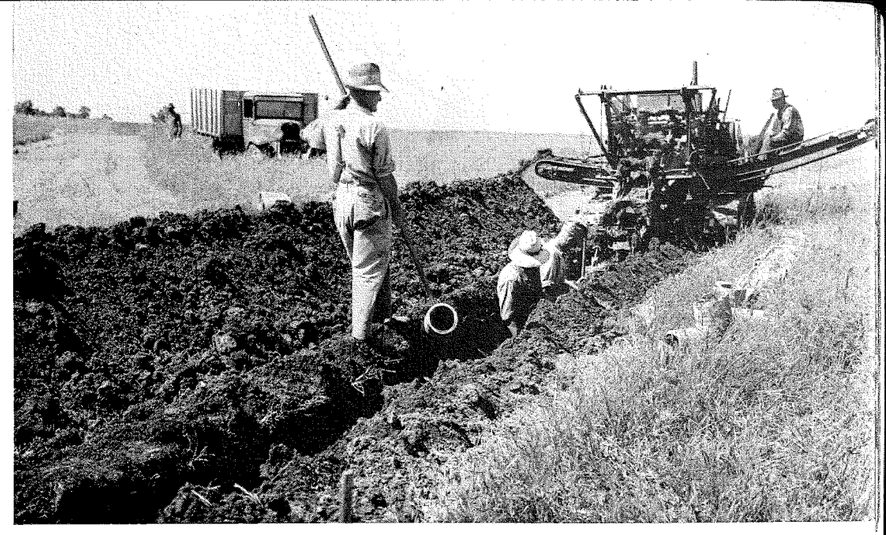
Wind stripping is always combined with crop rotation. The hay and winter grain strips will protect the strips of spring grain and row crops. Two strips of row crops are never side by side.

Wind strips leave only a narrow strip of land bare at one time. Water does not evaporate as much on the bare strips because the wind blows across the protective strips. The hay or winter grain slow down the wind near the surface on the bare strips.

Field Windbreaks

Field windbreaks also slow up the wind and keep soil from blowing away. A series of windbreaks spaced 40 rods apart gives effective control in preventing soil blowing. Windbreaks have one to three rows of tall trees with a row of dense shrubs on each side. Usually one or two rows of fast-growing trees, such as green ash, cottonwood, or native poplar, are used.

Field windbreaks conserve winter moisture by catching snow if the soil is not frozen. Snow fences and snow ridging are also used by some farmers to prevent drifting and save winter moisture. Buffer strips of corn, husked and left standing, also are effective in saving moisture. Windbreaks also provide winter protection for game and wildlife and nesting places for birds.



Drainage adds good land to farms and allows farmers to plant eroding hills to hay, pasture, and timber.

Drainage Makes for Good Land Use

GOOD SOIL often suffers because it has too much water! Drainage makes it possible to use this soil and the water that falls on many farms.

The purpose of farm drainage is to use soil moisture so as to increase crop yields and to improve crop quality. This is done by installing tile drains or open ditches to remove the extra water from the upper 3 to 4 feet of the wet soil.

Natural or artificial drainage does not disturb the useful water so essential to plants. A mineral soil suited to farming cannot be overdrained. Since most of the water that falls as rain or snow on the farm comes from oceans and seas, drainage has little effect upon rainfall. Drainage does not cause excessive floods or drouths. Farm drainage has little or no effect on the deep ground-water supplies we depend on for many things.

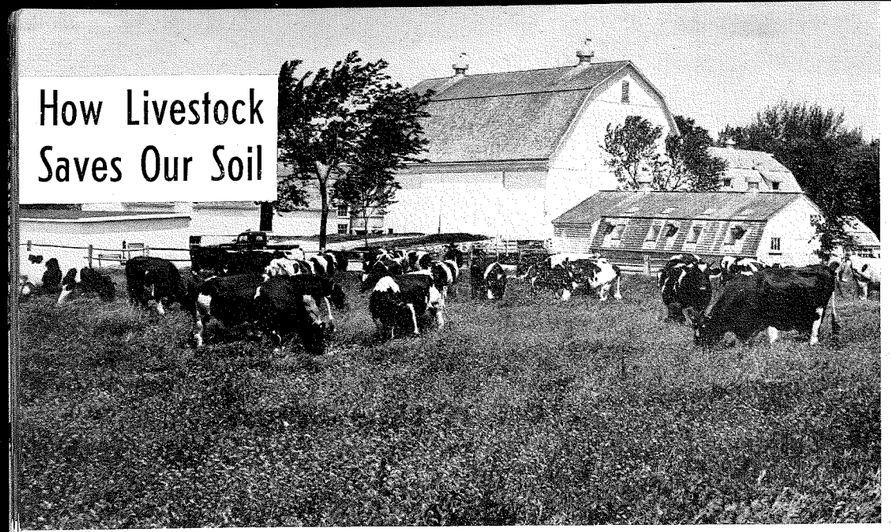
Drainage improves the chemical and physical condition of the soil. To obtain maximum yields from drained land it is necessary to follow well-established fertility practices.

The installation of a drainage system is expensive and should be supervised only by experienced drainage engineers. A good drainage system will pay for its cost through increased yields in from one to five years.

Almost every farm in the better agricultural areas of the state has drainage problems. In many sections of southern and western Minnesota it is difficult to plan a land use program without making better use of the wet lands on the farm.

By improving the yields of row crops from flat, wet acres, the slopes where erosion is serious can be planted to soil-saving and water-conserving crops such as grass and forest. Thus drainage actually adds land to farms.

How Livestock Saves Our Soil



Dairy cows help save soil! Cows need plenty of good hay and pasture. Hay and pasture crops prevent erosion.

Farm Animals Help Save Soil

CATTLE AND ALL other farm animals play a leading role in saving our soil. They often play as important a part in soil conservation as we humans.

Of course, cows and sheep don't build contours or lay out terraces. Neither do they turn the soil "wrong side up" as the Indian said when he first saw the white man plowing the prairie. Nor do they eat the grass into the ground unless they are held in by man's fences. They want farmers to provide them with good pasture and hay. In doing this, the farmer is helping himself save soil.

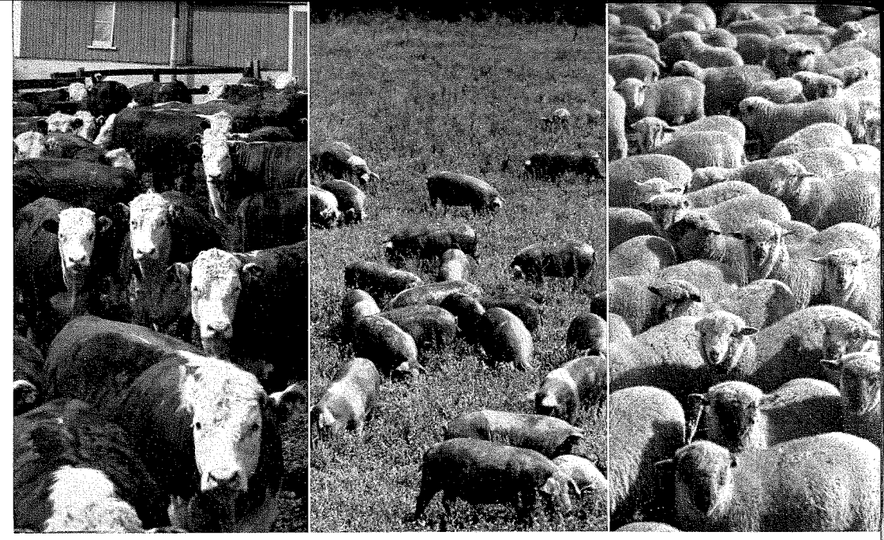
To do a good job of feeding livestock we must put more and more land into alfalfa, clover, and grass crops to both hold and build the soil.

Does that mean less return from the land? It does not.

Hay and pasture yield more energy-producing, high vitamin feed per acre than our grain crops on all types of soils in Minnesota. Good, well-managed pastures produce the cheapest and best feed for both beef and dairy cattle. Unfortunately, very few pastures are as good as they should be so what has been done in increasing grain yields can and must now be done with pasture and hay.

All types of livestock use grass. Poultry and hogs use it less than cattle and sheep, of course. This means that in Minnesota the big share of grasses and legumes is used by cattle. A good cattle man adds to his income if he can feed and manage his cattle well.

Pasture and hay have some other advantages over other crops, too. Hay and pasture crops are in less danger from insect pests, storm losses, and bad growing seasons. The new developments in hay making machinery and methods, grass silage, and electric fences all add up to the fact that pasture and hay acres are more easily handled than a few years ago.



Farm animals of all kinds—beef cattle, hogs, and sheep—are important friends of the soil.

Grass Feeds both Animals and Soil

A CONTENTED COW, munching on lush pasture, is a good sign for those interested in saving our soil. Good feed, such as legumes, for our livestock is also good for our soil.

Farmers, of course, want to raise as much fresh, tasty grass for pasture during the summer as possible. All kinds of livestock thrive on good pasture. At the same time, most farmers need to put more land in these soil-saving pastures.

Because of our long, cold winters, farmers have to store, or we might say "can," pasture for the winter. They try to store their grass as hay or silage so that it will keep most of its feed value for a long time. If grass and legumes are handled poorly, they may lose a half of their feed value between the field and the manger.

New machinery has cut down work in haying. Today, the modern farmer can bale his hay right in the field or he can chop it as he cuts. Labor-saving devices make it possible to raise more hay and more livestock. Thus, they can help farmers save their soil.

How good hay is, however, does not depend on the machinery used. The time of cutting and the time used in cutting, baling, curing, and storing the crop are more important. Sixty per cent of the feed value of legume hay is in its leaves. Rough handling or over-drying always mean loss of leaves and feed value.

The long time needed to cure hay also causes heavy losses. Barn drying and silage cut down these losses and, as a result, are becoming more and more popular. Farmers now may dry hay in the barn by forcing air through it. This cuts about in half the time hay must lie in the field, thus lessening the risk from rain.

Silage, of course, shortens curing time to a few hours or even to no time at all.

This county agent shows a 4-H boy how to test soil so he will know what the land needs to produce good crops.

Many Agencies Help Save Soil

FARMERS themselves actually do the jobs that save our soil. They put conservation into operation on the land.

There are many organizations in every county ready to help you in learning about soil and water conservation. Some are:

Soil Conservation District—Farmers set up and govern their own soil conservation districts. These districts can call on federal and state agencies for help.

Soil Conservation Service—This branch of the U. S. Department of Agriculture sends out soil conservation planners and other workers to help farmers in soil conservation districts establish better land use practices.

Agricultural Stabilization and Conservation—Every county has this branch of the U. S. Department of Agriculture. It helps farmers with programs to grow and sell the feed our nation and the world needs. A.S.C. encourages soil building and soil saving by providing farmers conservation payments through its Agricultural Conservation Service.

Minnesota Department of Conservation—This part of our state government provides game wardens, foresters, and flood control workers. They are interested in all conservation.

Forest Service of USDA—All states, and especially those with large forests, receive help from this service. It aids conservation by planning for future forests and improving present ones.

County Agricultural Extension Service—All counties in Minnesota have a county agricultural agent. Many counties have a 4-H Club agent and a home agent. Some counties also have a soil conservation agent. They are the educational representatives of the U. S. Department of Agriculture and the University of Minnesota. Their job is to give you information on farming and homemaking.

Building a model farm showing contour strips, pastures, and wooded areas provided these girls and boys an enjoyable day.

Showing How Conservation Works

THERE ARE MANY simple things we can do to understand water and soil conservation. Some of these are included in the following exercises:

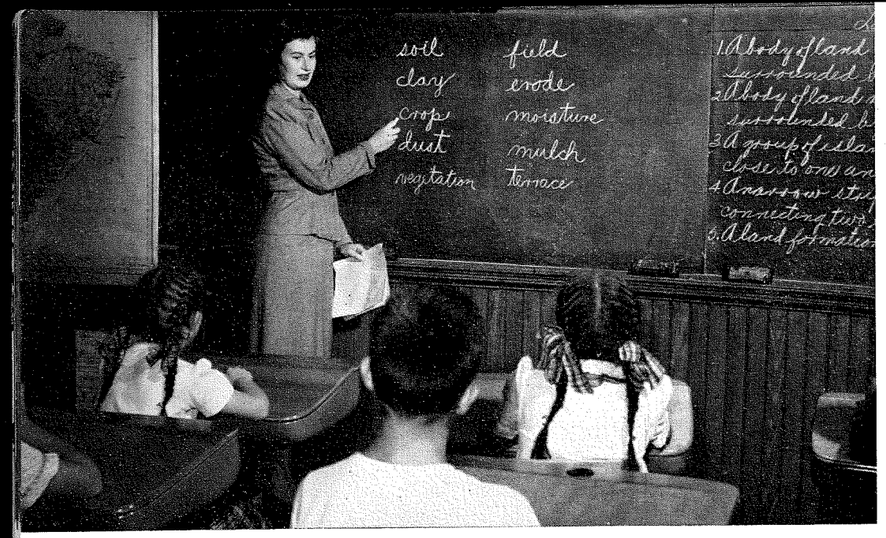
How Sod Slows Water Runoff—Obtain pieces of blotting paper and slick cardboard. Support each piece of paper so that it represents a sloping field. Pour a spoonful of water at the top of each paper. The blotter (like sod) absorbs the water, while the smooth paper (like a bare field) lets most of the water run off.

The Value of Topsoil—Fill a large flower pot with good topsoil and another with subsoil taken 2½ feet below the surface. Sow oats in each and water them lightly. After the oats are up a few inches, watch for differences in growth, color, etc.

Contour Farming Holds Soil and Water—Build a mound of soil in each of two shallow pans. With your finger, make some furrows running around one mound of soil. Run the furrows on the other from the peak down to the base. From a tin can with a few small holes punched in the bottom, let the same amount of water fall on the peak of each earth mound. See what happens.

Some Soils Blow Away—To show how wind erosion takes place and how it might be stopped, get a shallow box filled to the top with very fine dry soil. Set the box on a table and direct an electric fan on the soil surface. The dust will blow, the same as wind erosion. Now spread the soil with grass clippings about an inch long. With the end of a ruler, poke the clippings into the soil just enough to hold them. Turn on the fan again. Even the dry soil doesn't blow.

Which Soils Let Water In—Partly fill a water glass with soil from an old overworked field and another with soil from the fence row. Pour the same amount of water on each and see which one takes up the water more easily.



Learn about soil conservation by spelling words that mean so much to farmers.

Test Yourself on Conservation

1. Make a list of the foods found at home. Then list each food in a table like this:

Foods directly from the soil	Foods indirectly from the soil	Foods not from the soil
(Like potatoes, apples, carrots, etc.)	(Like bread, meat, etc.)	(?)

2. An inch of topsoil weighs 140 tons per acre. How many tons are there in a 40-acre field where the topsoil is 8 inches deep?
3. A rain washed away 4 tons of soil per acre on a 20-acre corn field planted in straight rows up and down the hill. On a nearby 20-acre field where the corn was planted on the contour (level rows around the hill) only one-half ton an acre was lost. How much more soil was lost from the straight-rowed field?
4. A farmer wants to plant trees in two small patches to control erosion as the soil is too steep for crops or pasture. One is 1½ acres and the other 3½ acres in size. It takes 1,000 trees to plant an acre. How many trees should he buy?
5. Simple words to spell:

bare	dust	land	row
blow	earth	level	sand
clay	field	plow	soil
crop	flow	rain	water

6. Harder words to spell:

agriculture	cultivate	furrow	nodules	subsoil
alfalfa	drainage	glacier	pasture	terrace
conservation	erode	legume	rotation	tillage
contour	erosion	moisture	runoff	vegetation
control	forest	mulch	steep	wildlife

7. Draw a map of your county showing the areas of best crop land.

There are many exhibits and demonstrations that can be given to explain what soil conservation is and how it works.

Exhibits Tell the Conservation Story

1. Set up samples of the main kinds of soils.
   Sand feels gritty and has very few dust-like particles.
   Loam has some grains of sand, but there are so many fine particles that you do not feel the grit.
   Clay has no sand grittiness. The damp soil feels greasy. It clings together when pressed into a ball.
   Muck is dark in color and not gritty. It holds much water but when dry is very light in weight.
2. Make a **scrapbook** to tell the story of "Our Soil To Use." Cut out pictures and stories to tell about contour farming, wind strip cropping, shelterbelts, sod crops, and gully control and sod waterways.
3. Set up a sample of soil layers (profile). Find a road cut which shows the soil from the top on down. Fill a clear glass pint jar from each six-inch mark from top down.
4. What do crop roots look like? An exhibit of the roots of crops such as corn, soybeans, alfalfa, red clover, timothy, blue grass (June grass), and brome grass will show us why some plants hold soil better than others. Dig at least 6 inches deep and remove carefully. Wash soil away in a tub of water. Dry the roots and fasten them to a piece of cardboard with tape.
5. Obtain a glass jar of water as it runs from a cultivated field after a heavy rain. Let it settle and exhibit it along with a jar of water from a well or faucet. You might also get a jar of water from a creek after a heavy rain. As it settles compare it with the others.

Make your own exhibits. You learn while making them and others learn by looking at them. An exhibit should show one simple idea. Have little reading matter with plain lettering.

Listening to the conservation story.

Telling the Conservation Story

1. **Write and give a play.**

   The two main actors could be Farmers Upancoming and Downanout. Or they could be named Mr. Wise and Mr. Dull. Mr. Dull might tell his troubles and Mr. Wise then might ask him about his helpers. Then Mr. Dull's helpers come in. They are Hard Work and Hope. These two tell how they try to aid Farmer Dull but the enemies prevent it. Now the enemies come in. They are represented by the erosion twins, Wind and Water. These two tell how they work to damage land and crops—how they steal soil and fertility and weaken crops.

   At this point the helpers of Farmer Wise come in. They chase the twins out. Mr. Wise now names his helpers as Crop Rotation, Contouring, and Sod Waterway. Each of them tells how he helps Farmer Wise.

   Farmer Dull begs for advice as to how he can get that kind of helpers. Mr. Wise says that the County Agent and the Soil Conservation District Representatives will arrange to help Mr. Dull.

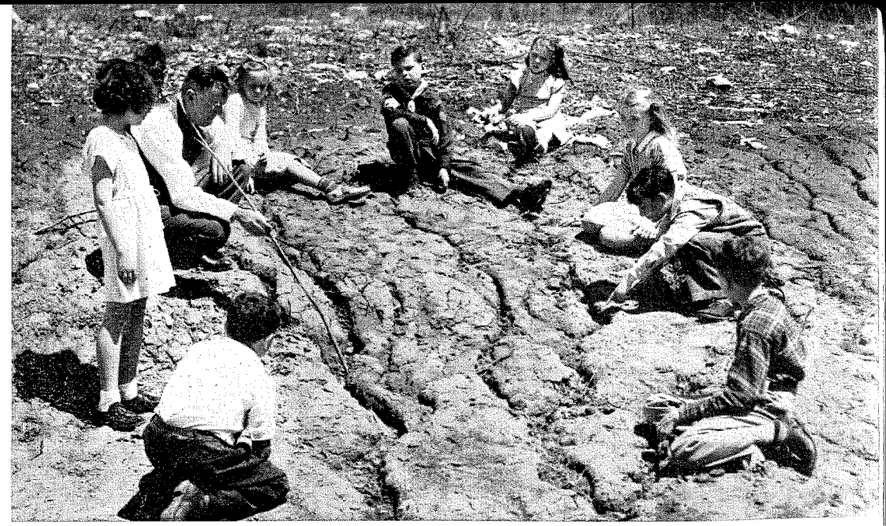
   The end finds Mr. Dull shaking hands with Mr. Wise and all are happy.

2. **Have a guessing game.**

   Charades (words to be guessed from description, representation, scenes) are easily used in soil conservation. One or more persons act out a word and the rest try to guess it. For "rain fall" the actor turns up collar or acts as if raising an umbrella and then falls down. Could you guess it?

3. **Soil Conservation "Good Deeds."**

   Answer school or 4-H Club roll call with a statement of a conservation good deed. You may have helped plan for more sod crops, planted trees on a steep slope, or built a bird house.



Many teachers take their classes out in the country to show them the destruction of soil erosion and the loss of soil fertility.

Things You Can See and Discuss

1. What is erosion? How does it affect crops?
2. Is there erosion on your farm? Or on one that you know of?
3. Is soil erosion more likely to take place on a long slope or a short one? Explain.
4. Does steepness of the slope affect erosion?
5. How would you protect the soil from the wind?
6. Explain each of eight or more methods of soil conserving. (Eight or more people may take part in this.)
7. What kind of rains do the most damage to our soil? When do they usually come?
8. What do we mean when we say wind erosion control, water erosion control, gully control, and grass waterways?
9. How do sod crops, fertilizers, and crop rotation affect soil conservation?
10. What conservation helps are most needed in this area?
11. What can we do to boost soil conservation?
12. Bad soil and land conditions I have noticed lately.
13. What soil conservation means to wildlife.
14. What does soil conservation mean to health?
15. What soil fertility and conservation practices are needed in your community?
16. How do crops show different plant nutrient deficiencies?
17. What is soil organic matter and how is it produced?
18. What is the difference between topsoil and subsoil?
19. What are the differences between prairie soils and timber soils?

Making your own poster, as students in a Minneapolis grade school did, makes soil conservation more interesting.

Contests Will Arouse Interest

4-H Clubs—The 4-H Club soil conservation project has various awards for club members who do extra good jobs.

The **national** 4-H soil conservation contest offers awards to winners. The **state** contest, in which all soil conservation project members are enrolled, has various local, county, and state awards. Soil conservation districts, the State Department of Conservation, fair boards, and others have provided prizes.

Essay—This often is a part of regular school work. Some are for grade and some for high school students. Local awards are available from time to time. The State Department of Conservation and farmers' organizations have essay contests also.

Poster—For a contest of this sort, it is best to discuss possible ideas for the poster. Each pupil or club member might make a poster and then the best could be chosen from the group. Posters should tell a story either with words or pictures. A simple poster might be lettered "Save Our Soil (S.O.S.)," "Conserve Now," "It's Later Than We Think," etc.

Slogan—Each school or club might select a slogan for soil conservation. All members could prepare one slogan and the best two or three would be selected for use. For example, one which has been suggested is "S.O.S. Means Save Our Soil."

Jingles—A person doesn't have to be a poet to think up a jingle of two or four lines. Here is one:

Good crop rotations
Are fine for all nations

Public Speaking—To hold such a contest announce a topic such as "Your Land and Mine."

No Burning Pledges—Obtain pledge blanks from your county agent and see who can get the most signers among the farmers.

A Final Look at Soil Conservation

THE SOIL is a demanding master. Crops are always uncertain. Yet, people who can sense the soil surging with growth and rich with the promise of harvest would choose no other place to live than on the farm. Living close to the soil provides a satisfaction that can be appreciated only by those who know what the soil will produce if it is properly cared for. The uncertainties of harvests are only a part of the hazards that make the use of the land a national problem. The loss of the soil's fertility or richness, the washing away of soil by water, the blowing away of soil by wind, and the misuse of land when man plants the wrong crops are all hazards to our soil and to our future.

People become rooted to the soil almost as plants do. They grow and live on the land from generation to generation. But the habits and customs of people are slow to change. The change in the land comes more rapidly. Now with our soil wearing out and croding so fast we must use our soil correctly if our soils are to be preserved. We must change our customs and habits to save our soil.

Keeping a soil productive demands a well-balanced program of land use (putting each acre to its proper use) and soil conservation. In recent years the term "soil conservation" has been widely used in connection with the physical and mechanical control of soil erosion caused by wind and water. Much emphasis has been placed on this phase of soil conservation through the encouragement of contouring, strip cropping, and terracing, to mention only a few practices. They are valuable and necessary. They do not, however, correct many of the basic causes of soil erosion. Soils erode because they have been used improperly!

We Must Replace Lost Plant Food

Soil conservation must include saving and replacing regularly plant food nutrients used by growing crops. Without these nutrients soils will not continue to produce all that they should. Proper land use is illustrated by the story of an old Indian who, years ago, was watching the white man's plow rip up grasslands of the plains. It is said that he solemnly held out his hands, palms up, and then quickly turned the palms down. This was his interpretation of "wrong side up" or wrong land use. To establish proper land use on any soil there are basic rules and steps to follow.

But before we use the land, we must study the land. Then we will know how it was formed, what type it is, what slope it has, how much it has eroded, and what kind of crops it can best grow. We call these soil characteristics. On the basis of these soil characteristics we must decide how the land should be used. Then we should—

1. Plant timber on steep eroded slopes.
2. Establish permanent pasture and hay on slopes that are too steep and eroded for cultivated crops.

3. Provide protection in timber, permanent pasture, hay areas, and lakes and streams for wildlife such as pheasants, water fowl, and fur-bearing animals.
4. Use a crop rotation on the remaining land area. We should rotate cultivated crops such as corn, potatoes, and sugar beets; grains such as oats, wheat, flax, and barley; and soil-conserving crops such as alfalfa, clover, and grasses.
5. Add lime, barnyard manure, and commercial fertilizer to the soil to supply the nutrients removed by crops.
6. Save all crop residues such as corn stalks and straw and return them to the soil. **Never burn** these valuable soil savers.
7. Use soil erosion control measures where needed. These measures include providing terraces and grassed waterways, contouring, strip cropping, and other such practices.
8. Raise livestock where practical, to use the hay and pasture and to produce meat, milk, and eggs for food. If there is no livestock, plow the hay and pasture crops back into the soil so these nutrients can be used to produce more crops of corn and grain.

Using and saving our soil is the responsibility of all of us, especially those of us who live on the land. By using land wisely, we will serve not only ourselves but future generations as well.

Conservation Terms You Should Know

Bacteria—Small organisms living in the soil, too small to be seen with the naked eye. Most are helpful but some are harmful.

Buffer strips—Long narrow areas of sod crops planted between areas of row crops. Buffer strips are a part of contour strip cropping.

Chlorophyll—The green coloring matter of plants.

Commercial fertilizer—A material applied to the land to replace plant foods such as nitrogen, phosphate, and potash which are taken from the soil by crops.

Contouring—The practice of plowing, cultivating, seeding, and harvesting around the slope instead of up and down.

Cover crop—A crop planted to protect soil from blowing or washing away during fall, winter, and spring.

Crop residues—Remains of crops after they have died or have been harvested.

Crop rotation—Changing crops from one field to another from year to year. One crop must be a sod crop.

Deficiency diseases—Diseases developed by animals because the feed they eat may have come from soils low in essential plant nutrients.

Drainage—The removal of extra water from wet soils so crops can grow.

Fallow—The practice of leaving land unseeded after plowing. Farmers work this soil so weeds and plants will not grow.

Fertile soil—A soil which will produce good crops if there is enough moisture and good weather.

Fungi—Small living plants too small to be seen with the naked eye.

Glaciers—Great sheets of ice or snow.

Grassed waterways—Natural drainage ways planted to grass so water can run down slopes without forming gullies.

Gullies—Ditches formed by water rushing downhill. They usually are too deep to cross with ordinary farm machinery.

Heavy soil—Soil with a large amount of clay. It is heavy work to pull a plow through this soil and so it is called heavy soil.

Humus—Well-decayed organic matter in soil.

Land use—Planting each acre to the kind of crop that will prevent erosion and build up soil fertility.

Legumes—A group of plants with nodules or "beads" on their roots. They include such plants as alfalfa, clover, and soybeans.

Light soil—Soil with a large amount of sand. It is relatively easy to pull a plow through this soil and so it is called light soil.

Lime—All materials, such as ground limestone and marl, used for correcting soil acidity.

Mulch—A covering of organic material such as straw, leaves, or manure. It protects soil from washing or blowing away.

Nodules—Small beads that form on the roots of legumes. Bacteria in these small beads take nitrogen from the air. The plant uses this nitrogen in its growth.

Nutrients (plant)—The nutrients such as nitrogen, phosphorus, potash, and calcium which are used by plants for growth. There are at least 14 nutrients required by plants.

Organic matter—Decaying plant and animal material. It stores food and water for the plants that grow in the soil.

Organisms—Living things. Organisms in the soil are too small to be seen with the naked eye.

Permanent pastures—Pastures left in grass and legumes all the time. They are usually on the steep slopes.

Prairie soil—Soil developed where tall grasses have grown.

Reservoir—A place where water is collected and stands until it is needed.

Rotation pastures—Pastures grown on cropland and alternated with other crops from year to year.

Rough tillage—Working land so as to leave a rough surface. This helps check wind and water erosion.

Runoff—Water which rushes off the land after a heavy rain, carrying with it fertile topsoil and plant food.

Sheet erosion—The even loss of topsoil from the surface of a slope.

Shelterbelt—An eight- to ten-row belt of trees around a farmstead to protect it against strong winds.

Sod crops—Hay and pasture crops such as legumes, legume-grass mixtures, bluegrass, brome grass, and timothy.

Soil—The natural material on the surface of the earth that holds moisture, supplies foods, and supports all types of plant life.

Soil conservation—Using land in such a way that its fertility is maintained and soil is kept from washing or blowing away.

Soil map—A map showing the different kinds of soils.

Soil profile—A side view of the soil from the surface down to a depth of 40 inches or more.

Soil survey—Studying the soil and making a soil map.

Strip cropping—Planting and growing crops in strips.

Subsoil—The soil below the topsoil. This is usually lighter colored and lower in organic matter than the topsoil.

Terraces—Shallow ditches built across sloping land to carry the runoff water away slowly.

Timber soil—Soil developed where forest has grown.

Topography—The lay of the land which can be described by such terms as level, rolling, or steep.

Topsoil—The upper layer of soil usually six inches or more thick. It is generally dark colored and well supplies with organic matter.

Water erosion—The removal of soil by water.

Windbreak—A two- to five-row belt of trees to protect fields from wind damage.

Wind erosion—The removal of soil by wind.

A Joint Effort

We have told you in this bulletin that soil conservation takes the combined efforts of many people, working together for their common good.

This bulletin, too, is the result of the efforts of many people—so many, in fact, that we cannot list all the authors. Authors represent all parts of the University of Minnesota's Institute of Agriculture. These include the College of Agriculture, Forestry, and Home Economics; the School of Veterinary Medicine; the Agricultural Experiment Station; and the Agricultural Extension Service.

The authors, moreover, received valuable advice and helpful suggestions from many persons outside the University. These persons represented the United States Soil Conservation Service, the Minnesota State Soil Conservation Committee, the State Department of Education, public schools, the State Department of Conservation, the United States Department of Agriculture, Agricultural Extension Service, and many others.

Pictures in this bulletin were supplied by the Minnesota Agricultural Extension Service, the United States Soil Conservation Service, the Agricultural Extension Service of the United States Department of Agriculture, the Midwest Crop Improvement Association, the State Department of Conservation (pages 17, 18), the *Kraftsman*, the Bureau of Visual Instruction, University of Wisconsin (page 36), and Columbia University Teachers' College (page 37).

Everybody Has a Part in Conservation

THIS BULLETIN tells the story of the wonderful resources given us by nature. It presents the values of the ordinary things in the great out-of-doors such as soil, water, trees, wind, birds, and wild animal life. The story tells how important it is to use properly, restore, and preserve our natural resources for the "better living" and happiness of all people, not only in America but in all the world.

This material has been prepared especially for our young people and as a guide for the parents, teachers, and leaders of such groups as the Boy Scouts, 4-H Clubs, F.F.A., and other youth organizations. Conservation is a job in which everybody has a part.

Parents have a real share in this important program through everyday farm and home activities. In this booklet teachers in our schools will find information for simple, interesting lessons in saving our soil.

Leaders of scouting, 4-H Clubs, and F.F.A. may use this material for their conservation activities, already a feature of their programs.

Church leaders are becoming more and more interested in their opportunities and responsibility in relation to conservation of natural resources. They will find this material of assistance in their efforts to help young people to understand and appreciate such statements as "The earth is the Lord's and the fullness thereof" and what is meant by "stewardship" of nature's gifts.

This attitude will give our youth a respect and love for the soil and things related to it and will help greatly to make farming a real vocation.

UNIVERSITY OF MINNESOTA, INSTITUTE OF AGRICULTURE,
ST. PAUL 1, MINNESOTA

Cooperative Extension Work in Agriculture and Home Economics, University of Minnesota, Agricultural Extension Service and United States Department of Agriculture Cooperating, Paul E. Miller, Director. Published in furtherance of Agricultural Extension Acts of May 8 and June 30, 1914.

20M—6-54