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Conservation in Text Books of Biology

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by

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PREFACE

We are living in a new day in the United States of America--a day when we are observing the results of the wasteful use of our natural resources--a day when we must give more study to the preservation of these resources or find ourselves having to do without them. In harmony with this idea, the content of the following dissertation has been selected and organized. The author has attempted to make the subject matter interesting, unified, definite, and of such character that the reader will be attracted and consequently come to realize the real significance of the problem of conservation. If the people can be convinced of the need for conservation, it will be easier to inspire them to assume the responsibility of restoring a natural balance which has been unwisely destroyed.

The study of conservation has vitally important contributions to make to the personal development of every high school student. Hence the desire was to learn if the trend of high school biology texts was toward a more thorough presentation and discussion of the problem of conservation or whether these same texts failed to present a conservation program in education.

Even with much omitted, the story of conservation is a long one, and there must inevitably be more material than could be presented in this brief study. However, it is the hope of the author that this survey embodies enough material to challenge someone to become concerned about more definite educational programs in conservation in the school systems.

The author acknowledges here, with grateful appreciation, the helpful suggestions submitted by Dr. H. M. Whisler of Butler University, and by many individuals who have been and still are interested in conservation education. He is indebted to Mr. P. S. Lowe for the use of an excellent library on soil erosion, to the U.S. Department of Agriculture for numerous, invaluable bulletins, to the State Department of Conservation for printed material, and to various libraries for their cooperation in securing books for use in this study. The author is also deeply grateful to Velma L. Swearingen for her faithful assistance in the compilation of the data.

P. V. S.

Frankfort, Indiana, 1941.

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INTRODUCTION

Purpose of Study

This study is the outgrowth of the writer's interest in conservation as a problem which is now confronting the people of the United States. It is the purpose of this investigation to find whether or not a need has developed for conservation which originally was not present, but which has been brought about by man's lack of foresight. It is also the purpose of this study to ascertain if there has been any change in educational text books, particularly those in the biological sciences, in their presentation of the problem of conservation to the students who in future years must assume the responsibilities of taking care of nature's resources.

Definition of Terms

It would be well at this point to define the term conservation as it applies to this study. One may say that conservation seeks to assure to society the maximum benefit from the use of our natural resources. It involves the making of inventories, efforts at preservation, the discovery and prompt employment of methods of more efficient use, and the renewal and even restoration of resources. The American pioneers found extensive areas of fertile soils, land covered with magnificent forests, and an abundance of fish and wild game. The amount and distribution of rainfall throughout a great portion of the land were adequate for agriculture. Vast supplies of fuel and of useful metals were discovered. Nature really had provided almost ideal conditions for human occupancy. However, forests were cleared away, soils were over-cropped, pasture lands over-grazed, and fish and game ruthlessly destroyed. As the decades of the nineteenth century passed, more and more of the scientific men of the nation recognized that we were rapidly depleting a great number of our natural resources, and that among those resources some were not replaceable. Therefore, public opinion was aroused in what is now known as the conservation movement. Modern conservation has many phases. As our ideas of conservation have developed we have seen them expand to include not only the care of forests, the prevention of soil erosion, the careful mining of metals and fuels, and the protection of wild life, but also the conservation of human life.[1] Conser-

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[1]A. E. Parkins and J. R. Whitaker, Our Natural Resources and Their Conservation. New York: John Wiley and Sons, Inc., (1936), pp. 1-20.

vation does not mean restriction from all use; it means elimination of waste in the use of our natural resources. Conservation has been well defined as "wise use". It is necessary that all those who are engaged in developing our natural resources be educated to realize that it is intolerable that those who occupy this land for only a few years should ruthlessly destroy those resources which are of such value to mankind. It might also be said that conservation does not mean the piling up or saving of our resources as a miser hoards his money, but rather the use of them without disturbing what is generally known as the natural balance. When one looks at nature as a whole he realizes that all her forces unconsciously depend upon one another--that there is a series of interrelationships between these forces by which one force keeps another from getting out of control.

> One spring a farmer had an unusually good field of wheat. Whenever he saw any birds in his field, he got his gun and shot as many of the birds as he could. In the middle of the summer he found that his wheat was being ruined by insects. With no birds to feed on them, the insects had multiplied very fast. What the farmer did not understand was this: A bird is not simply an animal which eats food that the farmer may want for himself. Instead it is one of many links in the complex surroundings, or environment, in which we live.[2]

And so it goes. Such nonliving factors as richness of

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[2]Bertha Parker and Ralph Buchsbaum, Balance in Nature. New York: Row, Peterson and Co., (1941), p. 3.

soil, amount of rainfall, and amount of sunlight, and such living factors as animals and plants are all closely woven together in the environment. Any change in that environment is likely to bring about a whole series of changes. The members of all the different living things in a region left to itself are likely to stay roughly about the same, year after year. There tends to be a balance among all the plants and animals of the region--a balance spoken of as the "balance in nature". If anything happens to bring about serious changes in plant or animal populations, we say that the natural balance is upset. Furthermore, man is the only living thing with the intelligence to realize the importance of keeping such a balance. Yet in recent years much has been written and said about the harm man has done by disturbing his environment. It is known that the cutting of timber of certain lands has helped cause the wearing away of valuable soils and the occurrence of floods in the Mississippi Valley. The English sparrow was introduced and it became a pest without its natural enemies. Passenger pigeons were hunted in such great numbers that they became extinct. Swamps were drained to do away with mosquitoes, but this also did away with birds that ate insects perhaps worse than mosquitoes. Simply planting a large field of wheat upsets the balance in nature, for the farmer clears away all the plant life that would naturally grow in the field and drives away most of the animals that would naturally live there, thus making conditions excellent for insects, that feed on wheat, to become serious pests. So we see that man is always changing the face of the earth. He is constantly causing trouble for himself by upsetting the balance in nature, and is always hunting for ways of undoing the harm he has done.[3] Hence, man's problem is to find ways to turn the natural phenomena to his own use without throwing the whole chain of relationships out of balance. In one sense the story of true conservation is a reaffirming of old Biblical wisdom, that tells us, "As ye sow, so shall ye also reap". Not even from mother nature can we always take away and never replace. Thus we should have a picture of replenishment of our resources as we use them. We should look at them from a crop viewpoint, so to speak, rather than from a storehouse viewpoint. Of course we realize that we cannot live on a land covered with forests and buffalo, but we can live so that a natural balance will be maintained. It must be admitted that all the methods of preserving such a natural balance are not known, but we do know a great number more than we are putting into practice. A great number of mistakes have

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[3]Ibid., pp. 4-29.

been made and are still being made. It is well known that

> The interests of people cannot help but clash with the interests of certain plants and animals. To feed ourselves, we must clear away forests and raise crops even if in doing so we upset the balance in nature. With the growth of our country, it was necessary to drive the bison out of the rich Mississippi Valley so that we could farm the land. But we could have left the bison the western plains which were never suitable for agriculture and which we have turned into useless dust bowls. Seeing the results of some of our mistakes should make us very careful about interfering with the balance in nature. . . If we are willing to follow the advice of scientists, we may save the natural resources of plant and animal life which still remain in our country.[4]

We are not going to conserve our water supply unless we conserve enough plant life to hold the rainfall in the soil; we cannot conserve our soil unless we prevent the rapid run-off of the water; and we cannot conserve our wild life unless we conserve their homes. Thus, increasing education is tending to prove that conservation depends to a large degree upon this natural balance.

Place in Present Day Education

Teachers are not interested in making technicians out of students, but they do want to give them such an insight into their environment that they will be able to maintain such a balance and secure the maximum benefit from the use of our natural resources. W. P. Beard states that there is

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[4] Ibid., p. 36.

no doubt that people sink in their standard of living when they allow despoiling of their natural resources.[5] Therefore, educators should show their students that the sum total of our natural resources is a cog in our economic and

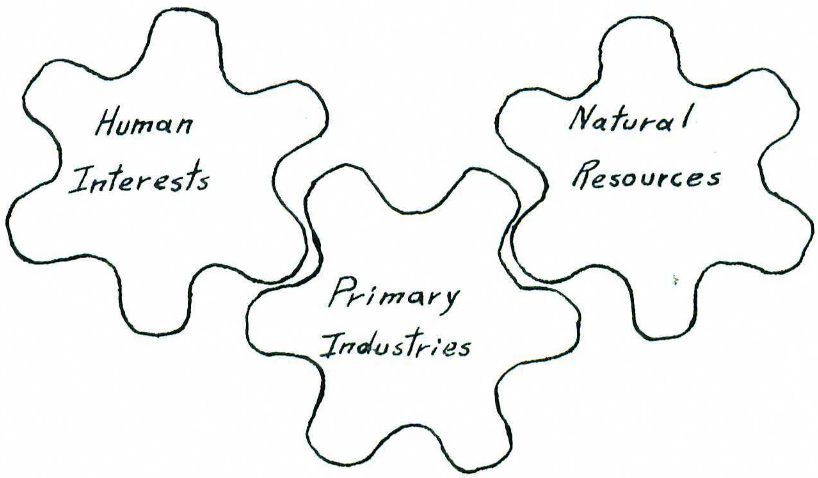

FIGURE 1. Interrelationship between our natural resources, primary industries, and human interests.

social machine. Figure 1 represents the natural resources as a cog in this imaginary machine--a cog interlocked with others representing our primary industries and human interests. When one turns, they all turn--as long as our resources remain productive, our primary industries will func-

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[5]W. P. Beard, Educational Specialist, United States Forestry Service, in a lecture given before the Indiana State Teachers' Convention, Oct., 1939.

tion and our human interests will be satisfied. Educators should teach the students this idea. Perhaps such teaching should start in the elementary general science courses, and without doubt a firm foundation for conservation should be laid in high school biology and agriculture.[6]

Statement of Problem

Every individual should be interested in any problem which influences his daily life, and should desire to know more concerning that problem. So it is the writer's aim, not only to find whether a need for conservation has developed, but also to see whether or not text books show a definite trend in their presentation of the subject. Since the future generation is now in the schools and since on its shoulders will rest the responsibility of the intelligent use and control of our natural resources, the writer believes that there should be an intensive educational program on the question of conservation.

Method of Solution of Problem

To simplify the solution of the problem it was divided into two phases. First, the problem of conservation was

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[6]Summary secured from the notes of the writer on the lecture, "Teaching Conservation in Biology," given by W. P. Beard, Educational Specialist, United States Forestry Service, at the Indiana State Teachers' Convention, Oct., 1939.

considered under four separate divisions; namely, conservation of soil, conservation of forests, conservation of water, and conservation of wild life. A retrospective study of each division was made to ascertain its history, development, and present status. This material will be discussed in the next four chapters. Second, a study of science text books was made to determine their trend as to subject matter pertaining to the problem of conservation. Both old and new texts were studied and comparisons were made in an effort to see a change, if any, in textual material. The results of this second study are found in the concluding chapters.

Limitation of Study

This study has been limited to educational policies as found in high school biology text books, and it is not intended to be complete as to all educational methods used at present. The writer is fully aware of other phases of conservation education as shown by the activities of the United States Department of Agriculture, State Departments of Conservation, Isaak Walton Leagues, National Association of Audubon Societies, American Ornithologists' Union, American Nature Study Society, American Tree Association, Wild Flower Preservation Society, and United states Bureau of Fisheries.

CHAPTER II

CONSERVATION OF SOIL

Erosion--Its Cause and Effect

Geological erosion is an old story which has proceeded down through the ages with a natural balance between soil manufacture and soil transportation. This country was designed by the activities of erosion and glaciers, but, like many natural phenomena, erosion can be both beneficial and destructive. The trouble arises when man, because of ignorance, removes the natural barriers and allows erosion to get out of control. What nature has spent thousands of years in building up, man has despoiled in two or three centuries at the most, and often in as little as twenty or forty years.[1]

The race has manhandled land, and has upset the natural balance by removing vegetation. When there is a stability of vegetative cover, erosion, which goes on beneath it, is so slow as to be nearly imperceptible. This may be seen from an examination of Figure 2, which shows a deep layer of

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[1] Russell Lord, To Hold This Soil, Miscellaneous Publication No. 321, 1938, U. S. Department of Agriculture, p. 4.

protective grass on the slightly wooded slope. Under this grass there is very little erosion and rich top soil has

FIGURE 2. Vegetative cover prevents excessive erosion. A deep layer of rich top soil has lain here for centuries slowly accumulating under a protective cover of vegetation.

been accumulating for centuries. But when man takes off this cover, rips off the trees and the sod, pulverizes the soil with plows and harrows, and deprives it of organic materials which make it more absorptive--then nature starts to take off the soil by wind and rain much faster than it is formed.[2] Some idea of this condition may be secured by studying Figure 3. Here the land may be seen to be marked by huge

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[2]Ibid., p. 5.

gullies because of the absence of soil-holding vegetation.

FIGURE 3. Eroded lands illustrate the ultimate consequences of the loss of vegetation.

In Rich Land, Poor Land (1936), Stuart Chase states, "Man-made erosion is dynamic and cumulative and has no end save complete destruction unless it is controlled."[3] There is no doubt but that the final result of uncontrolled erosion would be total destruction of useful land. When the top soil is washed away there is not much left to furnish a foothold for plant life of any form.

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[3]Ibid., p. 5.

Early Recognition of Land Deterioration

Washing of soil was recognized in colonial times but very few farmers took any measures to protect their lands. There were always new homesteads and good farms available in the West, and farmers failed to realize that these, too, might someday be gone. Washington, Madison, Jefferson, Edmund Ruffin, and others in early American history recognized the evils of soil erosion. George Washington in one of his letters states,

> Our lands, as I mentioned in my first letter . . . were originally very good; but use and abuse have made them quite otherwise . . . We ruin the lands that are already cleared, and either cut down more wood, if we have it, or emigrate into the western country.[4]

However, in 1890 the Census Bureau announced that free land was practically gone, and the western frontier ended. No longer could new lands be secured by merely moving westward.

Lack of Interest in Soil Conservation

Figure 4 shows the ultimate result of overgrazing. On the left may be seen a land covered with heavy grass--a land which has been protected; on the right, a land with only patches of scrub grass, separated by small areas of bare earth--a land overgrazed. The first evidence of concern as to overgrazing the open range is noted by Shaler: "An Act

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[4]Ibid., p. 24.

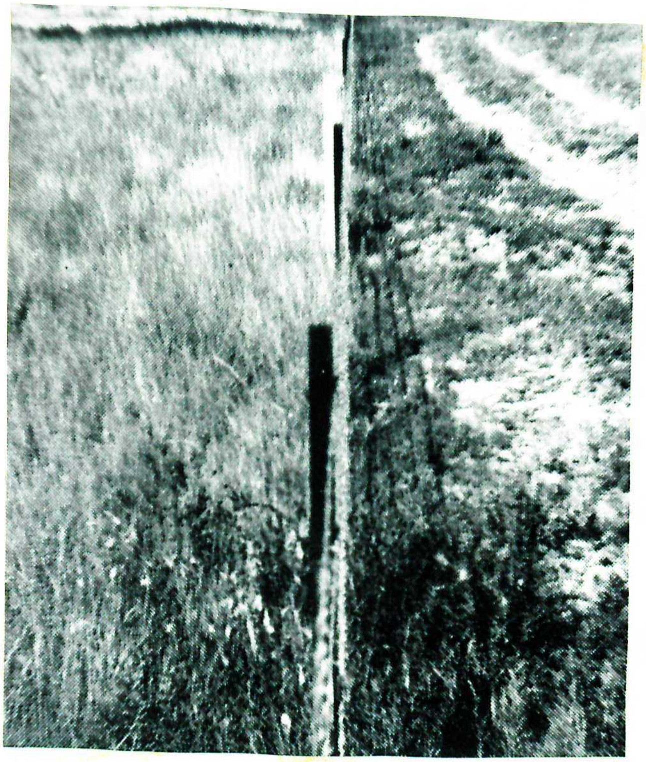

FIGURE 4. At the left, a range protected; at the right, a range overgrazed.

to Preserve the Range; that is, the Right of Public Pasture." This act was drawn up at Boone's Fort, Ky., in May, 1775. However, it was never enforced.[5] It was only after there was very little new land left to clear that the farmers became interested in saving the soil. The farm journals of the period around 1830 offered suggestions for saving the soil and some were actually introduced. Such practices as horizontal plowing, which was used by Thomas Jefferson, and hill-

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[5]Ibid., p. 25.

side ditching, then on trial in Europe, were tried out. These practices became well established with the most progressive farmers by 1860, but were far from being a national program.

Results of Erosion in the Piedmont Region

In the Piedmont region, which extends down along the east side of the Appalachian Mountains, Fifty thousand farms were abandoned between 1920 and 1930 because from four to eighteen inches of soil has been washed from sixty-five to seventy per cent of the fifty million acres making up that region.[6]

Wind Erosion and Dust Storms

During drought periods of recent years wind erosion has been very destructive over unprotected lands in parts of Oklahoma, Kansas, and Nebraska. An examination of Figure 5, showing wind-blown dirt heaped high around a building in the dust bowl area, will show to some extent the destructiveness and desolation caused by such wind erosion. Dust storms which have occurred on the Great Plains since 1934 have been unrivaled in intensity and extent. The dust ladened atmosphere, as shown in Figure 6, gives some idea of the

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[6]Austin E. Burges, Soil Erosion Control. Atlanta: Turner E. Smith and Co., (1936), p. 6.

FIGURE 5. A typical result of destructive wind erosion.

darkness which practically blotted out from view entire towns and country sides. The sudden recognition of the danger of such storms has caused a great amount of comment in magazines and newspapers throughout the country. The dust in the air has even been felt by the cities of the Atlantic coast. This situation, recognized by farmers of the Plains as a problem for fifty years, has been caused by the cumulative result of years of exploitation of the land and has been intensified by the unusually long and severe drought. However, there has not been a general recognition of the trouble, nor has there been any definite coordinated attack

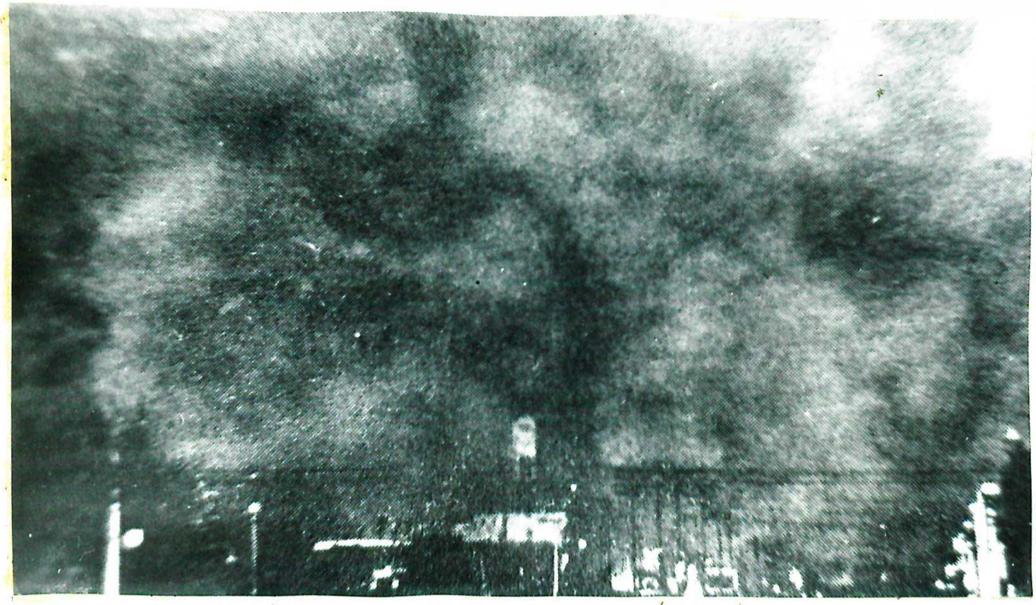

FIGURE 6. Dust ladened atmosphere during a dust storm.

upon it.[7]

Destructiveness of Erosion

Some individuals are able to look ahead and see what we are losing, but, as a nation, the United States is just now beginning to realize the full consequence of the reckless and insensible use of the soil. According to the statistics as given in Table I, it is found that out of approximately two billion acres representing the total area of our country many millions of acres have been ruined or seriously damaged because the soil has been washed or blown away. More than

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[7]Angus McDonald, Erosion and Its Control in Oklahoma Territory, Miscellaneous Publication No. 301, U. S. Department of Agriculture, p. 1.

*TABLE I. SUMMARY OF EROSION CONDITIONS IN THE UNITED STATES

(Released by U. S. Soil Conservation Service, April 16, 1935)

Erosion Condition	Acres	Percent
Total area (exclusive of large cities and water)....	1,907,721,392	100.00
Areas on which erosion conditions not defined........	144,904,389	7.6
Areas with little or no erosion....................	578,167,570	30.3
Total area affected by sheet erosion....................	857, 386,922	44.9
One-fourth to three-fourths top soil lost..	665,086,000	34.9
Over three-fourths top soil and some subsoil lost..................	192,300,922	10.1
Total area affected by wind erosion....................	322,961,231	16.9
Moderate wind erosion...	234,023,574	12.3
Severe wind erosion.....	79,735,880	4.2
Destroyed by wind erosion................	9,201,777	0.5
Total area affected by gullying[1]..................	866,821,976	45.4
Occasional gullies......	524,792,576	27.5
Severe gullying.........	337,851,662	17.7
Destroyed by gullies....	4,177,738	0.2

[1]In the Western states a considerable portion of the gullying is normal geologic dissection on which accelerated erosion may be, but is not necessarily, active.

*(From A. E. Burges, Soil Erosion Control.)

857 million acres, representing almost forty-five per cent of the total land area, have been affected by sheet erosion, with 192 million acres having over three-fourths of the top soil and some subsoil lost. About 322 million acres have been affected by wind erosion, eighty-eight million acres being seriously damaged. Approximately 867 million acres have been affected by gullying of which 337 million acres are very severely damaged and four million acres so badly eroded as to be unfit for cultivation. The facts thus presented bring about the conclusion that a day of reckoning is approaching. Erosion is costing the United States approximately four hundred million dollars a year because of soil depreciation and reduced yield.[8]

Erosion Control

Soil is a basic source of wealth and no one is completely unaffected by soil losses. Not only does it influence the welfare of the individual farmer and his family, but through them the welfare of the community of which they are a part and the town or city where they buy or sell. So all individuals should take the problem squarely upon their shoulders and assume responsibility of an erosion control program. For a number of years the Extension Services of

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[8] Austin E. Burges, Soil Erosion Control. Atlanta: Turner E. Smith and Co., (1936), p. xiv.

several agricultural colleges and the departments of vocational agriculture in some of the high schools have been carrying on conservation programs. Also, since January 1, 1937, the legislatures of twenty-two states have passed laws providing for the creation of soil conservation districts. But to the aid of these State and Federal agencies must come the educational institutions of the land, not as individuals, but as a unit presenting a solid front. This might be accomplished by teaching all students the importance and the need for conservation.

Summary

It seems almost yesterday that the average American thought of erosion as an age-long process that sometime in the past carved out the Grand Canyon. However, within the last few years, we have learned that modern erosion is far from being the harmless, geologic erosion. We know now that man's misguided use of the land has accelerated this ancient process until it has overwhelmed great areas of once fertile land. Under the blanket of vegetation, nature protects the soil from erosive forces of wind and rain, but man, faced with problems of existence, strips away the protecting cover and exposes the soil to these forces with the result that the rate of erosion is increased enormously. Certain dramatic events--as the terrific dust storms in the Midwest--have served to focus public attention upon the damage caused by the accelerated erosion during the time that ignorance and indifference clouded the process. The early colonist who entered this virgin American country looked upon a land so vast that there seemed no necessity for conservation in any form or degree. In this illusion of inexhaustible land resources lies the philosophy which has led to land extravagance, exploitation, and destruction. H. H. Bennett says,

> Today, America has banished her last frontier. The tide of empire has run its course. We have come to the limits of the good land we for so long thought limitless. We know that the United States has none too much of good land, and we are beginning to understand also that conservation of this is of paramount importance. We know, too, that we cannot return to pre-settlement conditions. The nation has its very roots in agriculture, and if it is to persist, its agriculture must go on. We cannot grow corn and cotton in the woods, or produce our wheat on unbroken prairie, but if we are to continue to grow these crops, we must be prepared to compromise with nature.[9]

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[9]A. E. Parkins and J. R. Whitaker, Our Natural Resources and Their Conservation. New York: John Wiley and Sons, Inc., (1936). p. 68.

CHAPTER III

CONSERVATION OF FORESTS

Preview

> A people without children would face a hopeless future; a country without trees is almost as hopeless; forests which are so used that they cannot renew themselves will soon vanish, and with them all their benefits. When you help preserve our forests or plant new ones, you are acting the part of good citizens.[1]

One of the oldest beliefs of man and certainly one of the most mistaken has been that natural resources are inexhaustible. In the case of forest control, perhaps, more than in any other field, it is true that history repeats itself. Almost invariably countries go through the same steps and make the same mistakes in regard to their timber lands. First, forests are found to be so numerous that they have no value, and they are cut and burned to get them out of the way so that crops may be planted. It is an era of unrestricted forest devastation. Later, laws are passed to protect the forests from fire and unrestricted cutting. Finally, measures are taken to plant the barren lands and to

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[1]Charles L. Pack and Tom Gill, Forests and Mankind. New York: The MacMillan Co., (1930), p. 111.

cut more carefully the remaining forests. The United States is just now entering this final stage.

Value of Timber Lands

But why should man be concerned with preserving the timber land? If a study of the problem were made it would be found that forests are of inestimable value inasmuch as, first of all, they supply us with wood, one of the most widely used of all materials. Also we know beyond a doubt that they make a land more temperate and less subject to sudden changes. They serve as windbreaks and thus prevent the hot winds from drying out the soil and killing crops. Rainfall is even affected by forests since winds passing over them pick up moisture and drop it where otherwise there wouldn't have been any rain at all. Forests have a tremendously important influence on the flow of streams. The thick mat of leaves and twigs beneath the trees is able to absorb a great amount of water which it holds and lets go gradually. Thus by holding the water the forests not only stem the power of floods but also prevent the destructive erosion of soil. Lastly, in addition to all these benefits, might be added the value of material products such as turpentine, Latex, and many others.[2]

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[2]Florence Adams, "How Forests Help Mankind," The Indiana Waltonian, XII, (December-January, 1937-1938), p. 3.

History of Forests and Their Depletion

Compared to other countries, America is one of the world's greatest users of wood. The annual per capita consumption of forest products in this country is 228 cubic feet. In Europe it is 35.8 cubic feet, and in England only fifteen cubic feet. Hence, man for man we use almost five times as much wood as Europe and England combined. Naturally, so long as there were plenty of forests, no thought was given toward growing them. The people had looked on forests as a perpetual gift of nature, just as they had the soil itself. They even spoke of the forests as inexhaustible since they were so numerous and covered so wide a range. To our earliest settlers wood was as great a necessity as food or clothing. Even in those days many of the rapidly expanding centers of civilization went through periods of timber shortage that forecasted in a small way the forest exhaustion that we are seeing on a national scale today. Very definite limits were imposed by the early forms of transportation on the distance it was worth while to haul logs to a mill. However, with the coming of the railroads, wholesale exploitation of forests began in earnest. When the New England forests began to give out, New York started cutting hers. Then Pennsylvania took the lead. By 1880 the forests of the Northeast were depleted and Michigan forged to the front. Wisconsin followed and until 1895 the Lake States held lumber supremacy. When their forests were gone the Southern States took up the task of supplying wood. We were using lumber many times faster than nature was able to replace it, and finally the so called inexhaustible forests of the South gave out. As region after region became deforested, the mills went farther and farther from the centers of population, and today they are making their final migration to the Northwest. Out there is the ultimate great stand of timber in America. Lumbering has been a migratory industry, remaining in one place only long enough to deplete the surrounding forests. Only very recently have mills been built with the idea of securing timber from one locality all the time.[3] Competition between areas has been effective in keeping prices relatively low, for, in regard to timber prices, we have known only the value of timber as a gift from nature and not its value relative to the cost of growing trees. Prices have not risen rapidly or high enough to cause a great curtailment in consumption or to stimulate artificial forestry.[4] So our forest history has been one of lavish use,

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[3] Charles L. Pack and Tom Gill, <u>Forests and Mankind</u>. New York: The MacMillan Co., (1930), pp. 133-138.

[4] <u>What About the Year 2000</u>? Prepared under the direction of the joint Committee on Bases of Sound Land Policy organized by the Federated Societies on Planning and Parks. Harrisburg, Pa.: J. Horace McFarland Co., (1928), pp. 89-90.

and rapidly diminishing resources. We began with a country plentifully supplied with forests but have destroyed them until only a few remain. We have cut down region after region and now are beginning on our last--the Pacific Northwest. But worst of all we have treated our forests like an old mine which once exhausted has finished its service to man. This is a needlessly wasteful thing to do, for with a little care and a little vision the forests of the United States can be made to produce much more than they produce now, in fact, far more than they have ever produced. Furthermore, they can be kept productive, and this is America's forest problem!

Until rather recently it was not important that we have any knowledge of the extent or composition of the world's forests. But conditions have changed and upon investigation it is found that only about one-sixth of the original forest land now bears virgin timber. Where have the original forests gone? Figure 7 shows that of the more than eight hundred million forest acres that grew here originally almost half has been cut to make farms, and ten per cent is practically barren after cutting. Thirty per cent has been used and is being restocked either by nature or by man, and only seventeen per cent remains uncut. The facts are further brought out by an examination of Table II. Almost half of the original 822,238,000 acres of forest land has been

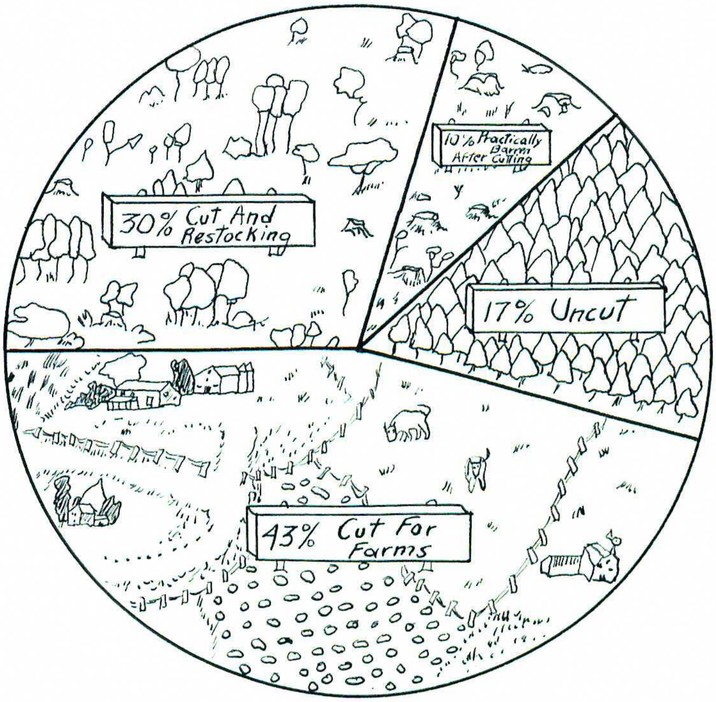

*FIGURE 7. Where our original forests went.

*(From Forests And Mankind by Pack and Gill)

permanently cleared and transferred to other uses, and only 138,000,000 acres of virgin timber remain. Of the remaining forest land 250,000,000 acres are developing a second growth of forest without much care or protection as compared with 81,000,000 acres which are so completely burned over that no restocking is taking place at all. In addition it is shown that increasing the forests by planting has been an insignificant item as compared to fire losses, for, up to 1925, only 1,625,000 acres had been planted as compared to the annual loss by fire of 8,000,000 acres.

TABLE II. SUMMARY OF FOREST CONDITIONS IN THE UNITED STATES

Forests and Forest Land	Acres
Original forests of the United States....	822,238,000
Virgin timber remaining.................	138,000,000
Permanently cleared and transferred to other uses.........................	352,000,000
Classed as forest land..................	470,000,000
Developing second growth without much care or protection....................	250,000,000
Classed as forest land, but so completely burned over that it is not restocking with trees on its own accord.............................	81,000,000
Annually destroyed by fire (average).....	8,000,000
Planted up to 1925......................	1,625,000

Originally four-fifths of our forests were in the Eastern United States, but because of the fact that eighty per cent of the population is in the East today the eastern forests have suffered to a greater extent. Figure 8 shows that in the East only 855 billion of the original 3400 billion board feet of timber remained in 1928, whereas in the West there was 1360 billion board feet left out of the original 1800 billion. Hence, in less than three centuries our forests have retreated westward and are now so far from the

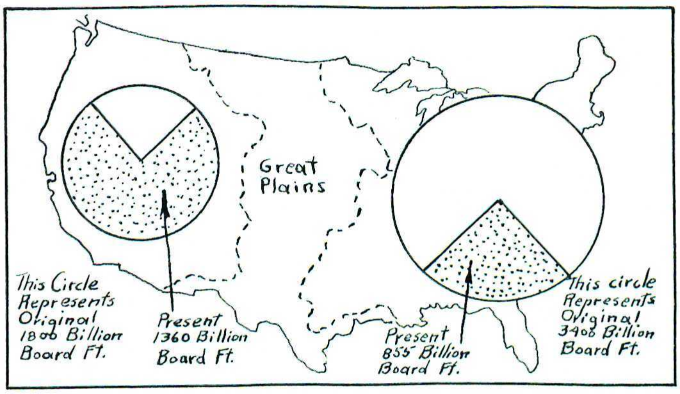

*FIGURE 8. Original and present timber supply of the eastern and western forest regions.

*(From What About the Year 200? by Joint Committee on Bases of Sound Land Policy)

centers of demand that today we pay two hundred and fifty millions of dollars as our yearly freight bill for lumber transportation!

It requires no prophetic power to tell which way a man is going who spends five times his income, and as far as our forests are concerned we typify that man. According to Figure 9 we see that only thirty per cent of our forest becomes rough lumber, while the remaining seventy per cent is usually lost. We actually could, and do sometimes, waste more of the wood that grows in the forest than we use. Fortunately only the more wasteful mills throw all this away and develop no by-products.

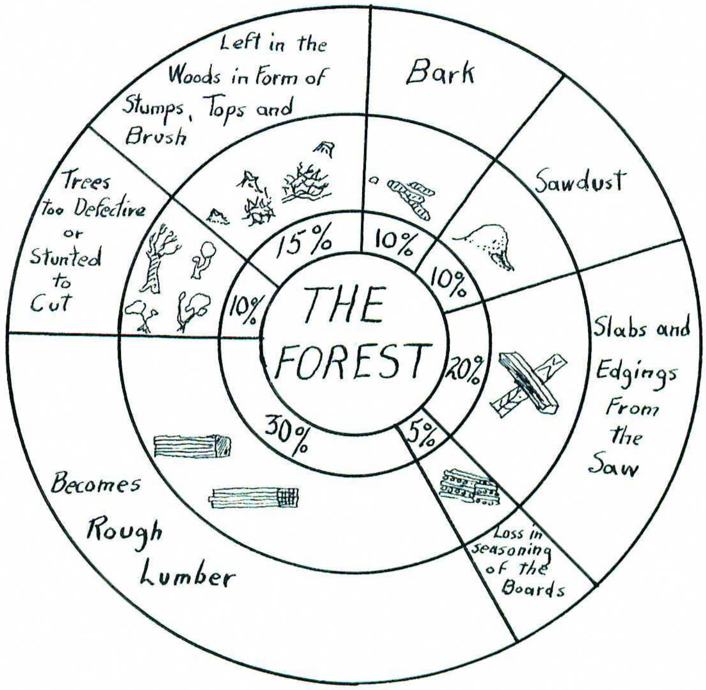

*FIGURE 9. Where the forests go.

*(From Forests And Mankind by Pack and Gill)

Our Present Predicament

The era of free wood in the United States is rapidly passing and future crops must be provided for or we will have to go without. Nature's process of restoring the original forests is too long and roundabout and would, perhaps, require centuries to complete. Even though man has not always thought of trees as crops he should be able to make timber lands permanently productive. Forest statistics are subject to error and any prophecies based upon them must be based somewhat on uncertainties. However, Figure 10 shows graphically that we grow annually about six billion cubic feet of timber and use twenty-five billion cubic feet. Hence, we are consuming much more timber than we are growing, but it is highly probable that forests could supply under proper management all the timber we would need. If the

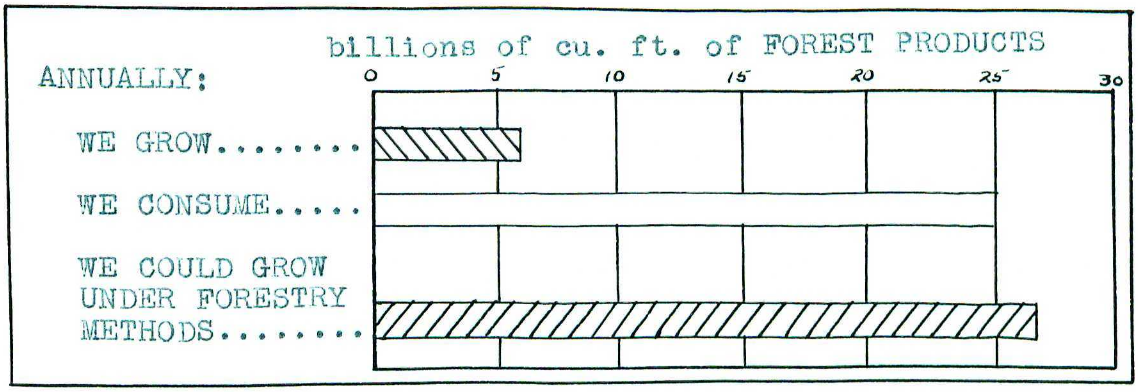

*FIGURE 10. Mathematics of our predicament.

*(From Forests And Mankind by Pack and Gill)

owners of forest land would practice even elementary forestry methods, such as fire protection and the leaving of seed trees, it is estimated that the annual growth on present acreage could be increased to 14,000,000,000 cubic feet. Intense forestry practices could increase annual growth on the present acreage to nearly 27,000,000,000 cubic feet, or more than the present total consumption.[5]

Forest Restoration and the Science of Forestry

Everything that is done to increase the growth, value,

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[5]Ibid., p. 92.

or productivity of the timber lands is known as forestry. This includes planting, fire protection, and scientific methods of cutting. Perhaps the greatest enemy of the forest is fire, since it not only destroys the timber but also prevents the formation of future forests by consuming the leaf litter, microscopic soil life, and even the soil itself. So the forester must work between two extremes, both of which mean waste. On one side he must not cut too heavily since he might impair future growth and productivity. Neither must he fail to cut trees which are ready for use. This too is waste, since the tree ultimately dies and decays. An examination of Figure 11 shows the major economic aspects of

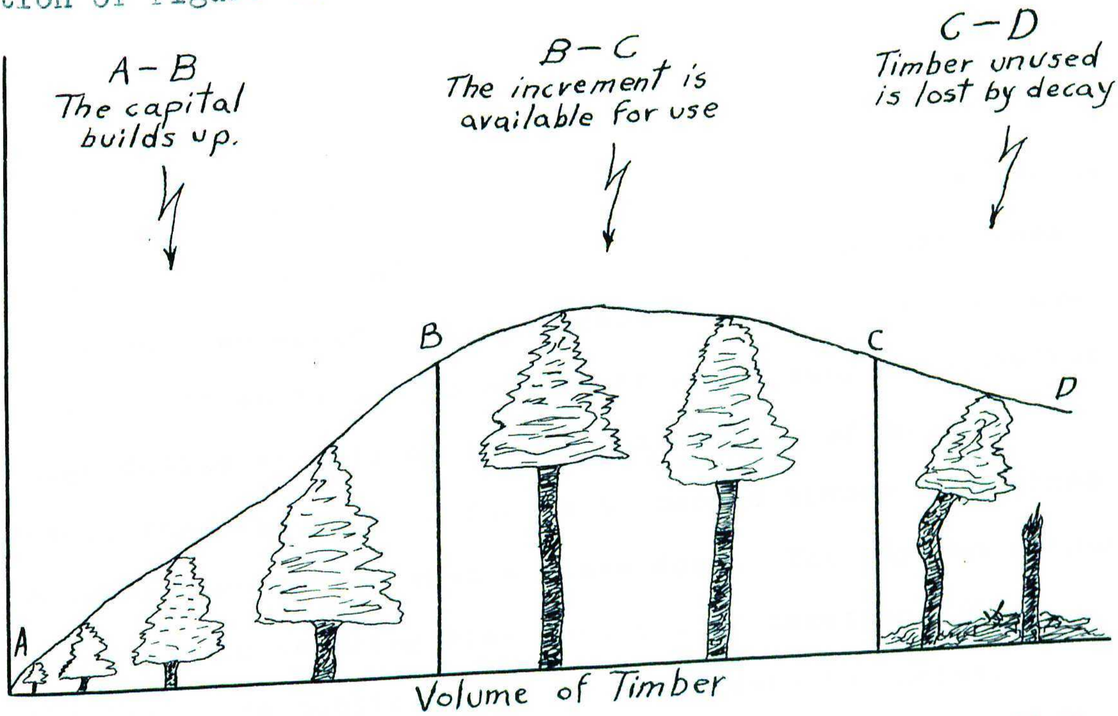

FIGURE 11. Major economic aspects of forest conservation.

forest conservation. Every tree undergoes a definite cycle of growth, starting as an immature seedling, progressing as the age increases to a point where it has the greatest value, and finally dying away because of old age and decay. Thus young trees must be protected and allowed to grow until they reach maturity, when they are ready for use. Should they not be used at the proper time, the timber would be lost by decay. Hence, there must be a balance between growth, maturity, and death. Man should know where to step in to conserve this balance. Some mature trees must be left for seeding and old and decayed trees must be removed. In fact, it should be made necessary for the lumber industry to leave the timber lands in a condition capable of continuous production.

Summary

We cannot go on using wood faster than we are replacing it. We would lower our standard of living if we used less wood because we would have to accept what are inferior substitutes. If we import more wood we would subject ourselves to high duties as well as to the uncertainty of supply. However, there is no need for us to become timber poor since we can make amends for what we have done. The way out of our trouble lies in securing wiser methods of taxation, fire protection, more public forests, proper care in lumbering, and research into timber growing and using. Ultimately it lies in growing forests on every available acre of soil.[6] And, above all, this conservation program cannot be carried out unless we give the proper education to those who will have to carry the responsibility later on. Since these individuals are now in our educational systems, it may be seen that there is an immediate, definite need for a thorough and comprehensive educational program on the problem of conservation.

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[6]Charles L. Pack and Tom Gill, Forests And Mankind. New York: The MacMillan Co., (1930), pp. 239-246.

CHAPTER IV

CONSERVATION OF WATER

Problem of Water Conservation

With all man's advances in the conquest of nature, the amount of rainfall is still a primary factor in determining where he can make his home and how he can live. But because of the apparently endless supply of water available at times, he is likely to waste it recklessly, little thinking of its great value. People cannot be separated from water any more than they can from the soil or forest, and because of the almost annual occurrence of droughts, in some regions, they are becoming more and more conscious of the importance of water. It is disturbing, however, to know that some places which suffer such severe droughts in the summer also suffer devastating floods in the winter and spring. The whole trouble isn't so much a matter of not getting enough rainfall, for all the regions get on an average as much as they ever did. Instead, the problem lies in conserving the water after it does fall. The conservation of this water supply and the control of its flow is a difficult and complex problem.

Influence of Conservation Farming Practices

Part of the problem of conservation of water supply could be solved by helping nature restore some of her safeguards which man has taken away. Conservation farming practices developed primarily for the prevention and control of soil erosion have given indications of wider usefulness. During periods of drought in recent years it has been demonstrated that these practices are of great value in conserving water in the land, and can also make a true contribution to flood control. By slowing down the run-off of rain water in order to curb erosion, the volume and velocity of the water, which might otherwise contribute to floods, is automatically reduced. Probably most farmers have looked on the matter of flood control as strictly an engineering problem, involving construction of levees, dams and spillways. The possibility that they might play an important part in dealing with flood waters has seemed to them rather remote. As a result, enormous quantities of rain water that should have been stored in the soil for crop use during dry seasons have flowed away as so much waste.[1]

Effect of Forests on the Flow of Streams

The flow of streams is tremendously influenced by

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[1] H. H. Bennett, Conservation Farming Practices and Flood Control, Miscellaneous Publication No. 253, 1936, U. S. Department of Agriculture, pp. 1-3.

forests. To understand this influence one may picture two tracts of land on two mountain sides. They are exactly alike, except that one is covered with forest, and the other is bare. A heavy storm bursts over both areas. On the bare mountain side the rainfall pours down but cannot sink into the ground because the surface has been baked and hardened by the hot rays of the sun. Instead, it runs off rapidly, creating torrents which carry along great quantities of soil. If the rain is sudden and severe these torrents may combine to form a raging flood which will wipe out roads, bridges and homes. Hence, under such conditions the rainfall has not served the country in any beneficial way. However, something quite different is happening over on the tree covered mountain side. The force of the rain has been broken by the branches and leaves, and the water falls gently to the ground or runs down the tree trunks. This water finds a cover of leaves and loose earth which absorbs most of the water. Later this cover allows the water to come again to the surface in the form of springs and steadily running streams. It must not be expected, however, that forests can, of themselves, prevent floods, but they can certainly decrease their severity. Also, winter snows remain unmelted much longer on forested lands than on those exposed to the direct rays of the sun. As a result, streams are fed by forest snows, and droughts that occur in open country are often avoided. This water is valuable particularly in regions that depend upon irrigation for their farm crops, because a slow, steady supply is secured.[2]

Floods and Flood Control

In early days the streams were fairly clear even in flood times because the soil was protected and kept porous and absorbent by forests and prairie sod. But the soil has now been laid open to the rain and has been washed away by the millions of tons. Hence, the flood damage, vast as it may be, is not the only loss. The loss of the soil is the greatest of all and the most permanent for it cannot be replaced for generations. A flood is like an epidemic. The time to stop it is before it begins. We have been building engineering works to take care of floods after they occur, but, even though these are necessary, they are not enough. We have done practically nothing to prevent floods from occurring. And there is no possible reason why this condition should go on. Thirty years ago the Inland Waterways Commission pointed out that a river is a unit from its source to its mouth and must be treated as such, and urged headwater as well as lower stream control. But engineers denied the effect of forests

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[2]Charles L. Pack and Tom Gill, Forests And Mankind. New York: The MacMillan Co., (1930), pp. 125-130.

and sod on the run-off of streams. The results of this denial are well known. Hence, there is now no doubt about what is required. We have to stop forest devastation at the headwaters, replant or protect natural regrowth on lands better suited for forests than for farming, and stop plowing uphill and down-hill and providing channels to carry off the soil. We need to give many acres to soil-conserving crops, and protect those that we do have from overgrazing. We need many little dams to hold back the waters of little streams along with other related measures at the headwaters. Whether these things will be carried out thoroughly and efficiently still remains to be seen, but we cannot go on letting the water go to waste and in so doing wash our lands out to the sea.[3]

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[3]Gifford Pinchot, "Conservation," The Indiana Waltonian, XII, No. 4, (August-September, 1937), pp. 9-10.

CHAPTER V

CONSERVATION OF WILD LIFE

Preview

On September 23, 1806, Meriwether Lewis and William Clark ended one of America's greatest epics of exploration and proved that a storehouse of wealth stretched from Saint Louis to the Pacific. This was just one hundred and thirty-three years ago. What would such an expedition entail today? Suppose forty-three men had to row a boat to the headwaters of the Missouri River and from there re-cross that expedition's route. Suppose they tried living off the country--off game and fish and wild plants, with only flint-lock guns, knives and courage to furnish bodily subsistence. Practically, such an expedition would mean death for there would be starvation or disease. It would be legally impossible to hunt or fish during most of the twenty-eight months spent on the way. Most of our game herds, fish, and flights of waterfowl and game birds are gone. It is unsafe to drink water from most streams, lakes, ponds, or rivers in practically all of our states. In the place of clean waters and free meat we have dust bowls, fire-gutted forests, oil-smeared marshes, overgrazed pastures, stenchy rivers, and polluted drainage ditches. Unfiltered water is dumped into state streams. Factories empty chemical death into fish-bearing waters. Cities dump sewage into rivers across which great dams now trap and accumulate the odorous material which is poisonous to aquatic animals and plants.[1] All these things have brought about a situation which must be corrected as quickly as possible or our wild life will be on the point of extinction as far as practical benefits are concerned. Necessarily, as the country has been developed, land has been cleared and the regions where wild animals and birds live have been reduced. This would cause sufficient loss of life, but greater damage has been done by useless or too extensive slaughter by man. In 1935 over 5,988,000 hunting licenses for taking wild game were issued to hunters in the United States and Alaska, and this, of course, does not include the millions who hunt without a license.

Conservation of Fur-bearers

According to the best authorities it is now a world wide problem to save wild mammals, especially those which are killed for their fur. The Biological Survey oficially says,

> We are headed straight for a general extermination of fur animals. The same neglect that caused the exter-

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[1]Nash Buckingham, "Prisoners of Hope," <u>Outdoor American</u>, III, No. 1, (November, 1937), p. 3.

> mination of the passenger pigeon and the decimation of the buffalo herds and that has brought the migratory waterfowl to a crisis is bringing fur animals there just as fast.[2]

Hence the need is imperative for an intelligent study of the whole question of conservation of wild fur bearers.

Conservation of Fish

The most prized fresh water fishes are dependent upon clean bottoms, abundant vegetation, and a good flow of water in dry seasons. These conditions characterized our streams in early times. However, clearing of timber has modified stream flow, and household and industrial pollution has changed the character of the water and covered the bottom with filth, to the destruction or injury of fishes. Fish were very important in the settlement and early development of our country. Salmon, shad, bass, trout, and many other kinds were available to eastern colonists--shad being the most important and abundant in all Atlantic coast rivers. Shad and salmon are now greatly reduced or exterminated in our Atlantic coast streams. The whitefish of the Great Lakes was once abundant, and the buffalo fish, which afforded the chief marketable species years ago in the Illinois River, now constitutes less than eight per cent of the fish catch. Ruth-

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[2]Truman J. Moon and Paul B. Mann, Biology. New York: Henry Holt and Co., (1938), p. 820.

less catching has been followed by sewage, and the sewage by industrial wastes. For the proper protection of fishes, fishways or fish elevators are needed in connection with river improvements.[3] The United States produces between two and three billion pounds of fish every year. This enormous consumption, together with the pollution of streams, reduction of flow, and construction of dams, has reduced the number of valuable fish. The only way out of the difficulty is to see that as many fish as are caught are returned to the streams.

Conservation of Birds

It is impossible to overestimate the value of birds in maintaining a normal balance. Every study of bird populations, however, shows that many of our birds are rapidly declining in number. For instance, there is not more than one insect-eating bird in Pennsylvania today, where thirty years ago there were twenty or more. About two hundred species of game birds which are associated with swamps, lakes, watercourses, and the seashore are possessed by North America. Seventy-four species of this number are edible, web-footed fowl. The food of sixteen of these has been shown to consist of wild rice, pond weeds, and wild celery--particularly pond

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[3]A. E. Parkins and J. R. Whitaker, Our Natural Resources and Their Conservation. New York: John Wiley and Sons, Inc., (1936), pp. 503-504.

weeds which will grow in waters not too badly polluted. All these birds are closely dependent upon water for breeding. Ducks eat large numbers of caterpillars, locusts, grasshoppers, and cutworms. Rails and coots have similar relations and habits. All these are beneficial to the farmer. There are about sixty species of long-legged, slender billed shore birds which devour quantities of insects, both larval and adult. However, the breeding grounds of the waterfowl have probably been reduced to one per cent of their original area in the Lake States and upper Mississippi Valley. These birds have decreased from almost untold myriads to a mere handful. Their food value was forgotten when a machine capable of draining the grounds was invented and investments which would make large profits to the landowners were at stake.[4] If this continues practically all our valuable birds will be gone in a few more years. It has been estimated by specialists that if birds were to disappear entirely, human life would vanish also in less than ten years. And birds may actually disappear if their rate of decrease continues. It would be very difficult to get along without birds that destroy weed seed, insects and rodents.

Conservation of Wild Flowers

Our wild flowers have also been decreasing in numbers

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[4] Ibid., pp. 504-505.

very rapidly. Even though some of the decrease is unavoidable as we extend our agriculture, there is much that can be done. The only way to preserve our wild flowers is to stop picking them, at least the kind that have become rare. If this were done, many of our wild flowers now threatened with extinction would be preserved. Laws, however definite, will not give the desired protection without education and publicity. People must be educated before a real conservation movement can be developed.

Flood Control and Wild-life Populations

Wild life conservationists are becoming very much interested in the flood control program and its possible effects on wild life populations. The program will, if the needs of wild life are really considered, add materially to the resources. However, if no consideration is given, there will be a great amount of damage caused. Considerable sums of money are now being spent in attempting to restore migratory waterfowl and upland game resources. Huge dams which create great catch basins are of very small value from a wild life standpoint, but whether large or small dams are required, it is being realized that the number, location, and size must be worked out to meet the needs and problems of each stream or river. These types of flood control structures will provide much better conditions for wild life, and this is of extreme importance in a country whose wild life is fast disappearing.[5]

Forestry and Wild-life Populations

The great majority of animals that go to make up our wild life depend largely on the forest for concealment, breeding grounds, and food. Although many species live their lives in the open fields, even greater numbers make the tree covered areas their homes. So there must be some guardianship over the forest and its inhabitants. Foresters and naturalists have proved that game animals increase most rapidly where forestry is being practiced. Deer, elk, moose, grouse, beaver, and bear actually follow cutting operations, since on carefully cut over lands food conditions are better. After all, the important factor which governs the abundance of wild life is the available food supply. If trees are cut and the underbrush is destroyed there will be little if any wild life because of the shortage of food. Figure 12 gives some idea of this condition for here is shown a forest with the underbrush destroyed, thus doing away with not only the food supply but also the protection afforded. But if large trees are removed so that the sunlight will filter through and aid the growth of young seedlings and food plants, the

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[5]Ira N. Gabrielson, "Floods and Wild Life," The Indiana Waltonian, XII, No. 4, (August-September, 1937), p. 9.

forest animals will be found in abundance. Figure 13 gives

FIGURE 12. For timber, firewood and maple syrup, an excellent forest--For wildlife a desert.

a good example of an animal paradise with its thick, tangled undergrowth among the trees. Forestry is proving itself a good friend of wild life. Fire is the greatest enemy of the forest life--bird, animal and fish, and forestry means fire protection. Not only does the fire surround and destroy animals and birds, but it also destroys the eggs and young and ruins the coverts and hiding places. Alkali ashes from forest fires cause the death of fish in countless numbers when washed into the streams, lakes or rivers because such

FIGURE 13. It's in tangled wood lot margins like this where you find game.

ashes are poisonous in nature.[6]

Conclusion

It doesn't matter what kind of program is set up as long as results are secured. The wild things befriended and protected will return many real profits. It should be a

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[6]Charles L. Pack and Tom Gill, Forests And Mankind. New York: The MacMillan Co., (1930), pp. 167-173.

part of everyone's profession to see that this great, varied life of fur animals, birds, fish, and wild flowers does not disappear.

CHAPTER VI

SUMMARY OF THE NEED FOR CONSERVATION

It has been shown in the preceding four chapters that the need for an adequate program of conservation is very acute. Hundreds of thousands of words may be written on the problem and still it may not be presented in its entirety. To take the bewildering mass of data and reduce it to its essentials is a problem in itself. The many phases of conservation makes all the more necessary an intensive educational study of the situation.

On Erosion

Our vital topsoil, now laid open by the removal of vegetation, is being carried away by the carload lots by the rain, or wind, or both. Every muddy stream and dust storm in the United States gives us a picture of one farm, county, and state moving into another, or out to sea. A manhandled land presents a picture of almost unlimited destruction. We see sheet erosion stripping off the topsoil evenly, gnawing down the whole surface, keeping it smooth looking, but making it more barren all the time. We find millions of acres being reduced to worthless gullied land whose surface is marred by non-tillable gashes in the soil. We observe unguarded cultivation; slashing and tearing of land; skinned farms; protruding subsoil; overgrazing with too many cows and too many sheep; deforestation; stunted growth where great forests flourished or acres of grass spread; farmers led by visions of fancy prices to overplowing and overpasturing and so to staggering losses of soil; farmers caught in a web of debt and forced to work the land all the harder in order to pay taxes, to buy goods they need, and to pay interest; and a life of hardship, toil and suffering for many. We see plows dig into the Plains--then dust; dust over Dakota; dust over Texas; dust for three years with hardly a pause, day and night; crops baked out; topsoil of whole counties moved north; mounting debts and diminishing reserves; people who go on half stifled, with dust in their noses and eyes, in their beds, in their food; people who just spit and carry on; people who cower in their automobiles and see the surface of the land rise; people who see roadside ditches drifted level with the road, fences disappear under a sea of dirt, and buildings and farm equipment covered from view; people who hundreds of miles away close their windows and dust the fertile soil from their counterpanes; people who say it will rain again because it always has! Rain?--of course it will, but one cannot keep on ripping a country up and counting on the rain to heal it.

On Forests, Water, and Wild Life

We have progressed from a nation with many square miles of undeveloped land and billions of dollars worth of untouched natural resources to one which has been exploited to almost an unlimited degree. As a nation of lavish wood users we have devastated our forests by fire and axe. We now see fire-gutted forests, fire swept wastes, poor management of forests, wasteful methods of cutting, sporadic and largely ineffectual attempts at forest protection, false economy, mounting lumber prices, and tree planting as yet a mere gesture. We have observed a falling water table, springs and streams going dry, floods on one hand, and droughts on the other. We notice the decrease of game herds, fish, and flights of waterfowl and game birds. We find oil-smeared marshes, stenchy rivers, and polluted drainage ditches to lessen our supply of wild life.

Conclusion

Perhaps times, conditions and national necessities all conspired to make it inevitable that we should pass through a period of wasteful exploitation in order to learn our lesson. However, civilization stands on three legs--land, water, and timber. If these are destroyed--what then? It is difficult to see how people can do such things to their own land, how they can carry out the headlong spoliation of soil, water resources, minerals, forests, game, fish, power, and scenic values in the United States, and how they can do such things and yet seem never to realize what they are doing.

CHAPTER VII

ANALYSIS OF BIOLOGY TEXTS

Restatement of the Problem

The problem was originally divided into two phases; first, to find whether a need for conservation has developed, and second, to find whether or not text books of biology show a definite trend in their presentation of the subject. The first phase has already been explored and discussed in the previous chapters. The problem now is to examine the texts to see a change, if any, in material devoted to conservation.

Source of Data

It is well known that there must be some organized data if an analysis of any problem is to be attempted, for it is from this data that the conclusions and recommendations are formed. With this fact in mind all possible biology texts were secured which, by chance, represented nearly all periods between the years of 1877 and 1939. This would enable one to see the progressive change, if any, in textual material on the subject of conservation. The following list of text books which were surveyed are arranged according to year of copyright, and such information as date, authors, title of text, place of publication, and publisher is given for convenience in study.

LIST OF TEXTS ANALYZED

	Date	Author	Title	Place of Publication	Publisher
1.	1877	T. H. Huxley H. N. Martin	A Course of Elementary Instruction in Practical Biology	London	The MacMillan Co.
2.	1895	William T. Sedgwick	An Introduction to General Biology	New York	Henry Holt and Co.
3.	1911	George W. Hunter	New Essentials of Biology	Chicago	American Book Co.
4.	1912	Herbert W. Conn	Biology--An Introductory Study	Chicago	Silver, Burdett and Co.
5.	1913	Maurice A. Bigelow Anna N. Bigelow	Introduction to Biology	New York	The MacMillan Co.
6.	1914	James F. Abbott	The Elementary Principles of General Biology	New York	The MacMillan Co.
7.	1914	George W. Hunter	A Civic Biology	New York	American Book Co.

LIST OF TEXTS ANALYZED (Continued)

	Date	Author	Title	Place of Publi-cation	Publisher
8.	1916	Maurice A. Bigelow Anna N. Bigelow	Applied Biology	New York	The MacMillan Co.
9.	1919	Elliott R. Downing	A Source Book of Bio-logical Na-ture Study	Chicago	The Univer-sity of Chicago Press
10.	1919	Benjamin C. Gruenberg	Elementary Biology	Chicago	Ginn and Co.
11.	1920	James F. Abbott	The Elemen-tary Prin-ciples of General Biology	New York	The MacMillan Co.
12.	1920	W. M. Small-wood Ida L. Reveley G. A. Baily	Biology for High Schools	Chicago	Allyn and Bacon
13.	1921	James E. Peabody Arthur E. Hunt	Elementary Biology, Animal and Human	New York	The MacMillan
14.	1921	Truman J. Moon	Biology for Beginners	New York	Henry Holt and Co.
15.	1922	William H. Atwood	Civic and Economic Biology	Phila-delphia	P. Blakis-ton's Son and Co.
16.	1923	Gilbert H. Trafton	Biology of Home and Community	New York	The MacMillan Co.

LIST OF TEXTS ANALYZED (Continued)

	Date	Author	Title	Place of Publi- cation	Publisher
17.	1923	James E. Peabody Arthur E. Hunt	Elementary Biology-- Plant, Ani- mal, Human	New York	The MacMillan Co.
18.	1924	Elliott R. Downing	Our Liv- ing World	Chicago	The Univer- sity of Chicago Press
19.	1925	Arthur G. Clement	Living Things, An Elementary Biology	Syra- cuse	The Iroquois Publishing Co.
20.	1926	S. J. Holmes	An Intro- duction to General Biology	New York	Harcourt, Brace and Co.
21.	1926	Alfred C. Kinsey	An Intro- duction to Biology	Chicago	J. B. Lippincott Co.
22.	1926	George W. Hunter	New Civic Biology	Chicago	American Book Co.
23.	1927	William H. Atwood	Biology	Phila- delphia	P. Blakis- ton's Son and Co.
24.	1929	W. M. Small- wood Ida L. Reveley G. A. Baily	New General Biology	Chicago	Allyn and Bacon
25.	1929	F. M. Wheat Elizabeth T. Fitzpatrick	Advanced Biology	Chicago	American Book Co.

LIST OF TEXTS ANALYZED (Continued)

	Date	Author	Title	Place of Publication	Publisher
26.	1929	James E. Peabody Arthur E. Hunt	Biology and Human Welfare	New York	The MacMillan Co.
27.	1930	W. L. Eikenberry R. A. Waldron	Educational Biology	Chicago	Ginn and Co.
28.	1931	W. H. D. Meier Lois Meier	Essentials of Biology	Chicago	Ginn and Co.
29.	1933	Alfred C. Kinsey	New Introduction to Biology	Chicago	J. B. Lippincott Co.
30.	1933	T. J. Moon Paul Mann	Biology for Beginners	New York	Henry Holt and Co.
31.	1934	W. M. Smallwood Ida L. Reveley G. A. Baily	New Biology	Chicago	Allyn and Bacon
32.	1934	F. D. Curtis Otis W. Caldwell	Biology for Today	Chicago	Ginn and Co.
33.	1938	Ella T. Smith	Exploring Biology	Chicago	Harcourt, Brace and Co.
34.	1938	A. O. Baker Lewis H. Mills	Dynamic Biology	Chicago	Rand McNally and Co.

LIST OF TEXTS ANALYZED (Continued)

	Date	Author	Title	Place of Publication	Publisher
35.	1938	Ralph C. Benedict Warren W. Knox George K. Stone	High School Biology	New York	The MacMillan Co.
36.	1938	Alfred C. Kinsey	New Introduction to Biology	Chicago	J. B. Lippincott Co.
37.	1938	T. J. Moon Paul Mann	Biology	New York	Henry Holt and Co.
38.	1939	George L. Bush Allan Dickie	A Biology of Familiar Things	Chicago	American Book Co.

Technique of Procedure

In making the survey of the various texts, four distinct methods of approach were used. These methods are discussed in the following four paragraphs so that some understanding might be gained as to the procedure used in collecting the data.

First, the term "conservation" was checked in the index of each text to ascertain how many words were devoted to pointing out specific references in textual material. This was done to find out whether there has been any trend toward guiding students in finding definite material on conservation anywhere in the text with less loss of time.

Second, each text was thoroughly examined for subject matter relative to conservation, whether it be listed in the index or not. It was very often true that no direction was given by the index, yet, material was found, scattered throughout the text, pertinent to conservation. As each text was studied the number of words on conservation were counted. In making this count it was believed that sufficient accuracy could be secured by finding the average number of words per line and counting the lines. This average was determined in each case by the actual word count in ten lines. To further increase the accuracy partial lines were added together to make complete ones before being counted.

Third, the number of pages of textual material devoted to conservation was counted. This count together with the total number of pages of the text gave the basis for calculating the percentage of area devoted to the subject.

Fourth, the number of student helps such as diagrams, pictures, and maps was recorded to find whether or not any attempt has been made to present the problem of conservation to the student in a picture form. Only those pictured helps pertinent to conservation were counted.

From all the data collected various tables and figures were made to show the trend as set forth in the problem. This presentation of data in the tabular form is accompanied by such explanation as is thought necessary for clarification.

Delimitations

It was impossible to secure all of the biology texts which have been published up to date. Therefore, the only alternative was to secure all those that could be found. Thirty-eight texts ultimately secured constitute a very good sampling and should be sufficient in number and character to determine any trends that may exist.

In counting the number of words devoted to conservation in each text, sufficient accuracy would be secured if an approximation were made, based upon the average number of words per line. Hence, it is not to be thought that the word count is perfectly correct. Also, in counting pages of subject matter, it was considered that counting to the nearest half page would give data sufficiently accurate to determine trends.

The term "illustrations" is used to include all illustrative material. No attempt was made to distinguish between various types of illustrations such as pictures, diagrams, maps, and tables or between colored illustrations and those in black and white.

No two people would analyze a text in exactly the same way and the same individual would not analyze the same book twice in exactly the same way. Therefore, no two persons would classify textual material in an identical manner, particularly as it pertains to conservation. In either case, however, assuming that all concerned made a careful study and analysis, the error by any one would be so small that the final tabulations and results would be the same as far as trends are concerned.

When the years represented by the various texts were divided into ten year periods, it was found that the first four periods contained insufficient data for the formulation of any definite conclusions. It was impossible to secure any texts to represent the two periods from 1881-1890 and 1901-1910, and only one text each could be secured to represent the periods 1871-1880 and 1891-1900.

Analysis of Data

The data for each individual text is recorded in Table III. A careful study of this Table gives a definite indication of the content of each book relative to material on conservation. The books are given by number and are arranged in yearly sequence so that any general progressive trends might be noted during the period from 1877 to 1939. Even though the individual data for each text may have

TABLE III. SUMMARY OF MATERIAL ON CONSERVATION AS FOUND IN EACH OF 38BIOLOGY TEXTS

Text	Date	Number of Words in Index on Conservation	Number of Illustrations	Number of Words Devoted to Phases of Conservation
1	1877	0	0	0
2	1895	0	0	0
3	1911	0	11	2260
4	1912	8	0	1250
5	1913	5	0	1080
6	1914	4	0	530
7	1914	15	14	2970
8	1916	5	1	1190
9	1919	0	6	2240
10	1919	30	5	3710
11	1920	4	0	530
12	1920	19	20	4590
13	1921	14	1	1910
14	1921	0	3	1880
15	1922	0	5	1470
16	1923	4	13	3640
17	1923	18	7	3030
18	1924	0	6	2240
19	1925	22	15	7810
20	1926	0	0	0
21	1926	5	12	2850
22	1926	21	13	11970
23	1927	3	22	8410
24	1929	41	25	14480
25	1929	4	1	90
26	1929	13	12	2660
27	1930	2	4	380
28	1931	10	34	5550
29	1933	8	14	3480
30	1933	36	27	6590
31	1934	38	19	3560
32	1934	24	41	17310
33	1938	40	10	4290
34	1938	8	34	7840
35	1938	10	8	1900
36	1938	61	45	17970
37	1938	264	29	7670
38	1939	73	81	36490

TABLE III. (Continued)

Text	Number of Pages in Text	Pages Devoted to Conservation	
		Number	Percentage
1	270	0	0.0
2	231	0	0.0
3	453	11.5	2.5
4	425	3.0	0.7
5	424	3.5	0.8
6	329	2.0	0.6
7	432	12.5	2.9
8	583	4.0	0.7
9	503	11.0	2.2
10	528	12.5	2.4
11	329	2.0	0.3
12	590	24.5	4.1
13	221	6.5	2.9
14	558	8.0	1.4
15	471	6.5	1.4
16	614	20.0	3.3
17	229	13.0	5.7
18	503	11.0	2.2
19	488	18.0	3.7
20	449	0	0.0
21	558	15.0	2.7
22	448	21.0	4.7
23	522	41.0	7.9
24	788	52.5	6.7
25	568	.5	0.08
26	585	20.0	3.4
27	549	4.0	7.3
28	529	32.5	6.1
29	840	20.5	2.4
30	773	33.0	4.3
31	636	23.5	3.7
32	718	66.5	9.3
33	696	20.0	2.9
34	733	39.5	5.4
35	744	10.5	1.4
36	845	71.0	8.4
37	966	36.0	3.7
38	695	135.0	19.4

little significance in itself, a definite trend is shown as the data is examined in a progressive way from the year 1877 to the year 1939. For example, the number of words listed in the index under "conservation" has in general, increased with the passing of years. This same condition is true when the other factors are considered; namely, the number of illustrations, total number of words, and the percentage of page area. Table III also shows that there are some books of late copyright date which do not measure up, as far as material is concerned, to some of those which are of earlier copyright. With this fact in mind it was deemed advisable to break down the total number of years into ten year periods so that averages might be secured which would be more indicative of general trends.

An examination of the data given in Table IV brings out the fact that a progressive change has occurred in the listing of the term "conservation" in the index from no listing at all to a more detailed account at the present time. Inasmuch as only two books could be secured to represent the first four periods, there is a decided lack of evidence on which to base comment for these periods. All that can be noted is that no mention of conservation was made in the index of either text. However, the last three ten year periods, covering the years 1911-1940, are well represented, and it is from the data

TABLE IV. AVERAGE NUMBER OF WORDS LISTED IN THE INDEX UNDER CONSERVATION BY TEN YEAR PERIODS AS FOUND IN 38 BIOLOGY TEXTS

Period of Time	Number of Texts in Period	Total Number of Words Listed in Index Under Conservation	Average Number of Words Per Text Listed in Index Under Conservation
1871-1880	1	0	0
1881-1890	0	0	0
1891-1900	1	0	0
1901-1910	0	0	0
1911-1920	10	90	9.0
1921-1930	15	139	9.3
1931-1940	11	572	52.0

shown by these periods that the trend is noted. In the period 1911-1920, an average of nine words per text were listed in the index under conservation. This average was increased only slightly during the next period, 1921-1930, showing only three-tenths of a word gain. However, a decided change occurred during the last period, 1931-1940--an average of fifty-two words being listed. This progressive change may be better seen by an examination of Figure 14. Here again the progressive trend is pointed out by the upward swing of the graph line. This graph shows that only a

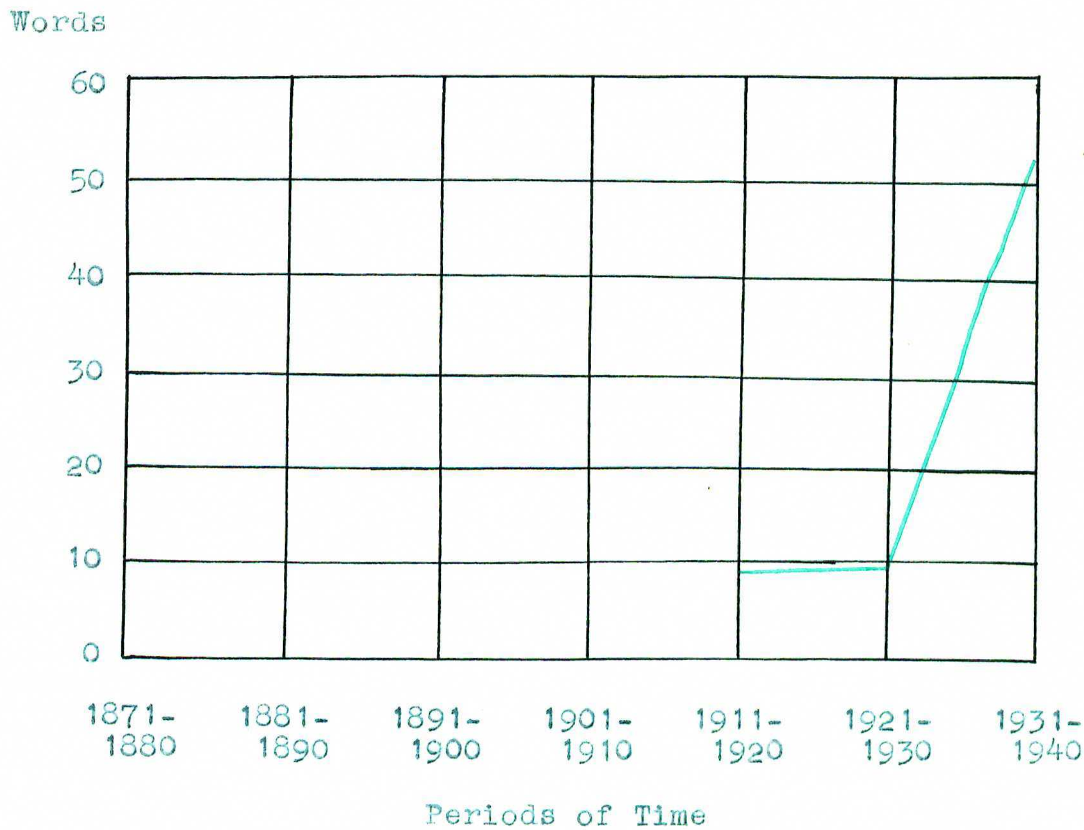

FIGURE 14. Average number of words listed in the index under conservation as found in 38 biology texts.

slight gain was made at first as compared to the rapid acceleration toward the last. Mention might be made at this point that at first only conservation of energy was listed; later conservation of soil was added; then, as the years went by, conservation of birds, wild flowers, forests, food fishes, animals, natural resources, food supplies, health, nerve force, water, useful mammals, game, trees, and wild life were included. In addition other listings were made, such as meaning of conservation, principles of conservation, problems in conservation, recreation and conservation, and diagram of means of conservation. All these facts indicate a definite trend toward a more detailed analysis of conservation in the index as a better guide for the individual who must find textual material.

An examination of Table V shows that the illustrative material devoted to conservation has shown an increase in

TABLE V. THE AVERAGE NUMBER OF ILLUSTRATIONS ON CONSERVATION BY TEN YEAR PERIODS AS FOUND IN 38 BIOLOGY TEXTS

Period of Time	Number of Texts in Period	Total Number of Illustrations	Average Number of Illustrations
1871-1880	1	0	0
1881-1890	0	0	0
1891-1900	1	0	0
1901-1910	0	0	0
1911-1920	10	57	5.7
1921-1930	15	143	9.5
1931-1940	11	342	31.0

amount as the years have passed. Again comment must be based on the last three periods, noting only that no illustrative material was shown in the two early texts surveyed. In the period 1911-1920, an average of 5.7 illustrations per text were given to aid in the presentation of the textual material on conservation. This average increased to 9.5 words per text during the period 1921-1930, and to 31.0 words per text during the last period, 1931-1940. This trend toward the inclusion of a greater amount of illustrative material as a teaching aid may be better understood after an examination of

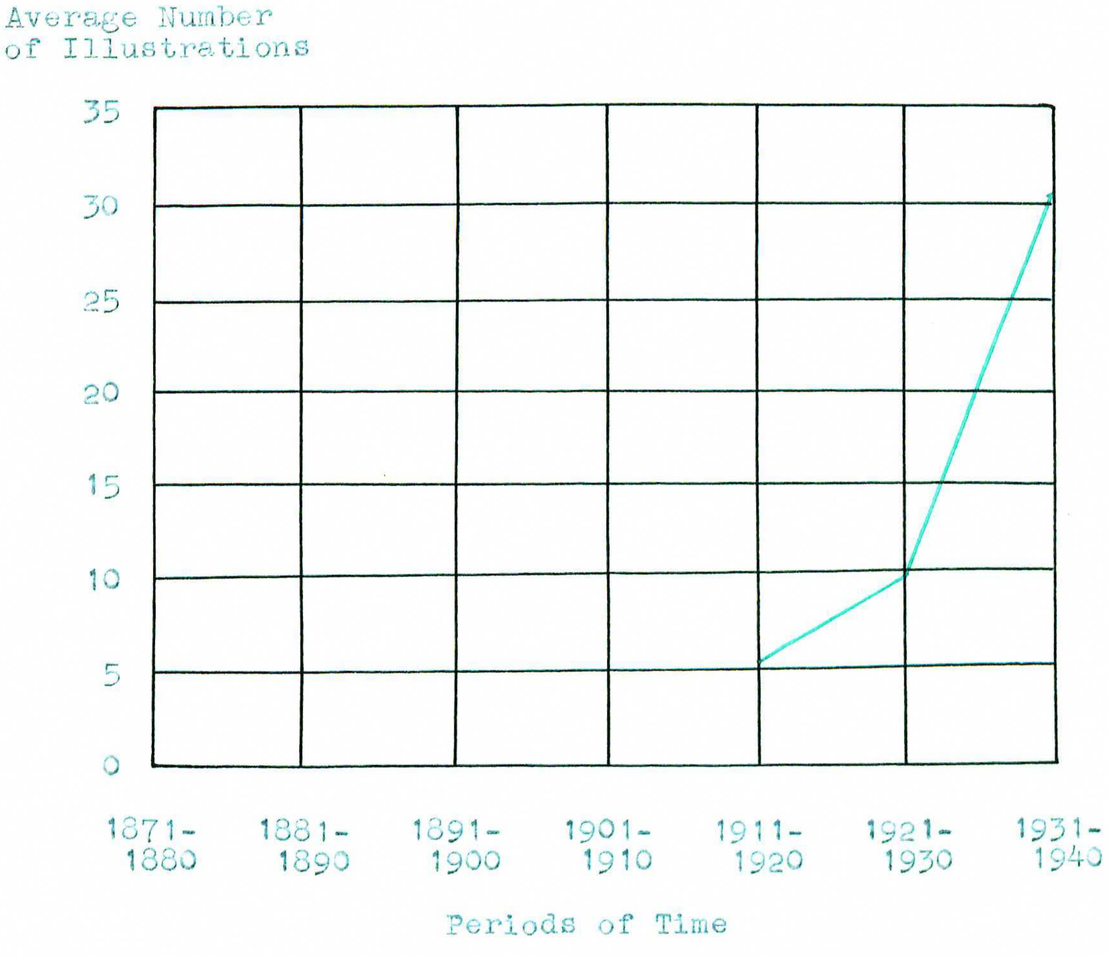

FIGURE 15. Average number of illustrations on conservation by ten year periods as found in 38 biology texts.

Figure 15, where, again, a consistent upward swing of the graph line is noted.

Table VI shows that the number of words devoted to the discussion of conservation has shown a considerable increase

TABLE VI. THE AVERAGE NUMBER OF WORDS ON CONSERVATION BY TEN YEAR PERIODS AS FOUND IN 38 BIOLOGY TEXTS

Period of Time	Number of Texts in Period	Total Number of Words on Conservation	Average Number of Words per Text on Conservation
1871-1880	1	0	0
1881-1890	0	0	0
1891-1900	1	0	0
1901-1910	0	0	0
1911-1920	10	20,350	2,035
1921-1930	15	62,820	4,188
1931-1940	11	111,750	10,159

during the thirty-year period from 1911 to 1940. The 4,188 words representing the average number per text during the period 1921-1930 show considerable increase over the average of 2,035 shown during the preceding period, 1911-1920. However, an even greater gain is indicated for the period 1931-1940 during which time each text averaged 10,159 words on conservation. This fact shows a definite trend toward a

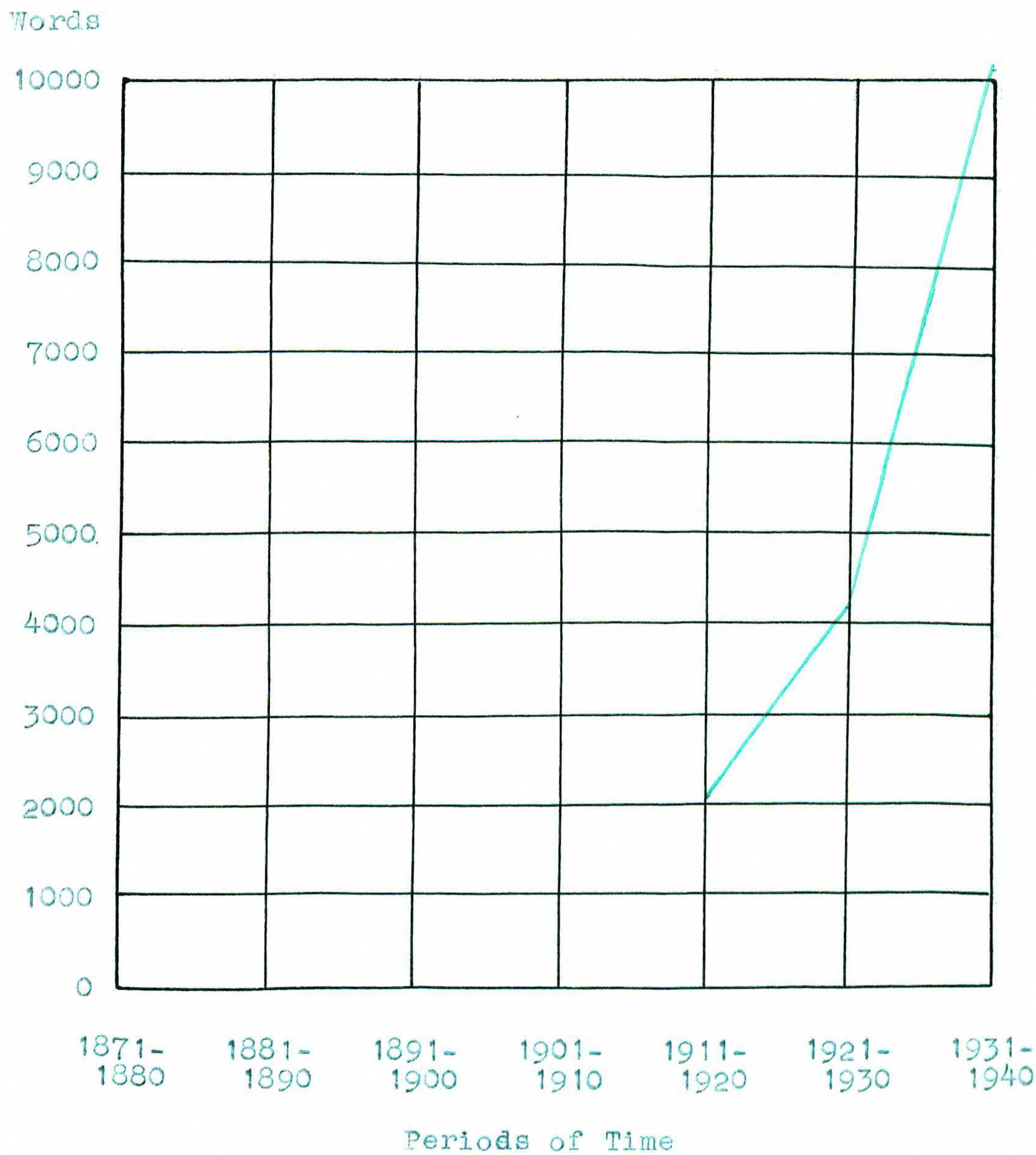

FIGURE 16. Average number of words devoted to conservation by ten year periods as found in 38 biology texts.

more complete and elaborate discussion of conservation as time progresses. Figure 16 shows this same trend in graphic form, the increase in the number of words being very definite, particularly during the last ten-year period. The first four periods are omitted from the discussion because of lack of data. In early editions, the term "conservation" applied to only a limited field, as for example, conservation of energy. This was discussed very briefly, being included in very few lines of textual print. Later, a noticeable change was seen in the presentation of conservation. Formerly this presentation was indirect, the authors discussing it in either a few, separate, brief paragraphs scattered in the book, or bringing it out in a chapter on forests and forestry. However, a new phase of presentation began to infiltrate into the content of the texts. Instead of a loose, rambling, disconnected survey, a more analytical method was found. With the advent of the unit plan, it was found desirable to devote a whole unit or two to conservation. Instead of a mere chapter on forestry, new chapters were presented which brought out more in detail all the phases of conservation. There was, for example, a progression from a 1250 word description of the conservation of energy in a text book of 1912 to a discussion of conservation comprising two full units of 135 pages or 36,490 words in a text book of 1939. In addition to this discussion material a definite effort was made to arouse interest by the inclusion of problems and suggested activities and by the use of the bibliography to direct additional study.

Table VII indicates that the trend has been toward

TABLE VII. THE AVERAGE PERCENTAGE OF PAGE AREA DEVOTED TO CONSERVATION BY TEN YEAR PERIODS AS FOUND IN 38 BIOLOGY TEXTS

Period of Time	Number of Texts in Period	Total Number of Pages in Texts	Average Number of Pages in Texts
1871-1880	1	270	270
1881-1890	0	0	0
1891-1900	1	231	231
1901-1910	0	0	0
1911-1920	10	4596	459.6
1921-1930	15	7550	503.3
1931-1940	11	8175	743.2

TABLE VII. (Continued)

Period of Time	Total Number of Pages Devoted to Conservation	Average Number of Pages Devoted to Conservation	Average Percentage of Area Per Text Devoted to Conservation
1871-1880	0	0	0
1881-1890	0	0	0
1891-1900	0	0	0
1901-1910	0	0	0
1911-1920	86.5	8.65	1.9
1921-1930	237.0	15.80	3.1
1931-1940	488.0	44.36	6.0

devoting a greater percentage of page area to the discussion of conservation as the years have passed. This trend is clearly shown by the last three ten-year periods, even though lack of sufficient data forces one to omit consideration of the first four. An average of only 1.9 per cent of page area was given over to the discussion of conservation during the period 1911-1920. During the next period, 1921-1930, the average was increased to 3.1 per cent, representing a rather definite gain. However, the increase was much more rapid during the last period, an average of 6.0 per cent of page area being reached. This trend may be also ascertained by examining Figure 17, which shows a definite rise in average

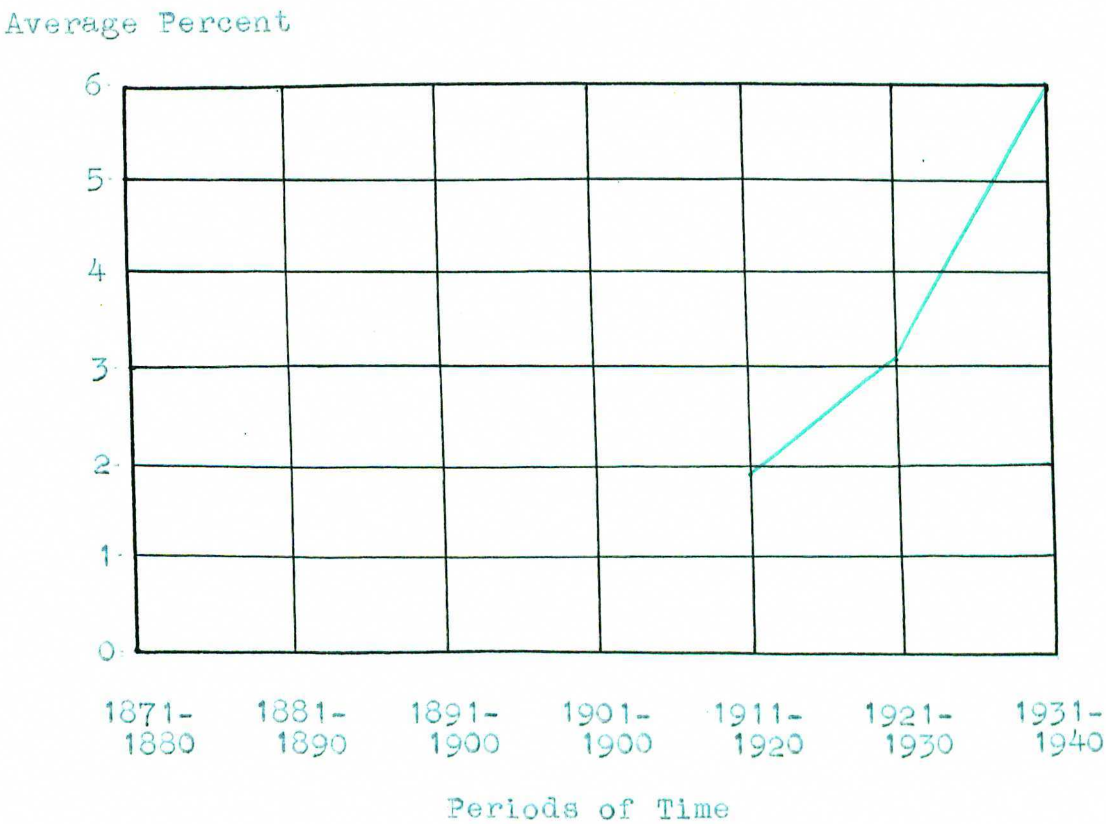

FIGURE 17. Average percentage of page area devoted to conservation by ten year periods as found in 38 biology texts.

percentage from period 1911-1920 to period1921-1930, and then to period 1931-1940.

Summary

To summarize, the following facts may be given: (a) a change in giving the term "conservation" in the index, the trend being toward a more detailed listing; (b) utilization of a greater amount of illustrative material to supplement the printed page; (c) allotment of a greater number of words to the discussion of conservation; (d) a trend toward including all phases of conservation in compact units with definite chapter headings rather than having these phases scattered throughout the text and discussed under more or less inappropriate titles; (e) allotment of a greater percentage of page area to the presentation of conservation; (f) better organization of conservation material from the standpoint of being a problem rather than just mere subject matter; (g) a definite effort to arouse interest by the use of problems and suggested activities (this being true only in the very latest texts); (h) the greater use of the bibliography to direct additional study on conservation.

CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

After a thorough study of the conservation problem and after an analysis of a number of texts in biology, the following conclusions may be set forth:

One.--A definite need for conservation has developed. This is shown by the present scarcity of our natural resources as compared with the plentiful supply which we had at the time of colonization.

Two.--There has been a definite trend toward a more thorough presentation of conservation and its related problems in biological text books as the years have passed. More space is devoted to conservation at present than before, and the textual material is better organized and arranged.

Three.--There should be an entire book devoted to the economic and social problems involved in conservation, for there is still ample opportunity for improvement in the presentation and organization of these problems. Even with the great forward strides which have been made, there is still too little space devoted to such an important problem.

On the basis of the foregoing conclusions, the following two recommendations may be made:

One.--In the revision of certain texts more space should be given to conservation and its discussion. This could be accomplished by omitting the less important material or by increasing the number of pages in the text.

Two.--The most important recommendation is that an entire book be written on conservation. Since the material on conservation is still more or less scattered in various books, and since there is still no complete, well organized discussion to be found, such a text would be of invaluable aid in a school system. It could be used as a source book in science classes or as a text in any conservation course, and would enable the problem to be given thoroughly and accurately as it should be.

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