A GUIDE

to

CONSERVATION

by
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INTERNATIONAL UNION FOR
THE PROTECTION OF NATURE

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When Columbus discovered America, he returned to the Old World with the good news that his people had a renewed lease on life, a new opportunity apparently to «live happily ever after». The folklore of all happy peoples is full of stories with happy endings. The great religions of all races and of all times almost invariably offer as a reward for righteous living a happy hereafter, a Heaven or a Happy Hunting Ground. Most religions teach that these rewards may be experienced in part at least here and now by those whose behavior unselfishly helps not only themselves, but their fellow men.

We believe that the goal of all life is happiness and that in the long run the greatest happiness comes from constructive, peaceful effort, from building rather then destroying, from good citizenship that makes the future better. We believe that we may approach this goal through the teaching of conservation. Conservation is based primarily on what we do regularly in applying the best knowledge available to the management of our environment, living and otherwise, to the end that we may live happily in harmony with the land, with the life it supports and with each other.

This booklet is written in the hope that it may help teachers and others to begin immediately to live happily wherever they may find themselves. We cannot expect any modern Columbus to discover a new America for us, but we can discover for ourselves a new way to live in whatever part of the world Fate may have placed us. That new way of living through conservation may be more successful in helping us live happily than would be the discovery of a new, undeveloped continent full of what we may consider as wealth. Wherever you may live, this new wealth is present if you can only discover it. We hope to help you do this.

WHAT DO WE NEED TO BE HAPPY

Recently a group of children aged 4 to 10 years from a variety of types of homes were asked what they would do to be happy if they could run the world. Their answers should interest us. One said that «delicious food is good for feeling nice» and recommended an abundance of good food. Many wanted health above all things so that they could be successful dancers, wrestlers, engineers or follow other aims. One said, «Being on a steam roller gives me the feeling like on an elephant. It gives me a powerful feeling when I want to be a giant. I also have times when I want to crawl in holes like a mouse. I have giant feelings and mouse feelings». Many expressed the hope that they could give gifts, particularly to their parents. These included an enormous diamond for mother, because «mother is a friend as well as mother» and «the biggest rosebush in the world», again for mother. This last youngster expressed a preference for little roses personally because «baby roses are cute». One wanted to create a «friendly painting» and another wanted a little pet bird that would say «hello», though she really liked «wolves best of all». One expressed the hope that she might have a «holy feeling».

When we as teachers look at these expressions of preferences on the part of children, it would seem that they rather well present a survey of Man's general needs. Children's needs and interests should be recognized in planning programs they are to follow. As adults who have had courses in zoology we may be interested in the anatomy and classification of a fish, but the youngster may be more interested in catching it. A program of conservation for children must therefore be built on what children want to do with their environment and enriched by experiences we may give them which will teach them to use that environment more wisely and to do this with satisfaction and conviction. If children like to build fires, to fish, to swim in clean waters, to have pleasing food, then if they are to live happily, we should see to it that these worthy pleasures are continually available to them because of the manner in which they have behaved.

Above all, we should not try to teach children too much too soon. We know from experience, however, that some things are essential to happiness. With these our program should deal.

Fire is terrifying and gratifying. It can destroy us or save us. To be happy, we must know how to use it wisely for many reasons. We cannot be happy if we are too cold or too hot. We must know how to manage fire and to be comfortably warm if we are to be happy.

No hungry or starved person is happy. Because of this, we should teach children how to recognize, to procure and to have available, good food in reasonable abundance.

Without water, plants and animals die of thirst. This is not a happy state of affairs and our program should be adapted to local conditions to show how suitable water must be available for consumption, for sanitary purposes, for recreation and for travel and industry based on the presence of water.

It may sound ridiculous to suggest that we plan a program based in part on the presence and qualities of air. In some areas, winds cannot be ignored and in all areas where living things exist, suitable air must be available if life is to continue. Wet soils can drown plants necessary for human food much as a lake of water can drown a human being whose life is of importance. Without air, we cannot live happily. Air may be polluted as badly as soils or water or food.

Many places may be managed successfully by simply letting in or keeping out light. One who is to live happily must know something of how sunlight contributes to health, helps in the production of food and has some relationship to temperature and moisture.

Shelter in the form of dwellings and clothing contributes much to human happiness. It would be well then that our program give some consideration to this in the hope that it may improve the shelter available to the children involved.

The truly happy person must be sensitive to what is going on about him. There is significance in sounds, in odors, in flavors and in feelings possible through the skin. Where these are of importance, they should be recognized in the program. Dangers may be avoided, food may be procured, a strange country may be understood by those able to use successfully their eyes, ears, noses, mouths and fingers. No adequate conservation program can be developed by a moron.

To be happy, human beings usually feel that they must be able to do some sort of work successfully. The nature of this may vary greatly with the individual, but conservation education should help us to plow more easily, to row more satisfactorily, to hunt, trap and fish more successfully and wisely and to get from place to place more conveniently.

Happy persons must have companionship, must know how to have a harmless good time, must have freedom to plan their lives and must recognize their personal debt to forces in the world larger than they. It is to the attainment of happiness along these lines that we here dedicate ourselves.

Ordinarily, the greatest happiness cannot be attained without effort. Our own attitude towards life is probably the most important factor in being happy or distressed. We inherit a past, but we make the present and the future. What we do today is possible because of what other persons, animals, plants and forces have done in the past and these factors added to our own actions determine what human beings may be able to do in the future. Through wise management, practically all of our renewable resources may be continually available to us and to our children. Similarly, through intelligent behavior on our part, our non-renewable resources may be made to last longer during which time suitable substitutes may be developed.

AN EXAMPLE OF CONSERVATION

Since every living human being has had some direct or indirect experience with fire, it might be well to use fire as an example of what we mean by conservation. Fire works quickly so we can see the results soon. It can be highly destructive or most useful, so it is worth knowing about. If we know how it continues to exist or how it may be destroyed, we may manage it. It is capable of helping or of harming great numbers of people, so it is important that most of us know something about it. What we do about it may affect others and what others do about it may affect us. If we develop the habit of controlling it wisely at all times, it may help us. If we do not do this, we may not be able to live at all. In other words, we must recognize fire as a problem-maker, know what it will do under given circumstances, know how to manage it, recognize that it may affect many people and develop habits of dealing with it that may result in its helping us all.

We should teach children how to make fires, to keep them going as long as they are needed, to put them out when this is desired, how to get the most from them with the fuel available, what to expect of them under various conditions and thus develop in children and others habits that will result in the use of fire for the good of all.

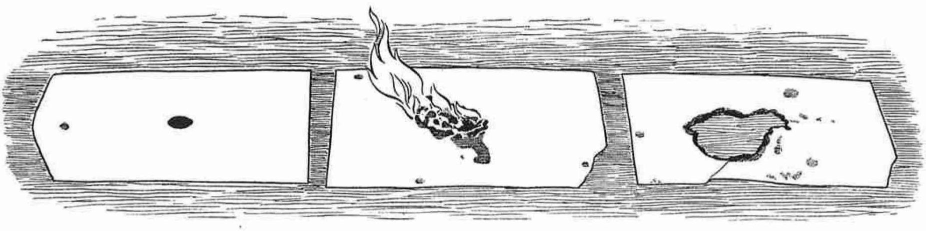
The International Union for the Protection of Nature at its Caracas meeting in September, 1952, made its first recommendation condemning the use of fire to clear agricultural and range lands unless fire could be used under controlled conditions and was justified by research. Our school program should attempt in part at least to implement this recommendation.

TEACHING ABOUT FIRE WITH FIRE

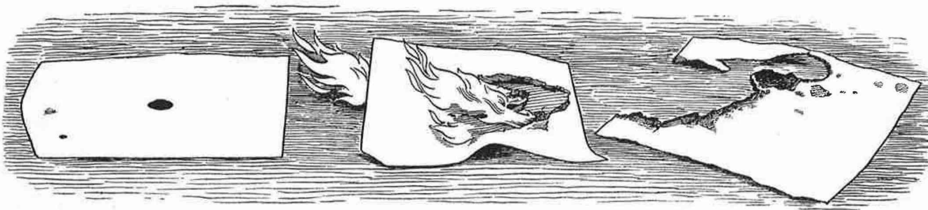
Many school programs recommend telling children about the great catastrophies resulting from fires. We prefer to recommend that children learn how to start, to control and to stop little fires. A few library cards or old playing cards or stiff heavy paper, some matches and a metal tray or dish will be helpful in introducing our lesson.

Fold two playing cards or library cards lengthwise and place them on the tray so that they form two roof-like ridges with the fold at the top and the free edges spread apart. Touch a lighted match to the center of the top of one of these ridges and watch how the fire spreads. When it has spread one or two inches from the starting point, put the fire out by covering it quickly with another card. Preserve the burned card to show the pattern a fire might be expected to follow along a ridge.

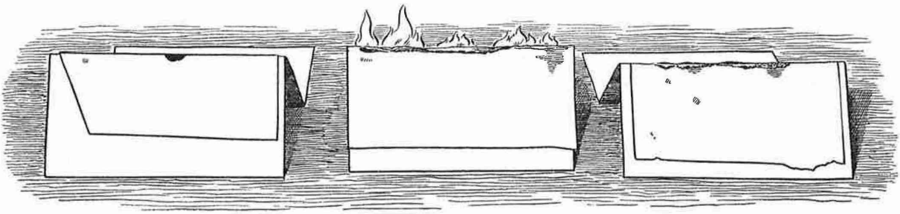
At the center of the bottom of either side of the remaining card ridge, touch another lighted match. When the fire has spread almost through the top of the ridge, extinguish it and keep it as a pattern. Make a number of similar card ridges. Mark half of them with a cross at the center of the ridge top and the other half with a cross at the bottom of the ridge. Draw with a pencil the patterns which you think the fires would follow if they were started at the cross marks. Doing these things you have observed what fire will do under two circumstances. You have predicted what other fires would do under similar circumstances. Set the fires and see how nearly your predictions are borne out by what happens. Based on these experiences, decide what you should do to try to control a ridge fire and a fire starting at the base of a hill. Notice how the two types of fires vary in the speed with which they spread. Would it seem safe to try to fight a fire that was down hill from you? With a brush, put some water on your cards in such a way that you can direct the pattern that will be burned. When the fire starts burning up the ridge, does the smoke come down the hill or up it, and after it reaches the ridge, does it go up into the air or go down the opposite slope? What significance is there in this?



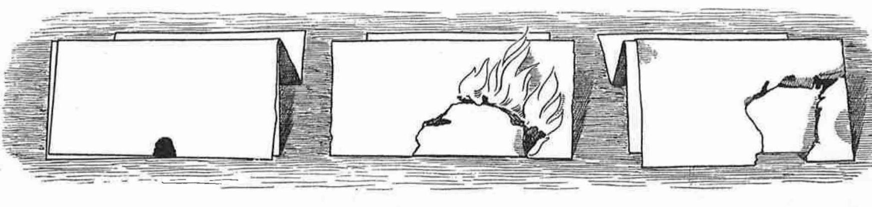
PATTERN OF A FIRE BURNING ON THE LEVEL WITH LITTLE WIND



PATTERN TAKEN BY A FIRE IN A WIND BURNING ON THE LEVEL



PATTERN TAKEN BY A FIRE BURNING ALONG A RIDGE



PATTERN OF A FIRE STARTING AT BOTTOM OF A SLOPE

Take another card and lay it in your tray. In the center, make a mark. Do you think that the card will readily burn if a lighted match is touched to this spot? You may be surprised at the result. You might even build a little log cabin of half-inch match sticks over the mark. Light the sticks and see what happens. It is surprising how difficult it is to get a fire started on a flat surface and where there is no wind. Even the log cabin of match sticks may not be enough to get things going. If the fire does get started, it does not ordinarily spread rapidly and the usual pattern is more or less circular around the point where the fire started. Such a fire on level ground then may be fought with safety from any angle or side when there is no wind.

Start a similar fire on a card that lies flat, but blow on it gently and continually from one direction. How does this change the pattern followed by the growing fire and the speed with which it spreads? When you think you can predict the patterns that will be followed by fires and can make them develop in any given direction, draw some patterns on cards, set fires on them and try to make the fire follow your pattern. If we could all learn to predict what fires will do and how we can make them do what we wish, we would make progress in using them wisely.

It should have been observed by now that a fire burns more rapidly if it has plenty of air coming to it. We saw this when we blew on the fire. On the «hillside» the fire rushed up rapidly because the hot air drew in fresh air to a fuel supply that was already in the path of the fire. Why did it not burn down the hill so rapidly?

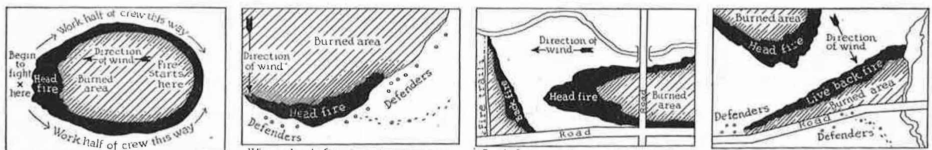
We can bring fresh air to a fire by blowing on it with our lungs or with a bellows and it can come naturally as wind. We can also bring it in by putting a chimney over it. In the chimney, a confined column of hot air draws in more fresh air than would be the case if the hot air were not confined. Where fuel is poor, we can sometimes make it burn by putting a chimney over it. The chimney may be nothing more than a few empty tin cans with their ends removed. If we can make poor fuel do the work of good fuel by the use of a chimney, we will be conserving the good fuel. New methods for burning a cheap, abundant fuel like lignite in the United States may make it unnecessary to develop many proposed dams for the production of power. This may save many square miles of good farm land from being flooded for the construction of reservoirs. It may help wildlife and revolutionize our conservation program. The illustration shows a simple way of using poor fuel to cook food quickly and well. A tin can stove gets more out of poor fuel than an open fire and in many places, fuel is so scarce that it has to be used wisely.

A COMPLETE COOKER

When a fire has burned fuel, there is little but ash left. Clearing of land by use of fire is highly destructive of useful plant foods that may be in the soil. Such fires also usually destroy young trees even though older trees may be able to survive a flash fire.

Fires can keep us warm or can destroy us or our wealth. It is good conservation practice to understand how they may be managed. Children may begin to get such understanding by experimenting with small fires with small cards. Make a note book of fire patterns.

Make some simple school studies of the following subjects related to fire using, where possible, using local examples. Where are the most comfortable places to live so far as temperature is concerned? How can other places be made more comfortably warm or cool? What fuels give the quickest fires and the best coals? Which fuels seem to keep burning the longest? How can good fuels be kept available in reasonable abundance for cooking or for keeping warm? What substances found locally reflect heat best or serve to keep the heat out? Do plants grow best on soil from which the plant material has been burned or from those in which it has been left unburned? What effects do fires out of control in the open have on young trees and shrubs, on annual plants, on perennials, on ground nesting birds, on insects active at the time of the fire, on game mammals, on the temperature and life in streams near burned-over areas? From these observations locally draw your own conclusions as to the management, the values and the dangers of fires.



Where back fire is not necessary. Back fire and fire trail to stop fire. Where back fire is necessary

CONSERVATION PROBLEMS OF WATER

Many of the problems of living happily could be solved if we could manage water properly so that we had it when and where we wanted it in the proper amounts and of the proper quality. Between floods, droughts, pollution, freezing and violence due to moving water, many persons find it necessary to spend much of their time with water problems just to remain alive. Some of the simplest of these problems should be developed with children at an early age. Possibly the essential ideas to be appreciated are among these:

Water is a part of every living growing plant and animal and its presence is necessary for life itself. You might try to disprove this.

To be useful to living things, water must be free of things that pollute it for such use. All forms of life are not affected equally by pollution of water resulting from such things as salt, lime, acid, sulfur, organic matter and other substances.

The temperature of water affects the life it can support. The high and low temperatures of water at which living things can survive vary with different kinds of plants and animals.

Water dissolves certain substances and this affects the suitability of water for use by different plants and animals. Alkali, acid and salt dissolved in water determine frequently the kind of plants and animals available in an area for the support of man and determine what men must do to continue to live.

Water is buoyant and light-weight materials in the soil are readily floated away with the slightest water movement. Because of this buoyance, stones and fine earthy materials weigh less under water than out and consequently may be moved more easily if they are submerged in water.

Swiftly moving water acts with greater force than slowly moving water. Even the splash of a single falling raindrop may move fine particles of soil some distance. The flow of water may be slowed by forcing it to go down a gentle instead of a steep slope and forcing it to stop at intervals where it may drop the loads it is carrying. Many practices of soil conservation and flood control are based on these ideas.

Some substances tend to increase the absorption of water while others delay it or prevent it.

If water is frozen, it expands and may fracture soil particles, plant tissue or fleshy tissues in the process. This may be helpful in making fine particles of soil or harmful in breaking fine root or animal tissues.

If moving water is carrying a load of materials, these will be dropped if the movement is stopped. If water has dissolved minerals, these may be left deposited if the water is evaporated. Evaporation of water is accompanied by some cooling effect. There are many things we can do to manage water so that it will or will not carry substances from place to place, freeze or not freeze, increase or decrease the amount of dissolved or polluting substances in it, be absorbed in or repelled from substances on which it may fall.

By knowing how to manage water, we can do much to help conservation practices by preventing soil erosion, floods and droughts, also we can help maintain the supply of fish, fur bearers, water fowl, turtles and water plants that have food value and other values to us. Putting into practice what we know about these things may help us live happily ever after.

The means of simple demonstrations to develop these points should be obvious to teachers. When we say that some things absorb water better than others, the teacher can show how different soils, plant products and other things vary in this respect. We cannot here be too specific when writing for a wide range of places. How these principles fit more specifically into the management of different areas will be developed later in this booklet. It is hoped that teachers will not attempt to teach the statements presented earlier in this section merely as words, but, as with the fire unit, will try to get the idea over by some simple homely demonstration that will need no equipment. One can sit on moist soil on a raincoat or with ordinary clothing and discover that substances vary in their ability to absorb or prevent the absorption of water. Nothing elaborate is needed to illustrate any of the points raised and yet understanding them all is essential to a sound conservation education program.

One of the recommendations of the Caracas Conference of the International Union for the Protection of Nature called for the recognition of the importance of drought in semi-arid regions. Another called for sensible development of hydro-electric plants; another, restoration and development of water resources. All of these depend on the understanding of the role of water in conservation.

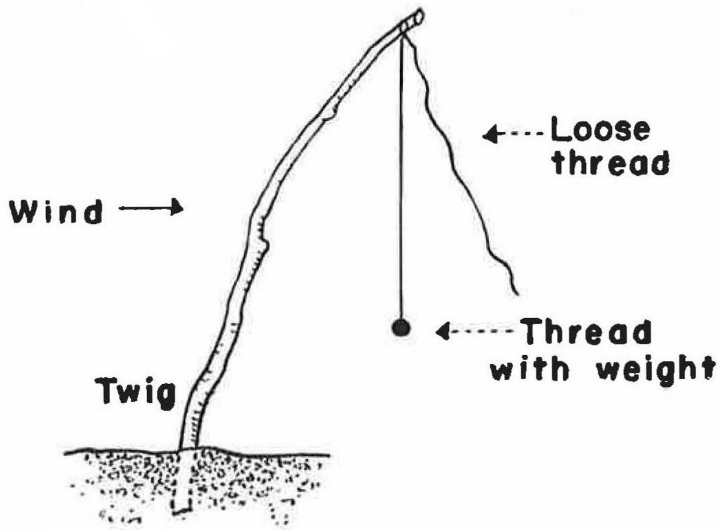
AIR STUDIES IN CONSERVATION

Moving air in the form of winds may interfere seriously with our desire to live happily. Such winds over waterways may wreck vessels in which we are moving or they may blow down dwellings in which we live or forests on which we depend. They may blow sand and fine earth particles against plants and destroy them or dry the plants out if the winds are hot and dry. In some cases, the air may be polluted with waste gases from industrial plants so that the air is unhealthy for breathing by man or beast. Winds may cause small harmless fires to spread and become tremendously destructive. They make snow or dust into drifts that cover food necessary for wildlife survival.

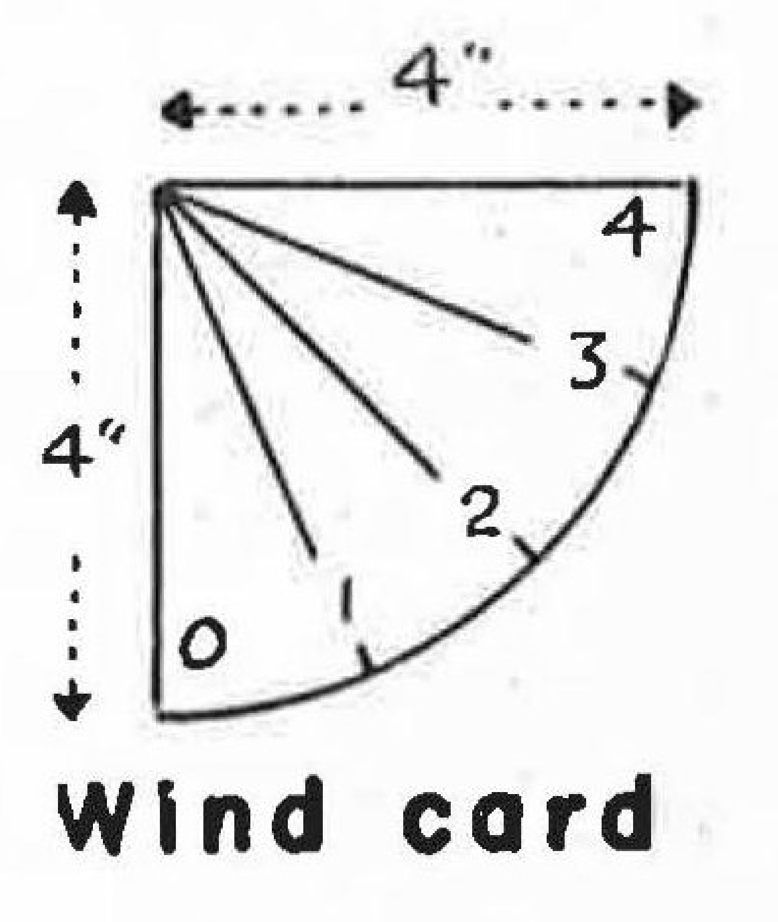
Winds are to be found in almost every place where man may live. They affect our happy living. They can be managed to a degree. If they are not managed, we may be in serious difficulties. They should be studied in any conservation program. Winds play an important part in drought problems in semi-arid regions and the Caracas meeting specifically recommended the study of this problem.

As is the case with other phenomena affecting our environment, winds may be useful or harmful. They are useful in drying clothing, wet lands and other things. They are affected by the lay of the land and ordinarily are not so strong in valleys as they are on hill tops or over open plains. Since they assist in evaporating water, they produce a cooling effect which may be useful. On the other hand, this may be harmful.

We may experiment easily with winds and for this reason they make excellent studies in school programs on conservation.



If you live in an area where snow drifts or sand dunes are found, it will be easy to demonstrate what wind does to snow and sand. Little fences erected across the path of the wind will create differences in the surface of the ground to windward and in the lee of the fence. A strip of wet paper a foot long and a few inches wide with dust sprinkled on one end and a ruler stood on edge across the middle may show something useful if the dust is blown towards the ruler. It will settle in eddies behind the ruler and stick there to the wet paper. In the open, you may lay a piece of paper on the ground where the wind is blowing. Fasten it firmly so that it will not blow away. Give the children some cardboard fences a foot or so long and half as high. Ask them to place the «fences» in such a way that the paper will be covered with dust, sand or snow by the wind.



In some countries, the sides of houses are little more than woven mats through which the air may pass easily. This has its advantages during times of the year when the air is hot and humid, but when cool or cold winds blow, such walls give little protection. Double walls even of these mats may do much to reduce the bad effects of winds. In many farming practices, dry winds may be as destructive as violent ones. In these cases, farmers frequently erect little shelters to the windward of such plants as oranges, avocadoes and some vegetables. Bananas are frequently grown most successfully in valleys where strong winds cannot tatter their leaves. Look for other examples of how wind is managed in your neighbourhood and discover how you may use it to help you live happily, either putting it to work by using wind mills or by even more commonplace methods.

If you are concerned with managing your environment, it might be well to know from which direction the strongest winds most commonly come. Observation of the simplest kind of weathervanes or of the way dust most commonly blows should be helpful in this connection. Knowing about these winds, you can plan better what plants that are affected by winds may be grown in a given place. If you are camping, the selection of a camp site in relation to winds may make much difference in the warmth or coolness you must experience, in the number of mosquitoes to be expected and in other things. Winds carrying pests that may fly from garbage dumps or from swamps or wastelands or gases from industrial plants or odors from farm buildings may affect greatly the value of a place in which we may think we can live happily.

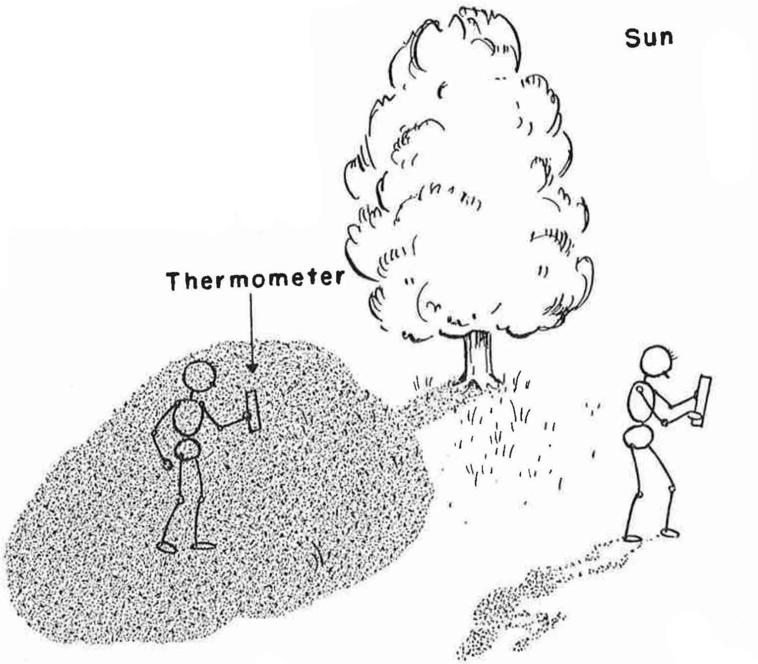
To the ends of a few dozen foot-long sticks fasten some tissue paper streamers. Stick these into the ground around your school or home and decide from what you see how the winds vary in direction and velocity in the morning, at noon and at night once a week through the year. Your findings may be helpful in growing a garden and in a number of other things.

The understanding of winds is most important in the management of wildlife. Many forms of game have keen ability to smell danger. Such creatures cannot be approached easily downwind, but may be approached upwind more easily. How do local forms of wildlife seem to vary in this respect? How do local forms of woody plants vary in their ability to withstand strong winds and which show signs of injury because they have been grown in the wrong place? Notice how different trees of a given kind vary in their ability to survive wind injury by the nature of their surroundings.

CONSERVATION THROUGH MANAGEMENT OF LIGHT

Great forested areas of the world have been cleared of their trees and shrubs so that other plants may be grown for food and clothing. One of the reasons the forests were cut was to let light get to the ground so that the cultivated plants could grow. Sometimes forests were merely burned so that light could come to the ground through the leafless tree tops.

Whatever the case may be, the management of light is important in conservation. Where light can reach the ground, low plants are encouraged to grow, wet soils may be dried more quickly, cold soils may become warmed for a longer growing season, snows may be melted more quickly and other things may happen.



In wildlife management, it has been found that most small wild creatures are more abundant at the edges where forested areas border unforested lands. Hunters and trappers know this well and it may be observed by any one willing to take the time to investigate. By cutting woodlands properly, we may increase the amount of edge territory in an acre and the amount of wildlife it will support. We also sometimes plant shrubs between fields providing edges in which small game may hide quickly, get food readily and travel safely from place to place because of protective cover. Similarly, we manage swamplands by cutting channels into the reeds and rushes, creating edges suitable for the needs of wildlife of such places. Letting light in and keeping light out is most important in the management of any land area for agricultural or wildlife purposes.

Teachers may help students anywhere to learn that certain plants and animals have definite light needs. Some plants are to be found only in the shade, while others must be exposed at times to direct sunlight. Even the changes in the amount available during the 24 hours of a day influence the activities of many plants and animals. The calls of some animals are heard only at night, in broad daylight or at some other specific time. Some move about or change their positions more freely at night than in the day and all of these things affect the survival of these animals or plants and must be taken into consideration if man wishes to manage them to the end that he may live happily with them.

The color patterns of many animals are such that the animals are not easily detected in certain environments and this helps their survival or prevents them from being found.

Light plays a most important role in the life of waterways. Without light, plants cannot be grown and without plants animals cannot live. Therefore, light must reach underwater plants that are to continue growing. This may be relatively easy in clear, pure waters. In waters that are fouled with pollution, however, the useful layer of water may be relatively shallow and the food produced correspondingly small. In the management of small fish ponds, light plays the major role. A heavy population of small forms of life is encouraged to develop in the upper layers of water and this shuts off light in the depths and keeps down the growth of water weeds that might otherwise clog the ponds.

Simple school experiments dealing with light and conservation may consist of selecting areas in the neighborhood which will have varied upon exposure to direct sunlight. For example, find areas which, at a given time of year, are exposed for four hours a day to direct sunlight and other areas that are exposed an hour or not at all. Notice if the plants and animals growing in the different places are the same.

Notice how the amount of light varies in different kinds of forested lands, how in evergreen forests little light reaches the ground and, consequently, there are few low plants growing. This may make such a place a sort of desert for animals that must live on low plants. Notice how trees develop when they are completely or only partly exposed to the sun and get some idea of how this might affect the trees if they are being grown for use as lumber. Would it be desirable to plant orchard trees close together so that their trunks would be clean and straight and their tops high above the ground? Try to manage some small plant by cutting off the light available to it or to parts of it. If an aquarium becomes filled with green organisms cut it off from the light for a few days to see if this changes the situation.

Notice how the amount of light available at a given point varies at different times of the year and how some spots get direct sunlight only once a year, possibly. Find such a spot if you can. Notice how the amount of light striking hillsides varies because of their exposure to the north, south, east or west and how this affects the plants and animals to be found there.

Teachers who feel bound to the schoolroom can still make studies of light with profit. A portion of the room, the floor or of the walls may be brilliantly lighted at one time and in the dark at another. Make observations at a given time one day, marking, for example, on the blackboard the edge of direct sunlight at 10 in the morning. Leave the mark on the board for a day and notice if the edge of light is the same place at 10 the next morning. Predict, if possible, where it will be the next day and a week and month hence. Check on what happens. Point out to the children that knowing the length of time a spot on the earth is exposed to direct sunlight is important if we wish to grow plants or animals there.

Give some suggestion about the role of sunlight in health suggesting that exposing clothing to direct sunlight may often destroy unwanted organisms. Note also how domestic animals seek or avoid exposure to direct sunlight at different times of the year and of the day. Make lists of the wild animals that have been observed «sunning themselves» and of animals that seem to avoid ever doing this. What poses do they assume that indicate they find the experience enjoyable?

Some teachers have found it interesting to color different grains blue, green, yellow and red, and expose even numbers of these grains to seed-eating birds and to mammals to get some idea as to whether either may be inclined to be colorblind and leave one of the colors untouched at least until the last. It has been proposed that selective poisoning might be done by coloring exposed food in such a manner that a colorblind bird might not see it, but a mammal might. Try this if it interests you.

SOILS AND CONSERVATION

Much of our conservation thinking has been identified with soil conservation. Soil is the basis of our economy and our ability to live happily in the environment we call home depends largely upon the management of our soils. There seem to have been two philosophies developed in teaching soil conservation, however. One preaches a philosophy that through the ages man has always been a destroyer and that he probably will continue to be with the inevitable result that in the end he will ruin the land on which he lives and face starvation, poverty and death. The records of history support that view in many ways and the present practices in many parts of the world also support it. Men still live who are proud of the fact that they have «worn out» more than one farm or killed the last duck or deer in the vicinity or caught the last fish out of a stream. It is true that we have lost and are still losing enormous amounts of valuable soils by erosion by water and wind and by one-crop agriculture that does not give the soil the chance to restore its values.

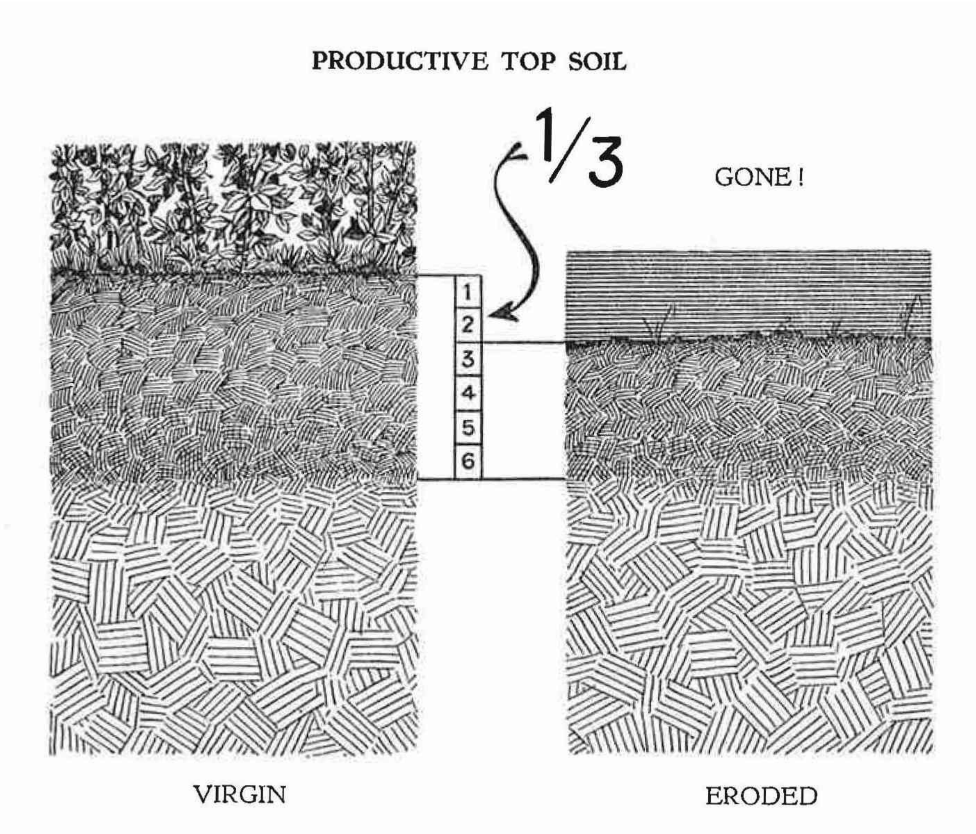
Fortunately, there is another philosophy which is not so gloomy and fatalistic. We know that we can manage our soils in such a way that they are better than they have been. We know that while we may lose valuable soils by erosion, we can also build valuable top soil by growing suitable plants and by reasonable fertilization. In America, we have brought beaver and deer back in numbers that are encouraging. In some areas, we are restoring our soils similarly. The destroyer cannot live happily. The hoarder cannot possibly be as happy as the builder, the one who makes his environment better than it was before him. To live happily, so far as soils are concerned, we must build soils as well as save those we have.

It has been said that it takes 500 years for nature to make an inch of topsoil, but man rarely lets nature do all the work. Rather, we help nature to work for us and there are those who seem to have demonstrated that they can, by management, convert a half-inch of subsoil into a good topsoil in a year.

Our school program should possibly recognize three ways of attacking the soil conservation story. We should recognize that man has and is wasting great quantities of topsoil that form the basis of our social economy. We should recognize that with reasonable procedures, we can cut down the drain on our natural reserves of useful soils and can live longer on those reserves by such practices than we could by doing as we have done in the past. Thirdly, we should recognize that we can build our reserves of useful topsoil that is the basis of our whole agricultural economy and that such a procedure probably is our only hope of living happily ever after.

Points which teachers will wish to emphasize in the management of soils may be the following. How this may be developed is shown later.

As shown by sections of the earth surface in road cuts or stream banks, the soils exposed at the surface to weathering, to air and water differ from the soils beneath in color and in texture. The darker topsoils are usually mixed with plant and animal remains and absorb water more readily than other soils.



Soils differ in color, in temperature, in texture, in origin, in the life they can support and in other ways.

When water is added to soil on the ground or in a glass jar, much of the fine earthy and organic material rises into the water and may be carried away if the water moves. Soils may, therefore, lose some of their elements if water moves freely over them. Water moves more freely over bare soils than over soils covered with vegetation.

Lime added to clay soils tends to make the soils form into little units that do not cake so readily into hard, impenetrable plates in which plants cannot thrive. Mud pies made of clay, and of clay and lime break differently if dropped. Lime added to muddy waters may have a clearing effect so far as the clay particles are concerned. Lime, therefore, may affect some soils favorably for agricultural purposes. Other chemicals may also affect the nature of soils by their presence or absence. Students may study the effect of salt or alkali on soils if the locality is such that these create a problem. Students may discover that soils may occur in layers with the chemical nature of adjacent layers differing greatly. By careful farming, one layer may be used and the layer beneath avoided. By unwise irrigation and farming, soils which have been useful may be made useless because of the nature of underlying layers of soil. This may be particularly true of layers rich in alkali or salt or, in some parts of the world, because of permanently frozen subsoils.

Farm practices designed to let air, water and organic materials enter subsoils are likely to contribute to the development of additional topsoil. Air, water and organic material may be mixed with subsoil in part by cultivation, in part by the vigorous growth of healthy plants made aggressive by proper management, and by the activities of such animals as earthworms, some insects and even microscopic animals. The microscopic life, both plants and animals, found in a healthy soil does much to change poor subsoil into rich topsoil.

Soil management consists primarily of letting in air, water and organic material, of holding desirable soils in position so that they are not lost by moving water or wind, of crop rotation that permits the soil to recover after certain crops have taken some materials from the soil, of growing on the soil plants which will restore nitrogen, particularly to nitrogen exhausted soil (the clovers are excellent for this). Soil management also calls for returning to the soil rich manures of domestic animals where this is possible and of avoiding overgrazing that may remove the protective plant cover that holds soils in place, holds moisture and modifies temperatures suitably. One of the recommendations of the 1952 Caracas meeting of the International Union for the Protection of Nature called particular attention to the abuse of soils by overgrazing of domestic animals, particularly goats, that remove plant cover too closely to the soil surface. Sheep might be considered as being almost as destructive as goats in this connection.

The management of soils calls for intelligent activities on the part of men if the soils are to continue or to increase their yield. This requires an understanding of the nature of soils and the proper use of this understanding. It calls for an understanding of the relations of soils to plants and to animals as well as to the ordinary physical phenomena. Proper management yields gratifying rewards to all.

CONSERVATION OF MINERAL RESOURCES

Through the wise use of air, water, soil, fire and sunlight, we may manage many of the resources so that they may be continually and often increasingly productive. In other words, some resources are renewable. This is not true of some resources such as the minerals. Once we have mined all the lead, zinc, copper, gold, silver, iron and coal from the surface of the earth, we cannot get more of these substances. We either have to learn to get along without them or find substitutes which will take their places. Already, we are learning how to recover some of these materials from sources that were formerly considered as uneconomical for development.

Industry that makes the gadgets such as tools, plows, stoves, automobiles that make many of us happy is dependent on having access to supplies of raw materials such as the minerals. Some of these, like quartz crystals and diamonds, are rarer than substances like asbestos and platinum, which are rarer than iron and copper and sulfur, which are rarer than lime, salt and clay and water. When we find a mineral which is rare so far as a nation is concerned and yet essential to the economy of that nation, it may be considered as a strategic mineral. The same mineral may not be strategic in other countries where it is more abundant and where industry is not so demanding. In the United States, for example, aluminum, antimony, chromium, manganese, mercury, mica, nickel, tin, tungsten and quartz crystals as well as some of the minerals demanded by the atomic development may be considered as strategic. The United States may process these materials if they are to be had from other countries and return them to those countries for their use in time of peace or war. A reasonable adjustment of how these minerals may be used calls for recognizing a world economy. It also calls for a wise use of the machinery and other things which create a demand for these minerals. It may call for the development of substitutes for the minerals which may not make their use so important. This calls for expert study and for cooperation of the everyday man who uses everyday tools, or whose safety may depend on the existence of the machines of war that may use them. It is doubtful if such wise use as is demanded by the situation can be guaranteed wholly by knowledge of the situation. It probably will be determined more largely by the fact that things requiring the use of some strategic minerals just cost too much and we learn to get along without them. The average family gets along perfectly well without diamonds, for example, and many families relation to diamonds is limited to the use of substitutes for decoration or of commercial artificial diamonds used in the drilling of rocks by companies of men searching for oil and gasoline of value in running some sort of gasoline engine.

In the United States, minerals such as asbestos, cadmium, fluorspar, graphite, iodine, platinum, titanium and vanadium are not so necessary for the economy of the country or are available in such amounts that they can be expected to be abundant for use for some time. These minerals the United States does not consider as strategic, but critical. Their use should be planned and they should be conserved.

Apparently, the United States has ample supplies of some minerals that are almost as useful as are some critical or strategic minerals. These are sometimes called essential minerals and in the United States include abrasives, arsenic, chlorine, copper, helium, iron, steel, lead, magnesia, molybdenum, nitrates, petroleum, phosphates, potash, sulfur, uranium, zinc and zirconium. These are not so abundant in some other countries. There some of them might be considered as essential or even strategic. The exchange of these important minerals between countries may be the basis of wholesome world trade or of a destructive war. Only by the former can we probably continue to live happily ever after.

Of course, even such a common substance as water may be of great importance in regions of concentrated populations. Great cities are constantly increasing their control over surrounding watersheds so that they may have water suitable to their needs. This may interfere with established agriculture in those areas. It may convert a superior fishing stream to a deep reservoir that may be full at times and empty at other times and useless as a source of fish. The only solution for such problems is in the cooperation of all parties concerned. The cities should adopt practices which make it unnecessary for them to modify unfortunately the activities of their rural neighbors. This may call for modification of practices of sanitation, of convenience and even of religion. It may call for the finest kind of conservation.

About one group of minerals there will always be conflicting forces expressing themselves. These are the fuels such as petroleum, coal, lignite and so on. It seems inevitable that we will some time exhaust the supply of those important substances. It also seems probable that by the time that happens, we will have learned how to use more efficiently those which we have and to find fuel substitutes in the form of using water power, sun power and even tide power. In the meantime, however, we should use what we have with every effort to conserve. One interesting development in the

United States might be elaborated here. In this case, the pendulum seems to be swinging back towards the use of these minerals.

In the great Mississippi Valley the flood plains and the lands adjacent to the rivers have been the basis of the most productive agriculture. However, floods have been regularly destructive downstream and moves have been made to build dams to prevent floods and to generate power. The proposed dams, unfortunately, would flood some of the richest agricultural lands, much to the distress of those who have lived in the areas for long periods of time. It is argued that equal flood control could be effected by many small dams in the upper stretches of the river, in controlled drainage of existing farmlands and in other practices that would not call for the flooding of the lands. The power argument is answered by the fact the region is abundantly supplied with lignite, whose fuel value is so inferior that in the past it could not be used efficiently. Modern techniques have been developed so that this fuel can now be used to produce power more cheaply than it could be produced by the construction of the proposed dams.

Other great river systems of the world may not have associated mineral deposits that may be used as substitutes. As the human populations increased in the upper reaches of the Nile, the whole nature of the flood plain near the mouth has been changed by floods or lack of floods. This must affect the whole economy of that part of the world. Surely, the presence or absence of minerals means much to people who wish to live happily ever after.

PLANT CONSERVATION

We have already suggested that plants are the basic food for all animals and that their development depends in part on proper combinations of soil, water, temperature, light and air. We have suggested that many plants may be destroyed by the unwise use of fire and by overgrazing of domestic livestock, It is appropriate that we consider more specifically the role plants play in the conservation picture, even though we shall develop it still further in the concluding sections of this paper.

One of man's first acts in «developing» a new territory is to change the plant life on it. He cuts down forests, even though later he plants other forests. He destroys useful native plants to make room for the growth of introduced plants that cannot always survive where they are planted. He burns over areas to save the labor of cutting, to drive out game so that it may be killed, to kill insect and fungous pests and sometimes just for the fun of seeing things go up in flame and smoke. He drains swamps to grow crops which cannot find a ready market because they are already so abundant that they cannot be sold with profit and he irrigates arid lands to grow crops that add further to the market competition. Sometimes it is difficult to understand why men do some of the things they always seem to be doing.

The fortunate part of it all is that man, at his best, knows now how to make plants care for his present needs with a minimum of effort on his part and without too much burden on domestic animals. If we use wisely the information we now have, it should be unnecessary that we invade sanctuary areas for the purpose of growing new crops or that we farm too intensively lands that are already in a state of high productivity. Certainly, there is little reason for wearing out the average land that produces crops for our benefit. The 1952 meeting of the International Union for the Protection of Nature held at Caracas emphasized the value of the preservation of plants in natural areas and particularly where rare species might be small in number. It recommended the restoration of vegetative cover where it had been reduced to a dangerous degree. Schools can help attain some of these goals by teaching the children how plants grow and what their value may be in order that the children may have some understanding of the necessity of plant preservation.

Of course, there should be some recognition of different kinds of plants and of the varied roles they play. We should also recognize that man has unwisely used many of the plant resources available to him. We have cut down forests, have introduced insect and fungous enemies of plants, have upset the conditions on which useful plants depend. We are now attacking marine plants as a source of revenue without always recognizing that their continued abundance is essential to the fish life which we may also use for food.

School studies may well be made to emphasize a few points. Plants differ in their appearance and needs. Some plants, like some of the fungi, destroy other plants either performing a service to us or injuring our interests thereby. Many plants like the clovers, some of the cone-bearers, orchids and other groups are directly dependent on fungi for their survival. Many of the undesirable fungi may be kept under control by crop rotation, by the use of chemicals and by plant quarantine. Unless reasonable controls are maintained, many of our cultivated plants and native wild plants will disappear from our environment.

The careless introduction into an area of new kinds of plants then may result in a loss rather than a profit to that region. The introduction of the Japanese beetle into America is a spectacular example of an animal that may have been introduced on plant material and which has spread its destruction to many plants that formerly prospered with little protection. On the other hand, the successful growing of some kinds of figs in some areas depends on the introduction of insects on suitable plant material. These things show that the management of plants should be based on researches such as were recommended at the Caracas meeting.

Since children and others will probably always be interested in picking wildflowers, it might be well to recognize some practices that may be followed which will protect the rarer species. In the first place, of course, there are in any area wildflowers whose abundance is such that there is little likelihood that picking them will affect their abundance. These species should be recognized as such. Rewarding children or others for the protection of rare plants should be a common practice.

Useful annual plants whose survival is dependent on the annual production of seeds should be recognized and something should be done to guarantee a continued production of the needed seeds. The promiscuous use of insecticides that destroy pollinating insects may be unwise at times. Apple crops, for example, and clover crops may not be produced if bees are killed by sprays designed to destroy injurious insects.

If we must pick flowers, it may be well to recognize a few things about some plants. A plant must have its green parts protected if it is to have the necessary food to survive. We may pick the flowers of many of these plants if we do not injure their green parts and if the plants do not need to produce seeds each year to survive. In many plants, there is what might be called the danger point above which the plant may survive, but below which death will result.

It should be recognized that while some plants are rare, there are spots where a few may be taken with safety. If, for example, we see to it that there are always left three vigorous plants of a given kind within a radius of three feet, we can be reasonably sure that the species will not be destroyed. It would be better, however, if we learn to confine our flower-collecting to those species that can safely withstand such a harvest.

Possibly the best appreciation of the value of plant protection may come through knowledge of what plants can do for us. Teachers might like to help students prepare lists of local plants that have these values: food, medicine, fiber, ground cover, beauty, wind break, lumber, pulp, producers of oils, resins, waxes, flavorings, scents and other things. Local talent may be enlisted in helping make a suitable list and then this may be reviewed by experts possibly with profit to the expert and local authority and certainly to the teacher and pupil. Knowledge about a plant may give that plant its most effective protection.

The role of plants as soil anchors and in the general economy of specific places has been touched on and will be elaborated further later on.

CONSERVATION OF ANIMAL LIFE

Animals are a part of every environment in which man lives. They do much to make life for him happy wherever he may be. It is important that we know some of the simpler ways of managing animals so that they may help us live happily ever after.

Some of the steps that might be taken to guide us in the wise use of animal resources might be these.

Before we attempt to remove animals from a given area or introduce them, we should know what their specific needs may be and how the area in question provides these conditions. We should not try to introduce animals like young fish into areas where they cannot possibly survive. If we wish to remove undesirable animals from an area, it is possible that this can be done conveniently by changing the conditions there so that they cannot survive. This need not necessarily lead to the destruction of all other kinds of life in the area. Selective trapping with specific baits, for example, might remove all members of one species from an area without in any way affecting the prosperity of others.

Before we attempt to harvest animals from an area for any reason, we should have some idea of the abundance of the animals there so that we will not destroy breeding stock if it is desired that the animals continue there in reasonable abundance. This may call for some survey of the abundance of the animals based upon direct observation, selective trapping, sampling of small sections, observations of signs and possibly abundance of animals with which they are normally closely associated.

Once we have determined reasonably well the abundance of the animal in the area, we should determine what its recuperative powers may be and gain some idea of the surplus that might be harvested without an appreciable harm to the remaining animals. Steps may then be taken to harvest that surplus without fear of disaster. This may call for the establishment of closed seasons, of limited bags, of limitation of harvest to one sex or another, of establishment of specific gear for harvesting and of other limitations. The harvest may be limited to periods in which a pelt is at its best or flesh is most likely to be edible or the animals are likely or not likely to be attracted by mating calls or by lights. It may be conditioned by the independence a new annual generation may have attained or the seasonal behavior which separates members of a family and assures survival of some members at least. Any local area will be able to find examples of practices that fit into at least a part of this picture.

Once it has been agreed on how many individuals of a population of animals may be harvested in safety, it is important that care be taken in processing the harvested product so that there need be no continued strain on the remaining population. If we kill or wound a duck and do not collect it for use, we may continue to seek other ducks reducing the supply to satisfy our needs. Hunters learn how to shoot to kill individual birds without wounding others, and this is good conservation. Trappers who have taken furbearing animals must remove the pelts so as not to injure the skins and thus make it necessary for the trapper to take more animals to satisfy his needs. Fishermen who take fish must see to it that the fish are so handled that they do not spoil before being used as food. This is true of commercial fishermen and of sports fishermen as well. An injured fish may spoil more quickly than one that is not bruised in the process of being taken or handled afterwards. Proper temperature, proper cleaning of entrails, proper storage of fish and game may lessen considerably the need of taking additional animals and be as good conservation practice as the raising and freeing of additional animals that may not be harvested efficiently. What holds for wild species of animals, of course, holds for domestic species as well.

Other steps between the live animal and the used dead animal that may be watched in good conservation practice include intelligent transportation, sensible marketing if the animal can be legally marketed and lastly, wise use of the finished product. If a fur coat is not given proper care, it may be necessary that a new fur coat be bought more quickly than would otherwise be the case. This would call, of course, for an increased demand for more pelts clear back to the trapper and to the territory that produced the animals. It would seem from this that probably all of us have a responsibility in the wise use of animal matter that we use for food, shelter or clothing.

Any study of animal conservation will be based on many aspects of the problem. It will call for understanding of the reasons back of game laws, the reasons for international agreement on the treatment of migratory species and of species that roam the high seas. It will call for recognition sometimes that loyalty to society is more worthy than loyalty to a friend who may have acted unwisely.

The wise management of the animal population of an area calls, first of all, for some understanding of the number of animals an area will support. At times, it may be recognized that it is wise to encourage the taking of young animals whose competition with their kind is so great that no individuals may make a satisfying development. A stream may be so full of young fish, for example, that none can reach the useful size. The number of deer or other grazers in a region may be so large that the vegetation cannot adequately nourish any and the result may be stunted animals. In cases such as these, a stimulated harvest may be the best policy, but any such practice should be based on the judgment of trained specialists who know the conditions in the area involved.

What is true of the prosperity of wild animals may also be true of the prosperity of domestic animals and to some degree of man himself. We cannot recommend the elimination of human beings the way we can of wild or of domestic animals. We can, however, recognize that any substantial increase in population calls for increased ability of the earth to produce the food and clothing the new population will need to live happily ever after. The increasing of any population calls for new responsibilities which must always be recognized by those responsible for the size of a family, a community or a nation. Fortunately, the people of the world have not yet exhausted the productive capacity of the lands on which they live and by the general use of what we know about the management of living things, we can continue to develop for some time to come. We must, however, recognize our responsibility to use wisely the resources at our disposal if we are to live happily.

There is little doubt but that the best conservation practice to be applied to man himself calls for the development in each individual of the best possible potentialities. Sometimes these are not recognized. It would be absurd to suggest to a colorblind individual that he undertake certain types of work as a livelihood yet he may have an excellent ear which would suit him for work not possible by one with normal or superior vision. Teachers should recognize in their pupils the skills and abilities possessed and potential in the group.

Possibly some progress may be made in this field by the simplest kind of competition based upon the different senses. Ability to see things close at hand and at a distance, to detect movement and to interpret it, to observe correctly different parts of the spectrum, to carry on a sustained and disciplined observation might be suggested as fields worthy of development. They suggest competition but winners in one category should recognize the value of those who excel in other ways.

Similar variation in ability to hear may be also expected. These things may be most important to those who make their living by taking food from the wilds. They are important to men engaged in war and to any of us living in an atmosphere of peace. The ability to see and to hear well may be accompanied by demonstration of the ability of individuals to produce satisfying pictures or music. Mastery in sensory appreciation of an environment may well be an important part of a conservation program.

The potentialities of different children in other areas should also be explored. Some may have a keen sense of smell and difference here may be recognized in pets owned by the children. Some have unusual ability to detect significant differences by the sense of touch. Wool classifiers make a living using this ability. There are professional tasters who have capitalized on their ability to detect differences through tasting, and other abilities are, of course, recognized in other occupations. Probably the most commonly used method of evaluating the service of some human beings is their ability to do work of various sorts. This may call for heavy work such as is done by a dock worker, skillful work such as is done by a mason or a machinist, sustained work such as may be called for by a truck driver, intelligent work such as may be called for by a farmer, teacher or professional man.

A complete conservation program calls for a sensible integration of the talents possessed by any community. Such groups working together are the groups that recognize the merit of adequate sanctuaries for wildlife, planned development of watersheds and cooperative effort in the development of a community prosperity. Conservation is of necessity an intelligent activity and the presence of an adequate conservation program in an area may be taken as some measure of the intelligence and maturity of the community. Conservation calls for the recognition of problems by the social science element of a community. The solution of these problems is left to the scientist and to the man who knows the material parts of the community. The application of known information to the problem may be made by the engineer and technician. Appreciation of the situation by the average citizen, whose support is also necessary.

COMMON CONSERVATION LABORATORIES

We hope that readers of this booklet will feel that they can understand conservation or appreciate it merely through having been able to understand what we have written so far. It can best be understood and appreciated through trying these ideas out in laboratories that are available to everyone. No expensive equipment is really necessary; nor are extensive field trips since almost any ordinary school has all that is necessary within a few feet of its building. Good equipment and well planned trips may be helpful in a conservation program, but they are not necessary and a well-planned exploration of an immediate environment may be much more valuable than more time-consuming and extensive experiment.

We propose here simple trips that will give experiences significant in understanding the major types of territory that contribute to man's happiness and success. These are briefly, waterways, grassland, woodlands, deserts and man-made environments such as homes, schools, and pavements. It is doubtful if there is any individual who lives where none of these areas is available for study along the lines we suggest. Most schools present opportunities for studying all of these areas. Only recently, the writer took a trip across the United States and deep into Mexico to see if schools had the facilities here considered. He has had similar opportunities for observation in Cuba, Jamaica, Hawaii, Fiji, and New Zealand. We believe that the suggestions are eminently practical and reasonably simple. We hope that they will be found to be profitable and welcome.

Briefly, we will find our waterway in a brook if one is close or in a gutter or eavestrough or drinking fountain. We will study grasslands on a bit of lawn or earth covered with vegetation. It need be only a few inches in diameter for our purposes, but naturally will be better if it is larger.

The woodland may be represented by a single tree or shrub. A shrub a foot high could be all that is necessary to study the problems of the forested areas of the world. We hope that such a shrub is available for your use.

A trip to a desert is possible by examining any paved footpath or driveway. Even a path of beaten earth will suit our needs if a paved area is not available. We have yet to see a school that does not have plenty of paved desert laboratories available for use in studying deserts. The average playground may be ideal for this purpose.

The man-made environment must be present if there are human beings present to engage in our program so we shall not worry further about that.

Remember, then, all you really need as a minimum for this program to understand the conservation problems of the world is a roof, a lawn, a shrub, a paved path, a man-made building. You do need a little imagination and ingenuity, but that will be developed with use and we hope that you will find it fun teaching this way so that you as a teacher will be able to teach happily ever after. You will not need to collect plants because they will be with you. You will not need to collect animals because they will come to you. For the most part in your studies you will use chiefly your eyes, your skin, your muscles and your intelligence to recognize differences that may help you appreciate the conservation problems of waterways, grasslands, wooded lands and deserts. Later, you may care to learn the same things in other ways.

All you really have to do is sharpen your senses, your wits and your imagination. With that, we are ready to go for the last phase of our story.

In developing each of these units, we will suggest first the study of the small unit that is local and then suggest how it may be used to understand the corresponding areas over the world, should it be possible to visit them.

A GRASSLANDS LABORATORY AT YOUR DOOR

Find a piece of lawn that is bordered by a paved or bare area. With a pocket knife or other tool or stick, dig a narrow ditch into it. This need be only a few inches long and an inch or so wide, though it might be better if it could be larger. Dig down at least an inch beyond where the grass roots seem to be abundant. Notice that there is a difference in texture of the soil where the roots are growing and the soil beneath this area. Possibly there is a difference in the color of these two areas. If so, which of the regions is the darker? If there is a clover plant in the grass plot and your trench has gone beside it, notice if the clover root system reaches deeper than the grass roots. If you did not cut next a clover, dig up a clover plant and notice if its root system is deeper or more shallow than the grass root system. What other plants growing near the grass have deep or shallow root systems? Which of these plants could probably reach deeper for water in time of drought?

If it is a bright, warm day, put your hand on the nearby paved or bare spot and then on the grass-covered spot. Which seems to be the warmer? On a hot day, is it more comfortable to walk barefoot over grassy spots or over bare paved spots? Notice if the sun is able to strike directly at the grass-covered soil as it can at the bare paved surface. If you have the opportunity, investigate the temperature of the grassy and the bare spots in the evening and in the early morning. Would you conclude from what you find that the temperature changes more rapidly on the vegetated area or on the bare area? We say that the area where there is the least change has the more stable temperature. Is the temperature of the grassland or the bare land the more stable? There are temperatures above which certain plants and animals cannot live. Would the temperature of the grassland probably suit more animals than the temperature of the bare land?

Try to determine which of the two has the more moisture, either by putting the hand on one and then the other or by sitting on the two. Which one will become wet more quickly and dry more quickly before and after a shower? Which has the more stable humidity, the grass plot or the bare spot?

Look carefully through the grass plants to see if you can find any animals. Sort out the material you removed in making the trench. In the grassland, can you find any animals such as slugs, ants, or earthworms? Examine the bare spot to see if you have similar success. On the bare spot, do you find any signs that animals may have visited it during the night? The shiny, slime trails of slugs may often show and sometimes the animals themselves get caught on the pavement and do not escape the heat of the day. If larger animals are present, do they seem to prefer being on the grassy spots or on the bare spots? Does this hold for all times of the year and all times of the day?

On a hot day, test the feel of the grassy surface, of the earth beneath the grass and of the surface of the bare spot. Later, we will explore beneath the bare spot but now decide which is the coolest spot of the three. From which of these surfaces do you imagine the water would evaporate most quickly?

Make a simple drawing of a section of grassland showing the depth to which the roots of clovers, grasses and other plants penetrate and indicating in some way which of the regions has the highest temperature on a warm day. If you wish to check this with a thermometer, do so, but you should be able to get the idea merely by feeling with your fingers. Indicate, if possible, any difference in the darkness of the soil at different depths.

One evidence that grassland may be a superior environment in which animals live may be the variety of animals to be found there. See if you cannot find on some neighboring grassland a mammal, a bird, a reptile, an amphibian, a mollusk (snail or slug), an insect, a worm. Do you have the same luck with the bare spot?

Notice if grass grown on a lawn that is clipped frequently is any more juicy than grass allowed to grow tall by itself. Would it seem that cutting grass permitting the development of new growth would improve its food value to cattle, or decrease it?

The grasslands of the world are much like the little grassland represented by your patch of lawn. They yield to us a majority of the food and fiber we get from plants. They are the great grazing areas from which we get beef, butter and hides. They are worthy of study.

If you can visit a pasture, notice that in all probability, the grass is not equally developed over it. Usually, it grows vigorously over the droppings of animals, indicating that by properly feeding grass, we can stimulate its development. Notice that while cattle will ordinarily avoid grass growing from their own droppings, they will eat it readily if it is plucked and handed to them. Mowing a pasture now and then may be helpful.

In an area where animals are grazing, if possible notice how animals like cows, horses, sheep and goats differ in the closeness with which they crop the grass. Remembering that grass cover helps keep the temperature and humidity of a soil stable, which would be more likely to ruin a grass cover, a cow or a goat? If herds of cattle, sheep or goats are crowded for a time into a small grassy area, what happens to the grass there? Notice what happens to the grass in a cow path or sheep path and decide if you think that the beating of the hooves of many animals can injure a stand of grass. Suppose you had only a few places where cattle could get water, would you find more domestic animals around the water, or some distance from it? Would this concentration of animals help the grass close to the waterhole? Some desert lands have been started by this sort of situation.

Make some estimate of the number of domestic animals that may be supported by an acre of local pasture land, judging by the vigorous appearance of the grass to be found in the pastures. If grasslands are the source of most of our food and clothing, suggest reasons why they should be managed carefully and how it would seem such management might be put into practice in your local area. In the long run, would it be better to try to raise on the land available the number of head of livestock that would not injure the grass cover or would it be better to crowd the pasture with all the stock it can support for a shorter period?

A DESERT IN YOUR OWN BACKYARD

We have already suggested that we will study a pavement or bare spot in your yard to get some idea of what happens in a desert. We have found by feeling with our hands that a pavement gets warmer than grass-covered land on a hot day and we may have found that it also gets colder on a cold day. In other words, its temperature may go higher and lower than does the grass-covered plot. We also found that the paved area gets wet more quickly in a rain and dries more quickly afterwards. We have found that there is likely to be both more animals and more kinds of animals living in a grassy spot than in a paved or bare spot. The reasons why these things happen you may have decided for yourself. At any rate, grass lands and bare lands differ remarkably in temperature, light, humidity and animal populations.

Let us continue our studies of the bare spots. With a stick, knife or other tool, dig a trench down through a dry bit of hard-packed soil. Notice if there seems to be the same variation in color and in texture that was noticed in the grassland. With your hand, try to decide if the temperature differences can be felt. Ordinarily on a hot day the temperature at the surface of such a spot is much higher than that underground. You may notice that in the cracks between pavement sections or in other openings, ants may have dug their burrows. This makes it possible for them to get to a cooler region by going a few inches down instead of having to go greater distances in the level. In winter, they may reach a relatively warm spot by going down a few inches.

If you have a chance to observe a paved spot at night or on a cool day, notice if there seem to be more animals active when the sun is not shining its brightest. Watch for the shining slug trails and try to decide whether they were made most abundantly at night or in the daytime.

You may find a few plants growing in relatively bare spots or in cracks in the pavement. Pull up or try to pull up a few of these. Are they usually shallow rooted or deep rooted? Why do you think they are as they are?

If there are a few plants growing in your relatively few spots, notice if they are to be found in depressions in the soil or is the soil usually lower around each plant? How do you explain what you see? Did the plants grow up on top of the little mounds on which they are usually found or do you think that the soil around the plants might have been removed by the wind, by water during a rain or by some other means? In other words, can you find evidence that plants hold the soil in place and that, therefore, you would expect that the surface soils would be likely to shift in a bare spot more than they would in a grass-covered area?

Fill a few tin cans with water. Pour one of these on a paved spot, another on a bare hard-packed spot, another on a sandy or gravelled spot and another on a grass-covered spot. Which of these shed the water most quickly and which absorb it most readily? Ordinarily, it takes a mosquito a week or so to develop to maturity from an egg and this period must be spent in water. Does this help you understand why mosquitoes are usually not too abundant in desert areas?

You may care to experiment more completely with this matter of how different soils shed or absorb water. If so, remove both ends from a number of ordinary small tin cans. Force one open end of a can into grass-covered soil and then force the others into bare loose garden soil, sand and other surfaces that are available. Fill one of the cans with water and with a watch see how long it takes for the water to vanish into the soil. Do the same with the other cans. This may give you some figures to use in deciding which soils are most porous. Knowing this, would you think that an area would benefit most from a rain shower if it were paved, covered with hard or loose bare soil or covered with grass? Which type of place would be most likely to produce a flood following a shower? Watch depressions beside pavements and across lawns to see if you came to the right conclusions.

It is what happens in these little areas that may give you a clue to deciding what would happen in a big area. What you have found from the little desert in your backyard should help you understand the flash floods of desert areas, the small number of animals seen during the day, the number of burrowing animals that are able to survive and which commonly come out at dusk or dawn in a desert area, and many other things. From what you may have observed about the plants growing in the cracks in your pavement, you may understand why it is that desert plants are commonly deep rooted. Many of our pavement crack plants are milky juiced as is the case with desert plants, some of them belonging to the same genus Euphorbia and many belonging to the family Euphorbiaceae. Some of the plants growing on your relatively bare ground are juicy as is the case with «pussley». The same holds for some of our desert plants. They are able to hold water once they can get it and this makes it possible for them to survive when other plants would die.

Of course, the fact that plants are not abundant in deserts is due largely to the fact that water is not abundant or at least is not present for long periods of time. This also means that the number of animals supported by such an area will be smaller. It also means that if conditions develop on a grassland where the grass cannot do so well as it has been doing, either the animals depending on the grass must be reduced in numbers or the grassland will become more like a desert. When it gets desert-like, the surface soil may become loose and wind-blown. The finer stuff in the surface soils will be blown away and the soil will be made even poorer. «Dust Bowls» to be found in some parts of the world are due largely to the forming of deserts by overgrazing of domestic animals and by trying to keep just too many animals on a given bit of land. A grassy prairie may become a desert in many ways and a desert may be made into a grassy prairie sometimes. Basing your judgments on what you have seen happen in the grassy and bare spots in your own front yard, decide how these things could happen.

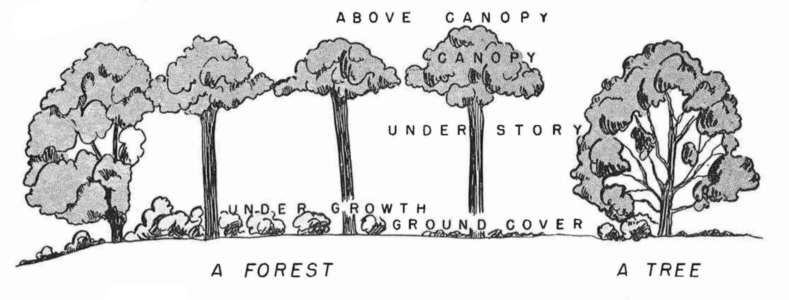
The second resolution of the Caracas meeting of the International Union for the Protection of Nature recommends action to «recognize the importance of drought in semi-arid regions as well as the damage which may result from overuse by domestic livestock and particularly goats». We hope that the experiments we have suggested will allow you to understand just what this means and possibly to demonstrate the principles to children without going outside your own schoolyard. This means that you will be able to reach all your pupils, not just a few of them.

A FRONT YARD FOREST LABORATORY

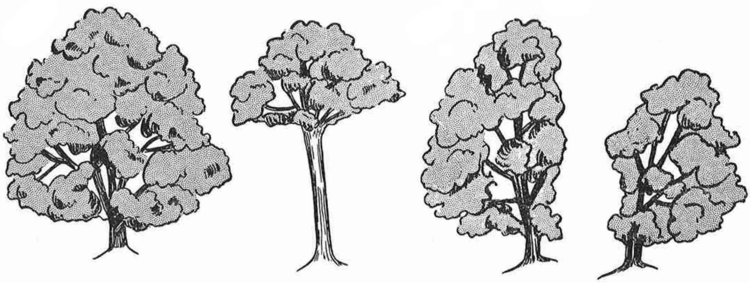
If you have a single tree or shrub in the yard of your school, this will be the laboratory that you will use next. You should be able to learn more from that plant than you can by reading many books and with what you learn, you should develop some understanding of the wooded lands of the earth.

Let us suppose that you have an ordinary shrub a foot or more in height. We can make studies of it somewhat similar to those made of the grassland and the bare spot. First, you must notice that it is shadier under the shrub than it is away from it. It also is probably cooler there, remains moist longer there than where the earth is exposed to the sun and the chances are good that rain is more likely to soak into the ground under the shrub than it does away from it. This may vary, of course, but in general you will find that this is true. Certainly, rain will not strike bare soil under the shrub the way it will where there is no plant cover. The rain that does come down is probably broken up into small drops that hit the ground in small units or it runs down the branches to the trunk and then to the ground.

If you should imagine a section down through the center of your shrub, you will find that the whole outer surface exposed to direct sunlight is relatively closely covered with leaves. These leaves cut off the light that would go below and as a result the center of the shrub as a whole may be leafless. The interior would look much like a maze of woody stems supporting an outer layer of leaves. This is about the way things would be in a great forest except that the stems would be longer and larger and the leafy canopy would be higher above the ground. You have in your little shrub a small imitation of a big forest. In this forest of a shrub, you can recognize the leaves forming the forest canopy, the twigs and stems inside representing the sub-canopy and the earth beneath representing the forest floor.



If you happen to have two shrubs available for study, one being an evergreen and one being the kind that sheds its leaves, you will have the opportunity of observing a little evergreen forest and a little broad-leaved forest. In this case, it might be well to notice if the canopy of the evergreen is not closer and, therefore, keeps light out better. Logic would say that if it keeps the light out better, there should be fewer leaves under the canopy and fewer low plants on the ground under the tree. Is this the way you actually find it?



It may be well to study the whole shape of your shrub whether it is evergreen or not, to note if its shape has been modified in any way by the presence of nearby plants that have cut off the light that might reach it. We give you a few pictures of forms of trees to show you how the neighbors of a woody plant may influence the shape of that plant. Look for trees in your neighborhood and try to understand their form. There may be a tree with a tall straight trunk and a high canopy. This might be a relic of an ancient forest and the canopy was merely a part of one that formerly was high above the ground.

If you have the opportunity to watch your shrub through the year, you may find that in the winter months, light can reach the ground better than in the summer, at least with the shrub that sheds its leaves in winter. This will mean that until a new crop of leaves is grown, plants growing close to the ground can get all the light they need. This may account for the fact that in spring you may find low woodland plants flowering more abundantly than at any other time of the year.

Also on the ground you may find an interesting study of what happens to the leaves and trash that fall to the ground in a wooded area. Are the leaves more quickly rotted under the evergreen shrub than under the others? Lay a stick about pencil size on the ground under a shrub so that one end is buried in the earth and the other is held above the ground by a small stone. Leave this stick for some months to see if the part next the ground or up off the ground begins to decay the more rapidly. If you wanted trash in a woodland to rot away quickly, would you push it into the ground or pile it so that parts were off the ground?

If you look through the trash under your shrub forest, you may find some small animals such as slugs, insects or other animals. Are these most abundant where there is the most trash or where is no trash? Knowing the answer to this, would you see to it that there were trash piles in a woodland if you wanted it to support a good population of animals?

Some time you may have a grass fire that reaches your shrub. Will it kill the whole shrub or will it just burn around the base? Does burning the base kill the different kinds of shrubs you have in the neighborhood? Do you have any shrubs that can withstand having their whole leafy tops burned off? Do fires affect evergreen shrubs the same as they do shrubs that shed their leaves? We hope that you will not experiment with fires to find the answers to these questions, but if you do have a fire, you will use these questions to help you interpret the story left by the fire.

The wooded lands of the world, of course, are of great value to man. They produce lumber that is useful in building shelters, pulp that is used in making paper, plastics that make the gadgets of the world. They give us resins and many other things.

In our woodlands, live many useful forms of wildlife that give us food, fur and fun. Some of the woodland animals have their dens in trees that could not make good lumber and these trees may be more valuable as den trees than any one lumber tree, since it may produce an annual crop of fur, while a lumber tree is marketed only once.

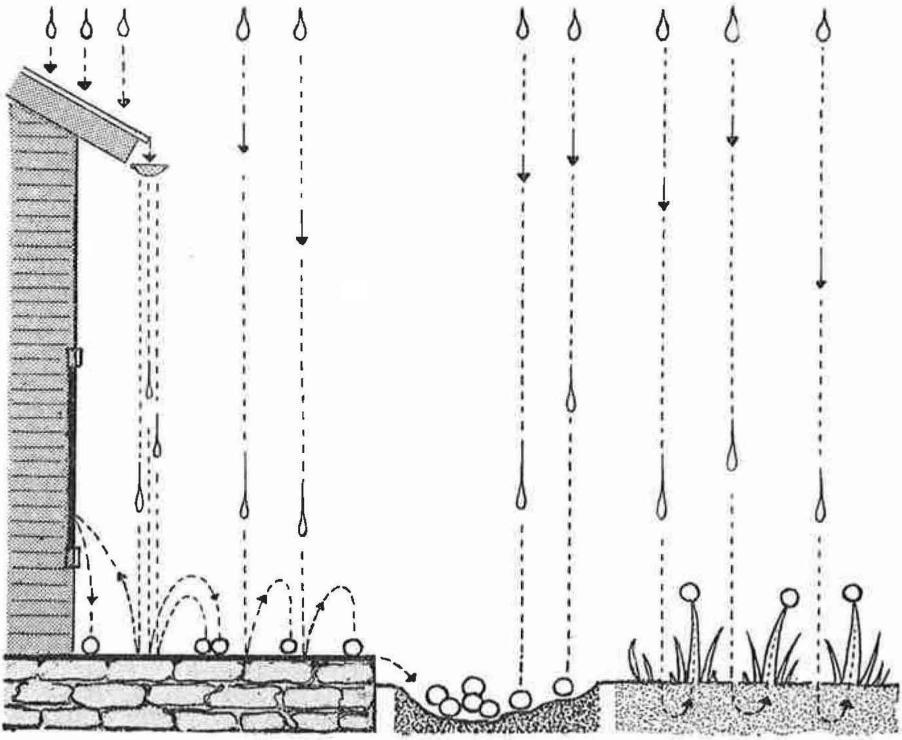
Our forested areas have a considerable effect on the flow of water off these lands. Water is held in forest lands as in a sponge. Streams that flow from such lands are less likely to flood and more likely to be clear and cool than are streams flowing from grasslands or particularly from open cultivation or from bare waste lands. As in the grasslands, the humidity, light and temperature at almost any point in a forest remains relatively stable as compared to the open fields.

We can manage forests just as we manage grasslands or other types of places, but we must know what we want from them. If we want a continuous production so that we may live happily ever after we must see to it that fires, grazing and vandalism do not destroy the young trees that will replace the old ones when they have passed maturity. We must recognize that in a forest as in other types of territory there are surplus trees that can be harvested without interfering with continued production. In fact, it may help. Your shrub in your front yard can tell you much if you will let it do so.

WET LABORATORIES NEARBY

If you have a pond or stream close at hand to study, you need not try to study an imitation of them, but many schools do not have waterways nearby, so we will start with something every school may have.

Any school that can get a quart glass fruit jar can make a little pond aquarium or a whole series of them. These are indoor things, but even the most desolate looking school has some evidence of the work of water on it. A school recently visited by the writer had seen no rain in over six months and yet there was plain evidence of what the last rain had done. At some time in the year water probably hits the roof of every school. The water runs down the roof to the edge. There it either falls to the ground or falls into an eavestrough and is carried over to a downspout to the ground. When it hits the ground, it does a variety of things. It is with this story of the water from the roof to the ground that we are at first concerned.



TEN LITTLE RAINDROPS

Ten little raindrops high up in the sky
Three hit the roof and fell by-and-by
They were joined by two others on the rocks
[as rain
But one spattered up and hit a window pane

Then they rushed to a ditch in water all aroil
Were joined by two others and routed out
[the soil
The last three fell on plant-covered earth
Soaked in the ground, and the grass proved
[their worth

When a raindrop hits a roof, it either soaks into the roof covering or starts its way downward to the edge. The distance from the ridge of a roof to the eave varies greatly. In some cases, the distance may be many feet; in others but a few inches. This means that the amount of water that will flow off the edge of the roof will vary with the length of the roof above it. The shorter that length, the smaller the amount of water. In cases where two wings of a building come together, there may be a valley between down which the water will flow from both roofs. The result will be that an even greater amount of water will come from the bottom of the valley.

These simple little observations of what happens on an ordinary roof should help us understand the story of watersheds that may cover a few square miles or many square miles. Some watersheds cover the greater portion of continents. Naturally, if the rainfall is equal over an area, these larger watersheds should produce the larger streams. In cold regions where icicles are formed, we may have a spectacularly large icicle forming at the lower end of a valley and only a row of small icicles along the rest of the edge of the roof.

If there is an eavestrough at the edge of the roof, it may be considered as a reservoir that collects the water from a watershed and may hold it and bring it to the ground through a downspout. If the downspout gets clogged or dammed, we will have a little lake in the eavestrough.

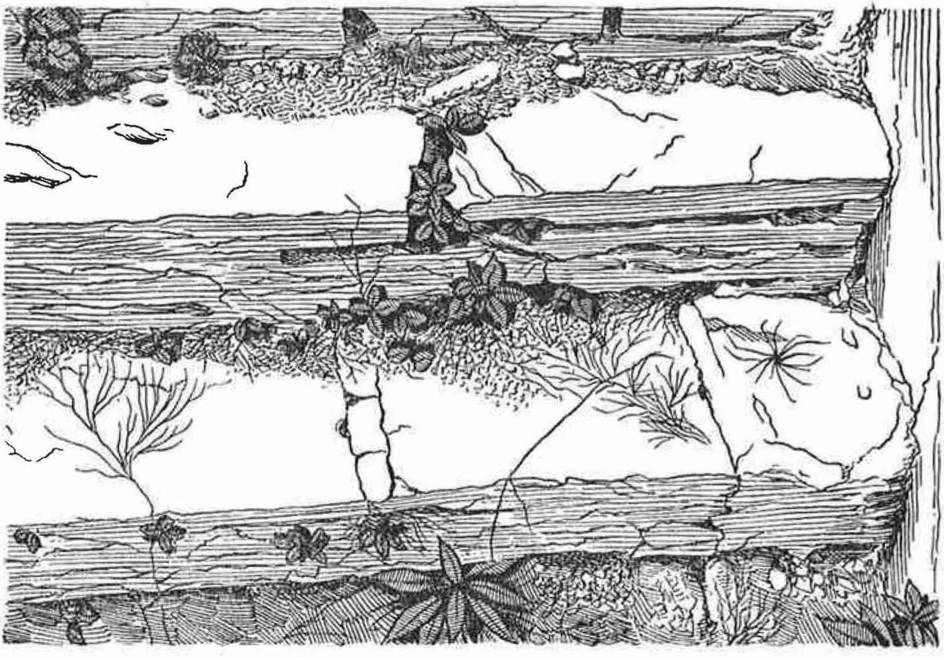
Where there is no eavestrough along the edge of a roof, the water falls directly to the ground from the eave. What happens then should be worth studying. Walk around a building and notice that there may be some spots where there is grass and some where there is no grass under eaves. Look at the walls or windows near the ground in these spots and notice if there is any evidence of spattering of earth up onto the side of the building because of the falling water. See how high this spattering takes place and measure over to where the water hit and try to get some idea of how far soil particles could be spread by this type of spatter erosion. Notice whether the dirt is spattered higher where the eaves are higher, or whether this makes little difference. Possibly the best observation will be that where there is a good healthy grass covering, there probably is little or no spatter erosion.

Ordinarily, the windows close to the ground around a school are rather dirty on the outside because of this spattering or because of dust blown on them from the nearby ground. When a drop of water strikes this wind-blown dirt on the window, it probably starts to flow down directly. As it flows, it washes off some of the dirt, leaving the glass beneath exposed. This is nothing but a little gully erosion, but it is really spectacular in some cases.

Where the water hits the bare ground in falling from the roof, many interesting things may be observed. Not only will there be little gullies and valleys cut by the water as it flows away, but there may be «badlands» with little «buttes» capped with small stones or other solid substances that are left suspended by wearing away of soft earth. These may appear on ground poorly covered with plant material or on bare ground where the water falls vertically and possibly not too violently.

Where the water flows off over the earth in sheets, it may remove sheets of earth which may leave small stones suspended on pinnacles of softer materials. This sort of thing is frequently seen along the edge of bare paths where there is a good slope of land.

Where water has the opportunity of flowing over a paved surface, it also tells interesting stories. On one side of such a path there may be left some deposits of silt and sand which are not to be found on the opposite side. This may be due to the fact that one side of the path is lower than the other. Where muddy water has flowed over a paved path, it may be stopped at cracks in small shallow «lakes». When these evaporate, they leave deposits of muds and sands which are small but significant in understanding how water may over greater areas make mud flats and sand flats, maybe miles in extent instead of just an inch or so.

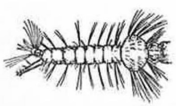


Some study should be made of the length of time that little pools of water are to be found around a building. The old rain barrel was a good example of a permanent pool that offered some interesting studies. The water remained warm and constant long enough so that mosquitoes could easily complete their life cycles in it. Little pools of sufficient size and of long enough duration may be formed in the eavestroughs along the edge of roofs, particularly if care has not been taken to remove material which may clog the outlets.

Simple jar aquaria properly used may tell many of the important stories of waterways. Mosquito larvae in such jars may be destroyed by the nymphs of dragon flies and by other insect-eating water insects. A small film of oil on top of a jar containing live mosquito larvae will easily demonstrate how spraying with oil results in cutting mosquito larvae off from an air supply causing them to suffocate and die. Once a child has seen this happen, he may understand how the use of oil is a good mosquito control.

From some stagnant pool collect some mosquito wrigglers. Put a few into each of three water filled tumblers or bottles. To one of the tumblers of water add the nymph of a dragonfly or damsel fly. To another add a nymph of a mayfly. Let the wrigglers live alone in the third tumbler. How does the mosquito population in the tumblers vary in the succeeding days? Do you think dragonflies or mayflies are more useful in controlling mosquitoes?

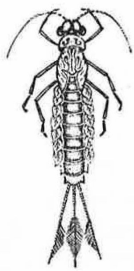
Some jars may be polluted deliberately or water may be taken from a stream above a town and put in a jar that stands next to a jar filled with water taken from below the town. The survival of water insects in the two jars may help one understand the effect of pollution on aquatic life.



MOSQUITO
Larva. — Length-1/2"

DAMSEL FLY
Nymph. — Length-1/2"

DRAGON FLY
Nymph. — Length-1 11/16" to 2 3/16"



MAY FLY
Nymph. — Length-1/2"

These studies of little waterways found around an ordinary building should be most helpful in understanding what goes on in larger waterways some distance from school.

CONSERVATION BEGINS AND ENDS AT HOME

Conservation is essentially determined by man. Give nature its own way and a reasonable balance in affairs would result. It is man who upsets things, who destroys forests, pollutes streams, kills the last animals and creates dust bowls. If civilization is to exist for ever after, it will depend largely on what man does himself. If things go wrong, he has no one but himself to blame. Of course, individual men suffer from the acts of other men, but that merely means that men who know the story have the obligation to tell it convincingly to others if they wish to survive. This means that teachers must teach conservation.

We hope that, in these pages, we have given some suggestion of the forces, phenomena and materials involved in continued happiness for man. We have tried to show you that wherever you may be, there are small counterparts of what may be found all over the world and that with a little imagination you can travel the world without going outside the school yard. We admit that we have not exhausted the possibilities of the situation, that we have not told you about the kinds of plants, animals, rocks and soil in your neighborhood. Had we done so, the paper would not have been useful to readers who do not live in the environment in which you live.

We hope that what we have done will make you appreciate where you live more than you have in the past. We want you to be happy where you are and to make it possible for you and your children to live happily ever after. This means that both you and your children must use sense in dealing with your surroundings.

A conservation program that is built on soil conservation, on forest preservation, on mineral use, on pollution or on any other one phase of the whole problem is unfair. Many conservation programs used in cities put the whole responsibility on the farmer who does not plant his crops on the contour and city dwellers accept no responsibility for wise use of fuel, water or processed goods. The man or child who opens a window in a city house to cool it off, rather than cutting off the heat that comes from fuel consumption, is less the conservationist than the farmer who here and there fails to follow the contour, or who in some particular year overgrazes a small bit of land. Conservation is the responsibility of every one of us.

Conservation covers not only our material environment but it deals with our own selves, with our health, with our ability to get along with others so that jointly we can use the resources available. Conservation is essentially a peacetime idea. War is destructive for the most part or basically. Harmony is evidence that conservation is being practiced. Discord is evidence that it is not. A home full of enough happy children, clean and adequately fed and clothed in accordance with the income of the family represents a basic unit in community and in world society. Without such basic units, we can have no democratic conservation. Such happiness depends on these smaller individual and family units being independent and independence requires adequate material resources to warrant it. A dependent parasite cannot be happy long. He may kill his host and thus be helpless.

The wise teacher will know the children being taught, their homes and their families. The teacher will be able to see where help is needed. It may be help in making the home free from the weather or in providing clothing adequate for the local climatic conditions. It may be that the family needs to know how to raise chickens more efficiently, how to make a better garden or how to live within the income. These things in the broadest sense are good conservation. They depend essentially on two things, an understanding of the problems of the physical environment and the development of established habits of human behavior that use that physical environment wisely. Conservation means living in harmony with the land, with yourself and with your neighbour. It is towards that goal that we must strive if we are to live happily ever after.

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THE AMERICAN NATURE ASSOCIATION

TRANSCRIBER NOTES

Mis-spelled words and printer errors have been corrected. Where multiple spellings occur, majority use has been employed.

Punctuation has been maintained except where obvious printer errors occur.

[The end of *A Guide to Teaching Happy Living Through Conservation* by Ephraim Laurence Palmer]