-Background Essays-

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MICHIGAN STATE
UNIVERSITY
EXTENSION

FOUR ESSAYS THAT MAY CHANGE THE WAY YOU LOOK AT FORESTS, FORESTRY, and TREES

Many times, reading and absorbing information about a topic is not enough to allow a full appreciation of the greater context. This is certainly true of forests and forestry. The following four essays well-illustrate the importance of natural resources; in particular forests and trees. An understanding of these essays will provide clarity to the other chapters of the Michigan Forests Forever Teachers Guide. They are well-written and thought-provoking.

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"**Alternatives to Forest Harvest and Wood Use; The Environmental Impacts Are Substantial**"

By Dr. Jim Bowyer, University of Minnesota

Proposals calling for a marked reduction in the harvest of wood from domestic forests are increasingly common. Such proposals are almost always based on concern for the environment, and are frequently promoted as part of what is described as a new ethical standard for forest management.

Reasons often cited for restricting the domestic harvest of timber include negative impacts upon aesthetics, wilderness values, tourism, wildlife values, water quality, plant and animal diversity, and long-term sustainability of the timber harvesting enterprise. Although there are definitely environmental impacts of harvesting timber, and a number of important factors that must be considered in planning a harvest, the impacts of gathering and processing alternative materials are quite substantial.

Moreover, alternate materials are largely imported, meaning that substitution of non-wood raw materials largely means that the environmental consequences of raw material gathering and processing are exported, usually to countries that have far less stringent environmental controls in place than the United States. An examination of realistic alternatives to sustainable domestic timber harvest suggests that restrictive protection of local resources without considering global consequences can translate to what amounts to irresponsible and unethical regional environmentalism, with adverse economic and strategic consequences. The requirements for materials and the need to protect the environment must be addressed jointly if workable solutions are to be found. When the world is viewed in this way, an inescapable conclusion is that the United States should be seeking to increase the sustainable production of wood from its forests.

Americans identifying themselves as environmental activists have, in recent years, increasingly taken the position that to protect the environment, any intensification of domestic raw material production -- whether timber, minerals, or energy resources -- must be resisted. This position has gained growing favor with a U.S. public that has generally lost an awareness of how much raw material it takes to sustain the economy, where raw materials come from, what the environmental impacts are of gathering and processing these materials, and the environmental tradeoffs involved in using one type of material instead of another.

Table 1 - Net Carbon Emissions in Producing a Ton of:

Material	(kg C/metric ton)
Framing Lumber	-460
Concrete	45
Concrete Block	49
Brick	148
Glass	630
Steel	1090
Aluminum	2400
Plastic	2810

Source: Honey & Buchanan, Dept. of Civil Engineering, University of Canterbury, Christchurch, NZ, 1992

In view of the environmental basis for objections to development of resources, it is ironic that failure to develop domestic resources simply results in a shift of environmental impacts to other regions of the world where impacts

are often more severe. In addition to the obvious moral and ethical issues that this situation raises, the environmental benefits are questionable. It is highly doubtful that the net impact on the global environment of interregional transfer of raw material extraction and processing is positive.

In this article, the harvest and use of wood will be examined in a global context, and assessed in light of demands posed by a growing human population. In all discussions of timber harvest, sustainable harvest levels are assumed.

Population growth: United States and worldwide

If environmental issues are to be effectively addressed, it is critical that plans and actions be based on rational thinking and realistic assumptions; planning must consider growing populations and the inevitable associated growth in raw material demand.

Table 2 - Forests Then, Now, and Future -- USA

Year	Population	Forest Area (million acres)	Forest Area per Capita(acres)
1785	3,000,000	1044	348
1850	23,300,000	926	40
1910	77,000,000	730	9.5
2000	274,000,000	737	2.7
2100	571,000,000	737	1.3

Source: personal communication with J.Bowyer

Birth rates worldwide are declining, continuing a long-term trend. However, the current average difference in birth and death rates is substantial, translating to a high rate of wood population growth (1), Even assuming a significant further decline in birth rates, the current world population of 6.1 billion is expected to rise to 11 billion or more by the end of this century. Most of the increase will occur in developing regions of the world: Africa, Asia (excluding Japan) and Latin America.

While the rate of population growth in the United States is relatively low, it is important to remember that populations continue to increase. With a current annual growth rate of 0.9 to 1.0 percent, some 2.3 to 2.5 million people are added to the U.S. population each year creating an additional Los Angeles every 3 years.

Domestic raw material demand and sources of supply

The United States economy is based on consumption of vast quantities of industrial raw materials. These materials are largely imported. An examination of Table 3 reveals that the United States is a net importer of the majority of raw materials used to sustain the economy, and often by a substantial margin. **Table 3** also shows that developing nations appear frequently in the list of suppliers. An examination of recent trends indicates that the level of importation is increasing.

Wood and wood fiber is used in very large quantities in the United States, both in familiar forms such as poles, timbers, lumber, and plywood, and in less known products such as molded interior panel for autos, adhesives, paints, food additives, drapes, tires, and even ping pong balls. In total, some 18 billion cubic feet of wood were consumed in the United States in 2000, representing consumption of 74 cubic feet per capita,

continuing a long-term rather than stable trend in per capita domestic wood use (**Table 4**).

Table 3 - Net U.S. Imports Of Selected Materials As A Percent Of Apparent Consumption—1998, And By Major Foreign Sources[a/b/c/d/]

Material	% Imported	Principal Foreign Sources (1994-1997)
Columbium (Niobium)	100	Brazil, Canada, Germany, Thailand
Mica (natural)	100	India, Belgium, Germany, China
Manganese	100	South Africa, Gabon, Australia, France
Graphite	100	Mexico, Canada, China, Madagascar, Brazil
Strontium (Celestite)	100	Mexico, Germany
Bauxite/Alumina	100	Australia, Guinea, Jamaica, Brazil
Fluorspar	100	China, South Africa, Mexico
Yttrium	100	China, France, United Kingdom, Belgium
Thallium	100	Mexico, Belgium, Canada, Germany
Platinum Group	94	South Africa, United Kingdom, Germany, Russia
Palladium	88	Russia, South Africa, Belgium, United Kingdom
Tin	85	Brazil, Indonesia, Bolivia, China
Antimony	84	China, Mexico, Bolivia, South Africa
Tantalum	80	Australia, Thailand, China, Brazil
Potash	80	Canada, Russia, Belarus
Barium (Barite)	80	China, India, Mexico, Morocco
Chromium	79	South Africa, Kazakhstan, Turkey, Zimbabwe
Tungsten	78	China, Germany, Bolivia, Peru
Cobalt	77	Norway, Finland, Zambia, Canada
Iodine	72	Canada, Mexico, Spain, Peru
Zinc	70	Canada, Mexico, Spain, Peru
Nickel	65	Canada, Norway, Russia, Australia
Silver	--	Canada, Mexico, Germany, Peru
Diamond (industrial)	51	Ireland, China, Germany
Titanium	49	South Africa, Australia, Canada
Petroleum (Crude & Refined)	48	Saudi Arabia, Venezuela, Canada
Lumber	35	Canada, Finland, New Zealand, Chile
Silicon	32	Norway, Russia, Brazil, Canada
Magnesium Compounds	28	China, Canada, Mexico, Greece
Gypsum	26	Canada, Mexico, Spain
Aluminum	25	Canada, Russia, Venezuela, Mexico
Cadmium	21	Canada, Australia, Belgium, Mexico
Iron and Steel	18	EEC, Canada, Japan, Brazil, South Korea
Sulfur	18	Canada, Mexico, Germany
Iron Ore	17	Canada, Brazil, Venezuela, Australia, Mauritania
Portland and Masonry Cement	17	Canada, Spain, Venezuela, Greece, Mexico
Copper	16	Canada, Chile, Mexico
Asbestos	6	Canada
Wood & Wood Products (Total)	0.7	Canada, Brazil, Indonesia, Finland, Mexico, Malaysia

[a/]Also significant import dependency for Andalusite, Arsenic, Bismuth, Caesium, Gallium, Gemstones, Germanium, Ilmenite, Indium, Iron and Steel slag, Kyanite, Lead, Leather, Lime, Lithium, Mercury, Mica, Natural Rubber, Nitrogen, Pumice, Pyrophyllite, Quartz, Rhenium, Rubidium, Rutile, Salt, Selenium, Sodium Sulfate, Stone (dimensional), Tellurium, Thorium, Vanadium, Vermiculite, Wool, Zirconium.

[b/]U.S. Department of the Interior. 1996. Mineral Commodity Summaries. Geological Survey and Bureau of Mines.

[c/]Data for wood, wood products, and wood pulp products are from U.S. Forest Service, Forest Products Laboratory and include logs, lumber, wood products of all kinds, pulp, paper, wastepaper, and chips.

[d/]Petroleum data from U.S. Department of Energy, Energy Information Administration.

Wood as a raw material

Economic importance

Perhaps the most effective way to illustrate the economic importance of wood is to examine how much is used relative to other materials. Today, for example, the quantity (weight) of wood used annually in the United States is roughly equal to the annual consumption (weight) of all metals, all plastics, and Portland cement combined!

Table 4 – U.S. Consumption of timber products for selected years

Year	Total domestic consumption (million cubic feet roundwood equivalent	Per Capita Consumption
1970	11,995	61.1
1975	11,105	54.1
1980	13,020	70.8
1981	12,225	66.9
1982	11,930	65.7
1983	13,665	72.0
1984	14,830	77.9
1985	14,790	76.2
1986	15,920	78.8
1987 (est.)	16,510	80.1

Source: *U.S. Bureau of the Census Statistical Abstract of the United States, 1990 (Reference #3).*

Energy consumption associated with wood use

A number of the significant environmental problems of today are traceable to consumption of energy. Energy use has major environmental impacts, ranging from acid rain and global warming, to oil spills. Thus when considering environmental tradeoffs associated with using one raw material versus another, it is useful to look at industrial materials in an energy context.

When materials are compared in relation to energy consumed in gathering, processing, and fashioning materials to final product, wood compares very favorably with other materials. An evaluation of energy inputs involved throughout the process from raw material extraction to finished product is on the order of 70 times higher for aluminum than for an equal weight of lumber, and 17, 3.1, and 3 times higher for steel, brick, and concrete block, respectively than for wood. A comparison of wood versus other materials used in a common product — such as in a wall section — show substantial energy advantages of wood materials (**Table 5**).

Table 5 - Energy Required in the Manufacture of Various Wall Systems

Type of Wall	Energy to Manufacture 100 feet of wall (million BTU oil equivalent)
Plywood siding, no sheathing, 2 by 4 frame	1,988
MDF siding, plywood sheathing, 2 by 4 frame	2,541
Concrete building block, no insulation	17,087
Aluminum siding, plywood, insulation board, over 2 by 4 frame	4,953
MDF siding, plywood sheathing, steel studs	5,106
Brick veneer over sheathing	17,887

Calculations of energy consumption include logging (or extraction), manufacture, transport to house site, and erection.
Source: Committee on Renewable Resources for Industrial Materials, 1976 (reference #4).
MDF = Medium Density Fiberboard

Growth versus harvest

It is generally acknowledged that substantially more wood is added in new growth in U.S. forests each year than is harvested. For softwood species the growth harvest ratio

was estimated in 1996 as 1.35, meaning that 35 percent more was being added annually in net growth than was removed through harvest. For hardwoods, the growth/harvest ratio in 1996 was estimated to be 1.7! For the United States overall, considering both hardwoods and soft-woods, the growth removals balance was reported as a healthy 1.45 (5).

Options to harvest of domestic forests

In view of the fact that the United States annually consumes vast quantities of wood and wood fiber, and is today a net importer of most industrial raw materials, including wood, wood fiber, and wood products of all kinds, any decision to reduce the domestic harvest of timber has a number of economic, environmental, strategic, and ethical implications. It is important, then, that various options to domestic timber harvest, and the consequences of these options, be carefully considered.

Options to domestic harvest of timber are: 1) to shift to the use of raw materials other than wood; 2) to use wood, but to import needed supplies; 3) to reduce the rate of raw material consumption in general; and 4) to recycle to a greater extent than current efforts. Each of these options are explored in the following paragraphs.

Shift to non-wood raw materials

As discussed earlier, the United States is currently a net importer of most important raw materials, and in a great number of instances, by a wide margin. Further, the United States today annually uses roughly as much wood by weight as all metals, all plastics, and Portland cement combined. Therefore, if there is to be a substitution of other materials in order to reduce timber harvest, it will be a massive substitution. Moreover, the materials substituted will be largely imported and nonrenewable, and the gathering and processing of these substitute materials will, in general, result in the use of larger quantities of energy and in more severe environmental impacts than will the use of wood.

From an environmental perspective, the impacts of gathering and processing wood are generally less than for potential substitute materials. A shift to non-wood raw materials is largely unacceptable, not only from an environmental perspective, but from economic and equity perspectives as well. An increase in raw material imports would adversely affect the trade deficit. Such a move would also raise strategic questions; the primary issue here is whether a world which has roughly twice the current population will continue to be willing to export the level of resources as it now does to the United States, much less a great deal more. With regard to equity, it is important to realize that when we elect, by design or default, to have raw materials gathered and processed elsewhere, rather than in the United States, we are, in effect, exporting the associated environmental impacts.

Use wood -- but import raw material needs

In considering this option, questions must be asked about where substitute wood might come from. Substitute wood supplies could be obtained from one or more of several regions that have relatively abundant supplies of wood; 1) Canada; 2) Russia; 3) Central and South America; and 4) Oceania.

Of these regions, only Canada, the Russia, and Central and South America have large areas of well-stocked natural forests with those in the Americas largely in the environmentally sensitive tropics. In addition to these natural forests, there are relatively small but expanding areas of plantation forests around the world that could (and that likely will) supply a part of our future wood needs. Because of issues surrounding the harvest of tropical forests, and because of the environmental stress now felt by the tropical regions, it is unlikely that the natural forests of Central or South America will contribute substantially to the future U.S. demand for wood. Canada could possibly supply more of U.S. needs, though there are signs that production limits are being approached in at least some of Canada's forests. It is the forests of the Russia that are the most likely candidate as a source of supply, and these will undoubtedly be tapped in the future by U.S. manufacturers.

This option may be acceptable as a strategy for achieving some reduction in domestic timber demand. However, the same ethical and economic implications that are connected with increased use of imported, non-wood materials largely apply to this option as well.

Reduce the rate of raw material consumption

When considering the rate of raw material consumption in the United States it is easy to conclude that a reduction in the consumption rate, through taxation, voluntary conservation, or other means, represents a realistic means of reducing pressure on the world's raw materials. Some reduction in domestic per-capita consumption may even be possible, though it is realistically unlikely. Additionally, it is important to remember that the U.S. population is still growing.

An assessment of prospects for reducing raw material consumption globally shows little likelihood of reduced raw material use. A number of factors, in fact, suggest that the future will bring significant increases in demand for raw materials of all kinds; among these factors are:

1. A likely near doubling of world population in the next 70 to 100 years.

2. A desire on the part of large segments of the world population for greater, rather than lesser, consumption of durable goods (e.g., Eastern Europe).

3. The fact that even modest increases in the standard of living for people now without adequate shelter and other basic necessities will translate to relatively larger increases in raw material demand.

It can be argued that improved technology leading to more efficient processing and increased recycling will serve to reduce future raw material demand. Gains in both areas are likely. In order to even maintain consumption of raw materials at current levels, however, it will be necessary to halve current per capita consumption, assuming a doubling of world population.

It is important to recognize that the United States uses vast quantities of industrial raw materials each year, and that the United States is a net importer of almost all important materials. Materials on the net import list include most metals, petrochemicals, and wood and wood products of all kinds. It is important as well to realize that world populations continue to grow at a rapid rate. Barring catastrophe, the world population will roughly double in the next 100 years. Similarly, demand for shelter and other goods are likely to at least double. Given this situation, is difficult to imagine that Americans would rationally seek to largely import future raw material needs, when environmentally responsible and sustainable options are available domestically. Beyond the issue of rationality is the fundamental question of whether a U.S. policy designed to create a pristine domestic environment through continued and increasing reliance on other regions of the world for heavy industrial activity is ethically and morally defensible.

Table 6 - Per Capita Consumption of Key Raw Materials U.S. and Western Europe vs. World Average - 1998

	Average Per Capita Consumption (kg)			Average Per Capita Consumption Compared To World Average	
Raw Material	U.S.	W.Eur.	World	U.S.	W.Europe
Wood*	2.27	0.81	0.55	4.1x	1.5x
Steel	418	360	132	3.2x	2.7x
Aluminum	25.5	14.5	3.7	6.9x	3.9x
Cement	381	485	253	1.5x	1.9x
Plastics	154.2	102.6	24.2	6.4x	4.2x

Wood quantities in cubic meters
Source: Personal communication with Jim Bowyer

Specifically with respect to forests and the harvest of timber, it is perhaps easy to conclude, in the absence of global or comprehensive thinking, that domestic harvest levels should be significantly reduced. Consideration of raw material options, and associated environmental impacts logically leads, however, to a much different conclusion. Wood is a critically important part of the U.S. raw material picture. Each year Americans consume roughly as much wood by weight as all metals, all plastics, and portland cement combined.

Moreover, the energy consumption associated with harvesting and processing of wood is substantially less than for potential substitute materials. Thus, if Americans choose, by default or otherwise, to produce far less timber than is possible on a perpetual yield basis, that decision leads to basically three alternatives:
1) use other raw materials (which will require a massive substitution of materials that are already largely imported and which will result in more serious global environmental consequences than the harvesting of timber);

2) use wood, but import our needs (thereby increasing the U.S. trade imbalance and stimulating timber harvest in places such as Russia or the environmentally sensitive Amazon region); or

3) drastically reduce our consumption of raw materials generally (through a reduction in production of everything from homes to furniture and/or increased emphasis upon recycling).

There is clearly much to be done in recycling our wastes and tremendous benefits to be gained from increased recycling. Though increased recycling will directly impact demand for virgin raw materials, the effects on current levels of demand may be modest.

When seeking to protect the environment, the lack of a global perspective can and does lead to what amounts to irresponsible and unethical regional environmentalism. We need to totally rethink our positions and approach to environmental issues, with global and comprehensive thinking and rational consideration of options key components of a new approach. To do otherwise would ill serve both the world's environment and its people.

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"**Green Spirit – Trees Are the Answer**"

By Dr. Patrick Moore, GreenSpirit and co-founder of Greenpeace
www.GreenSpirit.com

The forest industry stands accused of some very serious crimes against the environment. It is charged with the extinction of tens of thousands of species, the deforestation of vast areas of the Earth, and the total and irreversible destruction of the ecosystem. If I were one of the urban majority, and I thought the forest industry was causing the irreversible destruction of the environment I wouldn't care how many jobs it created or how many communities depended on it, I would be against it.

I have spent the last 15 years trying to understand the relationship between forestry and the environment, to separate fact from fiction, myth from reality. Since 1991 I have chaired the Sustainable Forestry Committee of the Forest Alliance of British Columbia. This has provided an ideal opportunity to explore all aspects of the subject. This presentation is the synthesis of what I have learned. But first, let me give you a little background.

I was born and raised in the tiny fishing and logging village of Winter Harbour on the northwest tip of Vancouver Island, in the rainforest by the Pacific. I didn't realize what a blessed childhood I'd had, playing on the tidal flats by the salmon spawning streams in the rainforest, until I was shipped away to boarding school in Vancouver at age fourteen. I eventually attended the University of BC studying the life sciences: biology, forestry, genetics; but it was when I discovered ecology that I realized that through science I could gain an insight into the mystery of the rainforest I had known as a child. I became a born-again ecologist, and in the late 1960's, was soon transformed into a radical environmental activist. I found myself in a church basement in Vancouver with a like-minded group of people, planning a protest campaign against US hydrogen bomb testing in Alaska. We proved that a somewhat rag-tag looking group of activists could sail a leaky old halibut boat across the north Pacific ocean and change the course of history. By creating a focal point for opposition to the tests we got on national TV news in Canada and the US, building a ground swell of opposition to nuclear testing in both countries. When that bomb went off in November 1971 it was the last hydrogen bomb ever detonated on planet Earth. Even though there were four more tests planned in the series, President Nixon canceled them due to the public opposition. This was the birth of Greenpeace.

Flushed with victory and knowing we could bring about change by getting up and doing something, we were welcomed into the longhouse of the Kwakiutl Nation at Alert Bay near the north end of Vancouver Island where we were made brothers of the tribe because they believed in what we were doing. This began the tradition of the Warriors of the Rainbow, after a Cree legend that said that one day when the skies are black and the birds fall dead to the ground and the rivers are poisoned, people of all races, colors and creeds will join together to form the Warriors of the Rainbow to save the Earth from

environmental destruction. We named our ship the Rainbow Warrior and I spent fifteen years on the front lines of the eco-movement as we evolved from that church basement into the world's largest environmental activist organization.

Next we took on French atmospheric nuclear testing in the South Pacific. They proved a bit more difficult that the US Atomic Energy Administration. But after many years of protest voyages and campaigning, involving loss of life on our side, they were first driven underground and eventually stopped testing altogether.

In 1975 we set sail deep-sea into the North Pacific against the Soviet Union's factory whaling fleets that were slaughtering the last of the sperm whales off California. We put ourselves in front of the harpoons in little rubber boats and made it on CBS, ABC and NBC evening news. That really put Greenpeace on the map. In 1979 the International Whaling Commission banned factory whaling in the North Pacific and soon it was banned in all the world's oceans.

In 1978 I was arrested off Newfoundland for sitting on a baby seal without permission of the Canadian Minister of Fisheries. I was trying to shield it from the hunter's club. I was convicted; under the draconianly named Seal Protection Regulations that made it illegal to protect seals. In 1984 baby seal skins were banned from European markets, effectively ending the slaughter.

Can you believe that in the early 1980's, the countries of Western Europe were pooling their low and medium level nuclear wastes, putting them in thousands of oil drums, loading them on ships and dumping them in the Atlantic ocean as a way of "disposing" of the wastes. In 1984 a combined effort by Greenpeace and the UK Seafarer's Union put an end to that practice for good.

By the mid-1980's Greenpeace had grown from that church basement to an organization with an income of over US$100 million per year, offices in 21 countries and over 100 campaigns around the world, now tackling toxic waste, acid rain, uranium mining and drift net fishing as well as the original issues. We had won over a majority of the public in the industrialized democracies. Presidents and prime ministers were talking about the environment on a daily basis.

For me it was time to make a change. I had been against at least three or four things every day of my life for 15 years; I decided I'd like to be in favor of something for a change. I made the transition from the politics of confrontation to the politics of building consensus. After all, when a majority of people decide they agree with you it is probably time to stop hitting them over the head with a stick and sit down and talk to them about finding solutions to our environmental problems.

All social movements evolve from an earlier period of polarization and confrontation during which a minority struggles to convince society that its cause it is true and just, eventually followed by a time of reconciliation if a majority of the population accepts the values of the new movement. For the environmental movement this transition began to

occur in the mid-1980s. The term sustainable development was adopted to describe the challenge of taking the new environmental values we had popularized, and incorporating them into the traditional social and economic values that have always governed public policy and our daily behavior. We cannot simply switch to basing all our actions on purely environmental values. Every day 6 billion people wake up with real needs for food, energy and materials. The challenge for sustainability is to provide for those needs in ways that reduce negative impact on the environment. But any changes made must also be socially acceptable and technically and economically feasible. It is not always easy to balance environmental, social, and economic priorities. Compromise and co-operation with the involvement of government, industry, academia and the environmental movement is required to achieve sustainability. It is this effort to find consensus among competing interests that has occupied my time for the past 15 years.

Coming from British Columbia, born into a third generation forest industry family, and educated in forestry and ecology, it made sense that I would focus on the challenge of defining sustainable forestry. After all, forests are by far the most important environment in British Columbia and they are also by far the most important basis of economic wealth for families and communities.

I soon discovered that trees are just large plants that have evolved the ability to grow long wooden stems. They didn't do that so we could cut them up into lumber and grind them into pulp; they actually had only one purpose in mind and that was to get their needles or leaves higher up above the other plants where the tree could then monopolize the Sun’s energy for photosynthesis. When foresters create openings or clearcuts when they harvest trees, one of the reasons for doing it is so the new trees growing back can be in full sunlight. Trees are basically plants that want to be in the sun. If trees wanted to be in the shade they would have been shrubs instead, they would not have spent so much time and energy growing long wooden stems.

Forests are home to the majority of living species; not the oceans, nor the grasslands, nor the alpine areas, but ecosystems that are dominated by trees. There is a fairly simple reason for this. The living bodies of the trees themselves create a new environment that would not be there in their absence. Now the canopy above is home to millions of birds and insects where there was once only thin air. And beneath the canopy, in the interior of the forest, the environment is now protected from frost and sun and wind. This, in combination with the food provided by the leaves, fruits and even the wood of the trees, creates thousands of new habitats into which new species can evolve, species that could never have existed if it were not for the presence of the living trees.

This gives rise to the obvious concern that if the trees are cut down the habitats or homes will be lost and the species that live in them will die. Indeed, in 1996 the World Wildlife Fund, at a media conference in Geneva, announced that 50,000 species are going extinct each year due to human activity. And the main cause of these 50,000 extinctions, they said, is commercial logging. The story was carried around the world by

Associated Press and other media and hundreds of millions of people came to believe that forestry is the main cause of species extinction.

During the past three years I have asked the World Wildlife Fund on many occasions to please provide me with a list of some of the species that have supposedly become extinct due to logging. They have not offered up a single example as evidence. In fact, to the best of our scientific knowledge, no species has become extinct in North America due to forestry.

Where are these 50,000 species that are said to be going extinct each year? They are in a computer model in Edward O. Wilson's laboratory at Harvard University. They are electrons on a hard drive, they have no Latin names, and they are in no way related to any direct field observations in any forest.

It's not as if humans have never caused the extinction of species; they have and the list is quite long. There are three main ways by which humans cause species extinction. First, and perhaps most effective, is simply killing them all, with spears, clubs, and rifles. The passenger pigeon, the dodo bird, the Carolinian parakeet, and back in time, the mammoths and mastodons, are all examples of species that were simply wiped out either for food or because they were pests.

Secondly, the vast clearance of native forests for agriculture. There may have been an orchid in that valley bottom that was found nowhere else. If all the forest is cleared away, burned, plowed, and planted with corn the orchid may disappear forever.

Third, and actually the major cause of species extinction by humans during the past 200 years is the introduction of exotic predators and diseases. In particular, when Europeans colonized Australia, New Zealand, and the other Pacific Islands, including Hawaii, they brought with them rats, cats, foxes, pigs, sheep, goats, chickens and cows, and all the other domestic animals and plants, including their diseases. This resulted in the extinction of hundreds of ground dwelling marsupials and flightless birds, as well as many other species.

We have long lists of species that have become extinct due to these three types of human activity but we do not know of a single species that has become extinct due to forestry.

The spotted owl is one of the many species that was never threatened with extinction due to forestry, and yet in the early 1990's, 30,000 loggers were thrown out of work in the US Pacific Northwest due to concern that logging in the National Forests would cause the owl’s extinction. Since that time, in just a few short years, it has been shown by actual field observations that there are more than twice as many spotted owls in the public forests of Washington state than were thought to be theoretically possible when those loggers lost their jobs. More importantly, it is now evident that spotted owls are capable of living and breeding in landscapes that are dominated by second growth forests. Over 1000 spotted owls have been documented on Simpson Timber's half

million acre second growth redwood forests in northern California. And yet, in reporting on the settlement of the Headwaters redwood forests nearby, the New York Times described the spotted owl as a "nearly extinct species" despite the fact that there are tens of thousands of them thriving in the forests of the Pacific Northwest.

So the general public is being given the impression, by supposedly reputable sources such as the New York Times and National Geographic that forestry is a major cause of species extinction when there is actually no evidence to support that position.

There is a reason why forestry seldom, if ever, causes species to become extinct. We tend to think that forests need our help to recover after destruction, whether by fire or logging. Of course this is not the case. Forests have been recovering by themselves, without any assistance, from fires, volcanoes, landslides, floods and ice ages, ever since forests began over 350 million years ago. Consider the fact that 10,000 years ago all of Canada and Russia were covered by a huge sheet of ice under which nothing lived, certainly not trees. Today, Canada and Russia account for 30 percent of all the forests on earth, grown back from bare rock. Go to Alaska where the glaciers are retreating due to the present warming trend, and you will see that from the moment the rocks are laid bare to the sun, it is only 80 years until a thriving new ecosystem is growing there, including young trees.

It follows from this that every species which lives in the forest must be capable of re-colonizing areas of land that are recovering from destruction. Indeed, forest renewal is the sum total of all the individual species returning to the site, each in their turn, as the forest grows back. In ecology, this is known as dispersal, the ability to move from where you are and to inhabit new territory as it becomes available. In humans, we call this migration, but it is the same thing. Dispersal is an absolute requirement for natural selection and the survival of species. No species could exist if it were not capable of dispersal. Therefore, so long as the land is left alone after the forest is destroyed, the forest will recover and all the species that were in it will return.

Fire has always been the main cause of forest destruction, or disturbance, as ecologists like to call it in order to use a more neutral term. But fire is natural, we are told, and does not destroy the forest ecosystem like logging, which is unnatural. Nature never comes with logging trucks and takes the trees away. All kinds of rhetoric is used to give the impression that logging is somehow fundamentally different from other forms of forest disturbance. There is no truth to this. It is true that logging is different from fire, but fire is also very different from a volcano, which in turn is very different from an ice age. In fact, no two fires are ever the same. These are differences of degree, not kind. Forests are just as capable of recovering from destruction by logging as they are from any other form of disturbance. All that is necessary for renewal is that the disturbance is ended, that the fire is out, that the volcano stops erupting, that the ice retreats, or that the loggers go back down the road and allow the forest to begin growing back, which it will begin to do almost immediately.

If you don’t think fire destroys the ecosystem, you should try counting the species left alive after a severe forest fire. A hot wildfire in a dry pine forest not only kills every living thing above the ground, it also burns the soil, killing the roots and seeds, basically sterilizing the site and leaving it lifeless. Yet it is often only a few years after such a fire that the land is alive with grasses and flowers again. Everywhere in the world there are pioneer plants which produce seeds with fluff on them. They can carry for 100 miles on a light breeze, looking for a place to settle in the open sun and germinate. A recently burned forest is a perfect place for these seeds; the shade of the trees is gone allowing full sun to reach the ground, and the ash from the fire provides nutrients for new growth.

In Yellowstone National Park, fire burned over one million acres in 1988. Even after eight years, the most severely burned areas off the park have very little vegetation growing back. This is partly due to the very short summers at 8000 foot elevations, but also because extremely hot fires not only remove nitrogen from the soil but also vaporize the phosphorous, thus depleting the soil of two of the three most essential nutrients. While nitrogen is returned to the soil relatively quickly through the action of nitrogen fixing bacteria, phosphorous must be weathered from the minerals in the soil. This may take 50 or 100 years but eventually the soil will heal and a new forest will emerge.

In some areas of the Yellowstone fire the soil was wet at seepage sites, and even though everything above the ground was killed, the seeds of the pine and other species survived in the soil. Here a new forest is growing back quickly and the new pines will produce seeds in 10 or 15 years. These seeds will gradually march across the landscape, reforesting the land where the seeds were burned.

In order to witness total destruction by nature, there is no better place to go than Mount St. Helens in Washington State. When this volcano blew up in 1980 it destroyed over 150,000 acres of forest, much of it old growth growing on the flanks of the mountain. Interestingly, the forest that was destroyed was in two distinct jurisdictions. Part of it was federal public lands, the Gifford Pinchot National Forest, controlled from Washington DC. Part of it was private timberlands owned by the Weyerhaeuser Corp. based in Tacoma, Washington.

The US government re-designated the portion of their land that was destroyed the Mount St. Helen’s National Volcanic Monument, "where nature will be permitted to recover, unaided by human beings, for the discovery of science." 18 years after the initial blast the Volcanic Monument still looks like a desert. The dead trees are still lying where they were blown over or had their tops blown off by the initial blast. A thick layer of volcanic ash then settled out, making a very sterile seed bed for seeds blowing in on the wind. Only a few hardy nitrogen-fixing plants, such as slide alder, have been able to take root in the poor soil.

Weyerhaeuser took a completely different approach. First they salvage logged 85,000 three-bedroom homes worth of timber from their land in two years following the eruption. By bringing in heavy equipment and dragging the big logs around, they broke

through the volcanic ash everywhere, exposing the fertile soil beneath it. This created a much more fertile seed bed for seeds blowing in on the wind, a classic case of site disturbance, or site preparation as it's called when we do it on purpose, increasing the fertility of the site. Something every farmer who plows their fields knows. Then they planted two-year-old Douglas fir seedlings that were advanced enough to get their roots down through the ash into the healthy soil beneath. Today these seedlings are over 20 feet tall and will produce a commercial crop of timber in the year 2026. The contrast between the National Volcanic Monument and Weyerhaeuser's land offers proof that a couple of interventions by people can make a dramatic difference to the way in which an ecosystem recovers after a natural disaster such as a volcano.

My grandfather, Albert Moore, clearcut large areas of coastal rainforest on northern Vancouver Island in the 1930s and '40s. He didn't know the word ecology, and the word biodiversity would not be invented for another 50 years. And you can be sure they weren't talking about the environment at the breakfast table on a dark, cold winter morning before they went out and worked hard six or seven days a week, to get the big timber down to the sea, sometimes taking half the soil with it due to the primitive logging methods of the day. Today these areas are covered in lush new forest in which bears, wolves, cougar, deer, owls, eagles ravens, and hawks have found a home again. These species have dispersed back to the site as the environment became suitable for them again.

We have all been taught since we were children that you should not judge a book by its cover, in other words that beauty is only skin deep. Yet we are still easily tricked into thinking that if we like what we see with our eyes, it must be good, and if we don't like what we see with our eyes, it must be bad. We tend to link our visual impression of what is beautiful and what is ugly with our moral judgment of what is right and wrong. The Sierra Club says, "You don't need a professional forester to tell if a forest is mismanaged - if a forest appears to be mismanaged, it is mismanaged." They want you to believe that the ugly appearance of a recently harvested forest is synonymous with permanent destruction of the environment. And yet, the unsightly sea of stumps is not nuclear waste or a toxic discharge, it is 100 percent organic, and will soon grow back to a beautiful new forest again. All the same, the fact that recently harvested areas of forest appear ugly to our eyes makes for very effective images in the hands of anti-forestry activists.

Taken in the right light, clearcuts can actually looked quite pretty. Think, for just a moment, of the clearcut as a temporary meadow. It is temporary because it will not stay that way; it will grow back into a new forest a gain. But it is meadow-like for the time being because the trees have been removed and now the sun can reach directly to the ground, fostering the growth of plants that could never grow in the shade of the trees. We never think of meadows and clearcuts in the same breath. After all, meadows are lovely places which you can walk across easily in the open sun, find a dry smooth place, lay your picnic blanket down and have a lovely afternoon. Clearcuts, on the other hand, are ugly places full of twisted, broken wood and stumps, and there is no nice smooth, dry place to put down a picnic blanket. These distinctions have nothing to do with

biodiversity or science, they are purely matters of human aesthetics. Meadows are actually small deserts where it is too dry for trees to grow. That's why they are so smooth. Meadows are only capable of supporting drought-resistant grasses and herbs. Clearcuts, on the other hand, can support a wider variety of grasses and herbs, as well as woody shrubs and trees. Within a year or two of harvesting, clearcuts will generally have far higher biodiversity than meadows. And within a decade or so they begin to look just as good too.

In the space of a few short years, a clearcut that is very ugly to look at can be transformed into a beautiful sea of blossoms growing from seeds that blow in on the wind after fire. Was the clearcut bad when it looked ugly? Is it good now that it looks beautiful? The fact is, it is a serious mistake to judge the environmental health of the land simply by looking at it from an aesthetic perspective.

The way we think the land should look often has more to do with personal and social values than anything to do with biodiversity or science. We tend to idealize nature, as if there is some perfect state that is exactly right for a given area of land. There are actually thousands of different combinations of species at all different stages of forest growth that are perfectly natural and sustainable in their own right. There is nothing better about old trees than there is about young trees. Perhaps the ideal state is to have forests of all ages, young, medium, and old in the landscape. This will provide the highest diversity of habitats and therefore the opportunity for the largest number of species to live in that landscape.

Deforestation is a difficult subject for the forest industry because it certainly looks deforested when all the trees are cut down in a given area. Unfortunately for the public's understanding of this term, cutting the trees down is not sufficient in itself to cause deforestation. What really matters is whether the forest is removed permanently, or reforested with new trees. But the unsightly nature of a recently harvested forest, even if it is going to grow back eventually, can easily give the impression of environmental destruction and deforestation.

On the other hand, a rural scene of farmlands and pasture looks pleasant to the eye and is neat and tidy compared to the jumble of woody debris in a clearcut. Yet it is the farm and pasture land that truly represents deforestation. It has been cleared of forest long ago and the forest has been permanently replaced by food crops and fodder. More important, if we stopped plowing the farmland for just 5 years in a row, seeds from the surrounding trees would blow in and the whole area would be blanketed in new tree seedlings. Within 80 years you would never know there had been a farm there. The entire area would be reforested again, just by leaving it alone. That's because deforestation is not an event, that just happens and then is over forever. Deforestation is actually an ongoing process of continuous human interference, preventing the forest from growing back, which it would if it was simply left alone. The most common form of interference with forest renewal is what we call agriculture. That's why deforestation is seldom caused by forestry, the whole intention of which is to cause reforestation. Deforestation is nearly always caused by friendly farmers growing our food, and by nice

carpenters building our houses, towns, and cities. Deforestation is not an evil plot, it is something we do on purpose in order to feed and house the 6 billion and growing human population.

The scene of cattle grazing in a lush green pasture is pleasant to the eye. Yet it wasn't that many years ago when McDonald's restaurants, bowing to heavy public pressure due to concern about deforestation in Central and South America to grow cows for hamburger, promised they would never buy another tropical cow. It was apparently fine, however, to continue buying cows grown in North America. Is this because we have a higher standard for deforestation in North America then they do in Latin America? No, it is a complete double standard. Deforestation is deforestation regardless of where it is practiced. The forest is completely removed and replaced with a monoculture pasture on which exotic animals that were not present in the original forest graze.

If you go to Australia, you'll find that most people think the worst deforestation is occurring in Malaysia and Indonesia, when in fact about 40 percent of Australia's native forest has been destroyed for agriculture. The same is true in United States; about 40 percent of the original forests have been converted to farming. We always like to think that the bad people are long way away and speak another language. We often fail to realize that we are doing exactly the same things we accuse them of doing.

And if you don't eat meat, you must eat vegetables in which case you will cause the creation of monoculture cabbage plantations and other such food crops where there once were forests. Now it's true that cabbages are prettier than stumps, unfortunately true for the public's understanding of deforestation. Birds and insects are not welcome in areas of monoculture crops. If they wish to avoid being shot or poisoned they had best retreat into a forest nearby where they are more likely to be left alone.

Don't get me wrong, I'm not against farming. We all have to eat. But it is interesting to note that the three things we can do to prevent further loss of the world's forests have nothing to do with forestry. These three things are:

1. Population management. The more people there are in this world the more mouths there are to feed and the more forest we must clear to feed them. This is a simple fact of arithmetic.

2. Intensive agricultural production. Over the last 50 years in North America we have learned to grow five times as much food on the same area of land, due to advances in genetics, technology, and pest control. If we had not made these advances we would either have to clear away five times as much forest, which is not available anyway, or more likely we simply could not grow as much food. Again, it is a matter of arithmetic. The more food we can grow on a given piece of land, the less forest will be lost to grow it.

3. Urban densification. There is actually only one significant cause of continuing forest loss in United States; 200 cities sprawling out over the landscape and permanently

converting forest and farm to pavement. If we would design our cities for a higher density, more livable environment, we would not only save forests, we would also use less energy and materials.

The sight of large bales of freshly mown hay placed evenly across a farm field is attractive to our eye in the late afternoon sun. The light and form of the hay bales is pretty to us, we tend to judge landscapes by how good a postcard they would make. The bales of hay are actually just large lumps of dead cellulose laying on a deforested piece of land. There is a very little biodiversity in a hayfield, yet it will more often catch the eye than surrounding forest land where biodiversity is high.

The same is true of the sight of a field of flowers in bloom. The bold, beautiful colors of a monoculture tulip plantation, sprayed regularly with pesticides to keep the petals perfect for the florist's shop, are attractive to our eye. We hardly notice the gray-green monotone of the native forest nearby, containing tens of species of native trees, hundreds of species of native birds, insects, animals and plants.

We need to give the public a new pair of eyes with which to see the landscape, to get beyond the immediate visual impression and to understand a little more about science, ecology, and biodiversity. This is perhaps the single most important task for the forest industry. The lesson is not a difficult one, but it is not intuitively obvious to people. They simply tend to judge the health of the environment with the same eyes they use to judge the aesthetics of the land. If a person strongly believes that forestry is bad because it is ugly, no amount of technical and scientific information will cause them to change their mind. First they must understand that the look of the land is not sufficient, in itself, to make judgments about ecology.

A large parking lot is the ultimate in deforestation. The automobile is arguably the most destructive technology ever invented by the human species. Especially when you consider the black stuff that is usually found beneath them, asphalt. Why is it legal to take the toxic waste from oil refineries and spread it all over the earth, killing every living thing, so that cars and trucks may roam about freely? When crude oil is put into an oil refinery, by the hundreds of millions of barrels a day, we take the gasoline off the top to run the cars, then the diesel oil to run the trucks and trains. Near the bottom we extract the bunker C crude oil which is used to fire the boilers on big ships as they cross the sea. But in the very bottom, left over, is this black, gooey crud. If you took it to a licensed landfill in a truck they would turn you away at the gate because it’s toxic, hazardous, and carcinogenic to boot. It is illegal to bury it, but perfectly legal to load it into huge fleets of trucks and dump it directly onto the earth in a thin layer, killing every living thing. This is the world's largest case of legalized toxic dumping, and we turn a blind eye to it because of our love affair with the automobile and our dependence on the transportation infrastructure it provides.

Think of a biodiversity on a scale from 0 to 100. You would have to admit that the parking lot is pretty close to 0. There might be a blade of grass poking through in the odd place. A farm field or pasture might rate 5 or 10, compared to the original forest that

was cut down, burned and planted to make the farm. Forestry, the way it is practiced today throughout most of North America, is 96, 98, 100, even 102. Because in some landscapes forest management results in a wider range of age classes and ecosystem types than would normally occur in the absence of human activity.

All this controversy, political pressure, and near-hysterical rhetoric over a few percent of biodiversity, with the camera lens focused squarely in on the most recent, ugliest, burnt-out clear-cut available, as if it's going to remain that way forever. The real extreme is the parking lot and other areas of deforestation, not the recently cut forest that is soon going to grow back into a beautiful new forest again.

We have to help take the blinkers off people’s eyes, and to give them a better appreciation of the full range of impacts caused by our various activities. When it comes to biodiversity conservation, there is no more sustainable primary industry than forestry.

You would think that since forestry is the most sustainable of all the primary industries, and that wood is without a doubt the most renewable material used to build and maintain our civilization, that this would give wood a lot of green eco-points in the environmental movement's ledger. Unfortunately, this doesn't seem to be the case. Greenpeace has gone before the United Nations Inter-Governmental Panel on Forests, calling on countries to reduce the amount of wood they use and to adopt "environmentally appropriate substitutes" instead. No list of substitutes is provided. The Sierra Club is calling for "zero cut" and an end to all commercial forestry on federal public lands in United States. The Rainforest Action Network wants a 75 percent reduction in wood use in North America by the year 2015. I think it is fair to summarize this approach as "cut fewer trees, use less wood". It is my firm belief, as a lifelong environmentalist and ecologist, that this is an anti-environmental policy. Putting aside, for a moment, the importance of forestry for our economy and communities; on purely environmental grounds the policy of "use less wood" is anti-environmental. In particular, it is logically inconsistent with, and diametrically opposed to, policies that would bring about positive results for both climate change and biodiversity conservation. I will explain my reasoning for this belief:

First, it is important to recognize that we do use a tremendous amount of wood. On a daily basis, on average, each of the 6 billion people on Earth uses 3.5 pounds or 1.6 kilos of wood every day, for a total of 3.5 billion tons per year. So why don't we just cut that in half and save vast areas of forest from harvesting? In order to demonstrate the superficial nature of this apparent logic it is necessary to look at what we are doing with all this wood.

It comes as a surprise to many people that over half the wood used every year is not for building things but for burning as energy. 55 percent of all wood use is for energy, mainly for cooking and heating in the tropical developing countries where 2.5 billion people depend on wood as their primary source of energy. They cannot afford substitutes because most of them make less than $1000 per year. But even if they could afford substitute fuels they would nearly always have to turn to coal, oil, or natural

gas; in other words non-renewable fossil fuels. How are we going to stabilize carbon dioxide emissions from excessive use of fossil fuels under the Climate Change Convention if 2.5 billion people switch from a renewable wood energy to non-renewable fossil fuels? Even in cases where fuelwood supplies are not sustainable at present levels of consumption the answer is not to use less wood and switch to non-renewables. The answer is to grow more trees.

15 percent of the wood used in the world is for building things such as houses and furniture. Every available substitute is non-renewable and requires a great deal more energy consumption to produce. That is because wood is produced in a factory called the forest by renewable solar energy. Wood is essentially the material embodiment of solar energy. Non-renewable building materials such as steel, cement, and plastic must be produced in real factories such as steel mills, cement works, and oil refineries. This usually requires large inputs of fossil fuels inevitably resulting in high carbon dioxide emissions. So, for 70 percent of the wood used each year for energy and building, switching to substitutes nearly always results in increased carbon dioxide emissions, contrary to climate change policy.

30 percent of the wood harvested is used to manufacture pulp and paper mainly for printing, packaging, and sanitary purposes. Fully half of this wood is derived from the wastes from the sawmills which produce the solid wood products for building. Most of the remaining supply is from tree plantation's many of which are established on land that was previously cleared for agriculture. So even if we did stop using wood to make pulp and paper it would not have the effect of "saving" many forests.

Many off you have heard of the idea that we should stop using trees to make paper and use "alternative fibers" such as hemp, kenaf, and cotton. "Tree-free paper" made from "wood-free pulp" would supposedly be better for the environment than paper made from trees. I speak at schools and universities on a regular basis and have found that many young people believe that this is the right approach to improve the environment. I ask them "where are you going to grow the hemp, on Mars? Do you have another continent somewhere that we don't know about? No, the fact is we would have to grow the hemp on this planet, in soil where you could otherwise be growing trees.

Give me an acre of land anywhere on Earth, tell me to grow something there with which I can make paper, that would also be best for biodiversity, and I will plant trees every single time, without exception. It is simply a fact that even the simplest monoculture pine plantation is better for wildlife, birds, and insects than any annual farm crop. It is ridiculous for environmental groups who say their main concern is biodiversity conservation to be advocating the establishment off massive monocultures of annual exotic farm crops where we could be growing trees.

It is therefore clear to me that the policy of "use less wood" is anti-environmental because it would result in increased carbon dioxide emissions and a reduction in forested land. I believe the correct policy is a positive rather a negative one. From an

environmental perspective the correct policy is "grow more trees, and use more wood". This can be accomplished in a number of ways.

First, it is important to place some of the world's forest into permanently protected parks and wilderness reserves where no industrial development occurs. The World Wildlife Fund recommends that 10 percent of the world's forests should be set aside for this purpose. Perhaps it should even be 15 percent. But then the question becomes, how should we manage the remaining 85 to 95 percent of the forest? I believe we should manage it more intensively for higher timber production, keeping in mind the needs of other species in the landscape. By just managing our existing forests better we could dramatically increase the world’s supply of wood. In addition, we should expand the geographic extent of our forests, largely by reforesting areas of land that were previously cleared for agriculture. In particular, huge areas of forest have been cleared for domestic animal production to supply us with meat. A modest reduction in meat consumption would open up large areas of land for reforestation. This would be good for our health as well as the health of the environment.

In the tropical developing countries there is a pressing need for sustainable fuelwood plantations as well as forest plantations to provide timber. We should direct more of our international aid programs towards this end. Relatively modest changes in fiscal and taxation policy could bring about a doubling of global wood supply within 40 years. All that is required is the political will to put these policies in place. But the general public and our political leaders have been confused by the misguided approach towards forestry taken by much of the environmental movement. So long as people think it is inherently wrong to cut down trees we will continue to behave in a logically inconsistent and dysfunctional manner.

I believe that trees are the answer to many questions about our future on this earth. These include - how can we advance to a more sustainable economy based on renewable fuels and materials? How can we improve literacy and sanitation in developing countries while reversing deforestation and protecting wildlife at the same time? How can we reduce the amount of greenhouse gases emitted to the atmosphere, carbon dioxide in particular? How can we increase the amount of land that will support a greater diversity of species? How can we help prevent soil erosion and provide clean air and water? How can we make this world more beautiful and green? The answer is, by growing more trees and using more wood both as a substitute for non-renewable fossil fuels and materials such as steel, concrete, and plastic, and as paper products for printing, packaging, and sanitation.

By far the most powerful tool at our disposal to reduce carbon dioxide emissions from fossil fuel consumption is the growing of trees and the use of wood. Most environmentalists recognize the positive benefits of growing trees to absorb carbon dioxide from the atmosphere. But then they say "don't cut them down or you will undo the good that's been done". This would be true if you simply piled the trees in a heap and lit them on fire. If, however, the wood is used as a substitute for fossil fuels and for building materials whose production consumes fossil fuels, we can dramatically reduce

the consumption of fossil fuels and carbon dioxide emissions. For example, consider a large coal-burning power plant. If we grow trees and use the wood as a substitute for the coal we are able to offset nearly 100 percent of the carbon dioxide emissions from the power plant. That is because sustainable use of wood results in a zero net release of carbon dioxide whereas coal combustion counts for the full 100 percent. If environmentalists would recognize this fact it would inevitably lead them to believe that the answer is in growing more trees and using more wood rather than in reducing our use of this most renewable resource.

To conclude, let me take you back to the rainforest of the West Coast of North America. About 300 feet from my house in downtown Vancouver is Pacific Spirit Park, 2000 acres of beautiful native forest, right in the heart of the city. It is not a botanical garden where people come and prune the bushes and plant tulip bulbs, it is the real thing, a wild west coast rainforest full of Douglas-fir, western red cedar, hemlock, maple, alder and cherry. But people who come by the hundreds each day to walk on the many trails in Pacific Spirit Park would find it hard to believe that all 2000 acres were completely clearcut logged around the turn of the century to feed the sawmills that helped build Vancouver.

The loggers who clearcut Pacific Spirit Park with double-bitted axes and crosscut saws long before the chainsaw was invented didn't know the words ecology or biodiversity any more than my grandfather did on the north end of Vancouver Island. They just cut the timber and moved on to cut more somewhere else. Nothing was done to help restore the land, but it was left alone. It became part of the University of British Columbia Endowment Lands, and was not developed into housing like the rest of Vancouver. It all grew back into a beautiful new forest and in 1989 was declared a regional park.

In Pacific Spirit Park, there are Douglas-firs over four feet in diameter and over 120 feet tall. All of the beauty has returned to Pacific Spirit Park. The fertility has returned to the soil. And the biodiversity has recovered; the mosses, ferns, fungi, liverworts, and all the other small things that are part of a natural forest. There are pileated woodpeckers, barred owls, ravens, hawks, eagles, coyotes and a colony of great blue herons nesting in the second-growth cedar trees. It is a forest reborn, reborn from what is routinely described in the media as the "total and irreversible destruction of the environment". I don't buy that. I believe that if forests can recover by themselves from total and complete destruction, that with our growing knowledge of forest science in silviculture, biodiversity conservation, soils, and genetics; we can ensure that the forests of this world continue to provide an abundant, and hopefully growing, supply of renewable wood to help build and maintain our civilization while at the same time providing an abundant, and hopefully growing, supply of habitat for the thousands of other species that depend on the forest for their survival every day just as much as we do. The fact is, a world without forests is as unthinkable as a day without wood. And it's time that politicians, environmentalists, foresters, teachers, journalists, and the general public got that balance right. Because we must get it right if we are going to achieve sustainability in the 21st century.

"**Conquest of the Land Through Seven Thousand Years**"

By William C. Lowdermilk, formerly Assistant Chief, Soil Conservation Service

PREFACE "Conquest of the Land through 7,000 Years" is Dr. Lowdermilk's personal report of a study he made in 1938 and 1939. Despite changes in names of countries, in political boundaries, and in conservation technology, the bulletin still has significance for all peoples concerned with maintaining and improving farm production.

Dr. Lowdermilk studied the record of agriculture in countries where the land had been under cultivation for hundreds, even thousands, of years. His immediate mission was to find out if the experience of these older civilizations could help in solving the serious soil erosion and land use problems in the United States, then struggling with repair of the Dust Bowl and the Sullied South.

He discovered that soil erosion, deforestation, overgrazing, neglect, and conflicts between cultivators and herdsman have helped topple empires and wipe out entire civilizations. At the same time, he learned that careful stewardship of the earth's resources, through terracing, crop rotation, and other soil conservation measures, has enabled other societies to flourish for centuries.

The Natural Resources Conservation Service has reprinted this bulletin without change to meet the continuing demand from teachers, clergymen, writers, college professors, garden clubs, environmental groups, and service organizations for copies of the report as originally written by Dr. Lowdermilk.

Sometime ago I heard of an old man down on a hill farm in the South, who sat on his front porch as a newcomer to the neighborhood passed by. The newcomer to make talk said, "Mister, how does the land lie around here?" The old man replied, "Well I don't know about the land a-lying; it's these real estate people that do the lying."

In a very real sense the land does not lie; it bears a record of what men write on it. In a larger sense a nation writes its record on the land, and a civilization writes its record on the land a record that is easy to read by those who understand the simple language of the land. Let us read together some of the records that have been written on the land in the westward course of civilization from the Holy Lands of the Near East to the Pacific coast of our own country through a period of some 7,000 years.

Records of mankind's struggles through the ages to find a lasting adjustment to the land are found written across the landscapes as "westward the course of empire took its way." Failures are more numerous than successes, as told by ruins and wrecks of works along this amazing trail. From these failures and successes we may learn much of profit and benefit to this young Nation of the United States as it occupies a new and bountiful continent and begins to set up house for a thousand or ten thousand years -- yea, for a boundless future.

Freedom Bought and Sold for Food

Pearl Harbor, like an earthquake, shocked the American people to a realization that we are living in a dangerous world dangerous for our way of life and for our survival as a people, and perilous for the hope of the ages in a government of the people, by the

people, and for the people. Why should the world be dangerous for such a philanthropic country as ours?

The world is made dangerous by the desperation of peoples suffering from privations and fear of privations, brought on by restrictions of the exchange of the good and necessary things of Mother Earth. Industrialization has wrought in the past century far-reaching changes in civilization, such as will go on and on into our unknown future.

Raw materials for modern industry are localized here and there over the globe. They are not equally available to national groups of peoples who have learned to make and use machines. Wants and needs of food and raw materials have been growing up unevenly and bringing on stresses and strains in international relations that are seized upon by ambitious peoples and leaders to control by force the sources of such food and raw materials Wars of aggression, long and well-planned, take place so that such materials can be obtained.

These conflicts are not settled for good by war. The problems are pushed aside for a time only to come back in more terrifying proportions at some later time. Lasting solutions will come in another way. We can depend on the reluctance of peoples to launch themselves into war, for they go to war because they fear something worse than war, either real or propagandized.

A just relation of peoples to the earth rests not on exploitation, but rather on conservation not on the dissipation of resources, but rather on restoration of the productive powers of the land and on access to food and raw materials. If civilization is to avoid a long decline, like the one that has blighted North Africa and the Near East for 13 centuries, society must be born again out of an economy of exploitation into an economy of conservation.

We are now getting down to fundamentals in this relationship of a people to the land. My experience with famines in China taught me that in the last reckoning all things are purchased with food. This is a hard saying; but the recent world-wide war shows up the terrific reach of this fateful and awful truth. Aggressor nations used the rationing of food to subjugate rebellious peoples of occupied countries. For even you and I will sell our liberty and more for food, when driven to this tragic choice. There is no substitute for food.

Seeing what we will give up for food, let us look at what food will buy for money is merely a symbol, a convenience in the exchange of the goods and services that we need and want. Food buys our division of labor that begets our civilization.

Not until tillers of soil grew more food than they themselves required were their fellows released to do other tasks than the growing of food that is, to take part in a division of labor that became more complex with the advance of civilization.

True, we have need of clothing, of shelter, and of other goods and services made possible by a complex division of labor, founded on this food production, when suitable raw materials are at hand. And of these the genius of the American people has given us more than any other nation ever possessed. They comprise our American standard of living. But these other good things matter little to hungry people as I have seen in the terrible scourges of famine.

Food comes from the earth. The land with its waters gives us nourishment. The earth rewards richly the knowing and diligent but punishes inexorably the ignorant and slothful. This partnership of land and farmer is the rock foundation of our complex social structure.

In 1938, in the interests of a permanent agriculture and of the conservation of our land resources, the Department of Agriculture asked me to make a survey of land use in olden countries for the benefit of our farmers and stockmen and other agriculturists in this country. This survey took us through England, Holland, France, Italy, North Africa, and the Near East. After 18 months it was interrupted by the outbreak of war when Germany invaded Poland in September 1939. We were prevented from continuing the survey through Turkey, the Balkan States, southern Germany, and Switzerland as was originally planned. But in a year and a half in the olden lands we discovered many things of wide interest to the people of America.

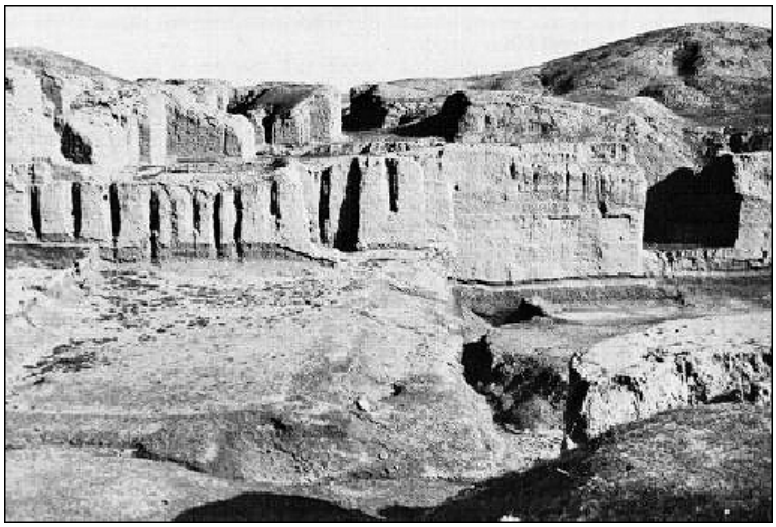

FIGURE 1.Ruins of Kish, one of the world's most important cities 6,000 years ago. Recently archaeologists excavated these ruins from beneath the desert sands of Mesopotamia.

Graveyard of Empires

We shall begin our reading of the record as it is written on the land in the Near East. Here, civilization arose out of the mysteries of the stone age and gave rise to cultures that moved eastward to China and westward through Europe and across the Atlantic Ocean to the Americas.

We are daily and hourly reminded of our debt to the Sumerian peoples of Mesopotamia whenever we use the wheel that they invented more than 6,000 years ago. We do homage to their mathematics each time we look at the clock or our watches to tell time divided into units of 60.

Moreover, our calendar in use today is a revision of the method the ancient Egyptians used in dividing the year. We inherit the experience and knowledge of the past more than we know.

Agriculture had its beginning at least 7,000 years ago and developed in two great centers the fertile alluvial plains of Mesopotamia and the Valley of the Nile. We shall leave the interesting question of the precise area in which agriculture originated to the archaeologists. It is enough for us to know that it was in these alluvial plains in an arid climate that tillers of soil began to grow food crops by irrigation in quantities greater than their own needs. This released their fellows for a division of labor that gave rise to what we call civilization. We shall follow the vicissitudes of peoples recorded on the land, as nations rose and fell in these fateful lands.

A survey of such an extensive area in the short time of 2 years called for simple but fundamental methods of field study. With the aid of agricultural officials of other countries, we hunted out fields that had been cultivated for a thousand years the basis of a permanent agriculture. Likewise, we tried to find the reasons why lands formerly cultivated had been wasted or destroyed, as a warning to our farmers and our city folks of a possible similar catastrophe in this new land of America. A simplified method of field study enabled us to examine large areas rapidly.

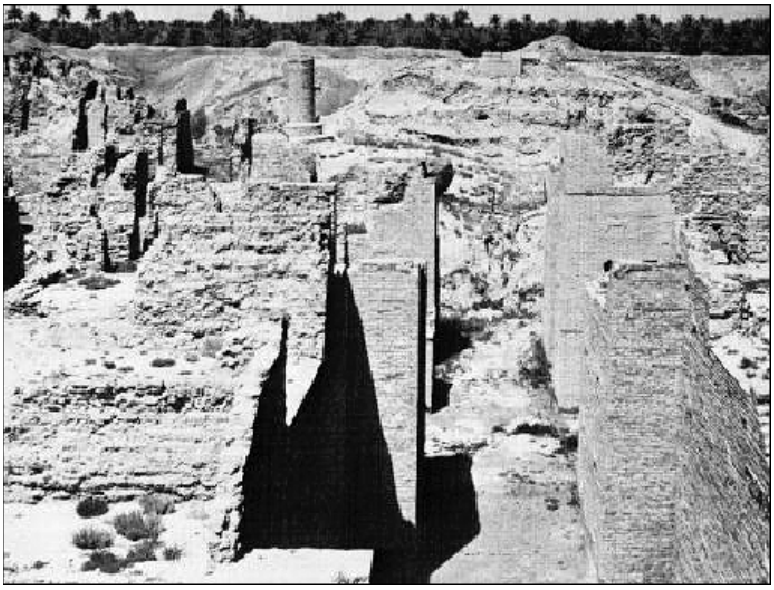

FIGURE 2.Ruins of the famous stables of Nebuchadnezzar in Babylon built during the sixth century B.C. Babylon died and was buried by the desert sands, not because it was sacked and razed but because the irrigation canals that watered the land that supported the city were permitted to fill with silt.

In the Zagros Mountains that separate Persia from Mesopotamia, shepherds with their flocks have lived from time immemorial, when "the memory of man runneth not to the contrary." From time to time they have swept down into the plain to bring devastation

and destruction upon farming and city peoples of the plains. Such was the beginning of the Cain and Abel struggle between the shepherd and the farmer, of which we shall have more to say.

At Kish, we looked upon the first capital after the Great Flood that swept over Mesopotamia in prehistoric times and left its record in a thick deposit of brown alluvium. The layer of alluvium marked a break in the sequence of a former and a succeeding culture, as recorded in artifacts. Above the alluvium deposits is the site of Kish (fig. 1).

At the ruins of mighty Babylon we pondered the ruins of Nebuchadnezzar's stables (fig. 2), adorned by animal figures in bas-relief. We stood subdued as though at a funeral as we recalled how this great ruler of Babylon had boasted:

That which no king before had done, I did . . . A wall like a mountain that cannot be moved, I builded . . . great canals I dug and lined them with burnt brick laid in bitumen and brought abundant waters to all the people . . . I paved the streets of Babylon with stone from the mountains . . . magnificent palaces and temples I have built . . . Huge cedars from Mount Lebanon I cut down . . . with radiant gold I overlaid them and with jewels I adorned them.

Then came to mind the warnings of the Hebrew prophets that were thundered against the wicked city. They warned that Babylon would become "A desolation, a dry land, and a wilderness, a land wherein no man dwelleth. . . And wolves shall cry in their castles, and jackals in the pleasant places." Believe it or not, the only living thing that we saw in this desolation that once was Babylon was a lean gray wolf, shaking his head as if he might have a tick in his ear, as he loped to his lair in the ruins of one of the seven wonders of the ancient world the Hanging Gardens of Babylon where air conditioning was in use 2,600 years ago.

Mesopotamia, the traditional site of the Garden of Eden, out of which come the stories of the Flood, of Noah and the Ark, of the "Tower of Babel" and the confusion of tongues, of the Very furnace which we found still burning today, is jotted full of records of a glorious past, of dense populations, and of great cities that are now ruins and desolation. For at least 11 empires have risen and fallen in this tragic land in 7,000 years. It is a story of a precarious agriculture practiced by people who lived and grew up under the threat of raids and invasions from the denizens of grasslands and the desert, and of the failure of their irrigation canals because of silt.

Agriculture was practiced in a dry climate by canal irrigation with muddy water from the Tigris and Euphrates Rivers. This muddy water was the undoing of empire after empire. As muddy river waters slowed down, they choked up the canals with silt. It was necessary to keep this silt out of the canals year after year to supply life-giving waters to farm lands and to cities of the plain.

As populations grew, canals were dug farther and farther from the rivers. This great system of canals called for a great force of hand labor to keep them clean of silt. The

rulers of Babylon brought in war captives for this task. Now we understand why the captive Israelites "sat down by the waters of Babylon and wept." They also were, doubtless, required to dig silt out of canals of Mesopotamia.

As these great public works of cleaning silt out of canals were interrupted from time to time by internal revolutions and by foreign invaders, the peoples of Mesopotamia were brought face to face with disaster in canals choked with silt. Stoppage of canals by silt depopulated villages and cities more effectively than the slaughter of people by an invading army.

On the basis of an estimate that it was possible in times past to irrigate 21,000 of the 35,000 square miles of the alluvium of Mesopotamia, the population of Mesopotamia at its zenith was probably between 17 and 25 million. The present population of all Iraq is estimated to be about 4 million, including nomadic peoples. Of this total not more than 3 1/2 million live on the alluvial plain.

Decline in population in Mesopotamia is not due to loss of soil by erosion. The fertile lands are still in place and life-giving waters still flow in the Tigris and Euphrates Rivers, ready to be spread upon the lands today as in times past. Mesopotamia is capable of supporting as great a population as it ever did and greater when modern engineering makes use of reinforced concrete construction for irrigation works and powered machinery to keep canal systems open.

A greater area of Mesopotamia thus might be farmed than ever before in the long history of this tragic land. But erosion in the hinterlands aggravated the silt-problem in waters of the Tigris and Euphrates Rivers, as they were drawn off into the ancient canal systems. Invasions of nomads out of the grasslands and the desert brought about the breakdown of irrigation that spelled disaster after disaster.

In Egypt's Land

Let's now turn to the other great center of population growth and development of civilization in the Valley of the Nile. Here, the mysterious Sphinx ponders problems of the ages as he looks out over the narrow green Valley of the Nile lying across a brown and sun-scorched desert.

In Egypt as well as in Mesopotamia, tillers of soil learned early to sow food plants of wheat and barley and to grow surplus food that released their fellows for divisions of labor, giving rise to the remarkable civilization that arose in the Valley of the Nile. Our debt to the ancient Egyptians is great.

Here, too, farming grew up by flood irrigation with muddy waters. But the problems of farming were very different frown those of Mesopotamia. Annual flooding with silt-laden waters spread thin layers of silt over the land, raising it higher and higher. In these flat lands of slowly accumulating soil, farmers never met with problems of soil erosion.

To be sure, there have been problems of salt accumulation and of rising water tables for which drainage is the solution. This is especially true since yearlong irrigation has been made possible by the Aswan Dam. But the body of the soil has remained suitable for cropping for 6,ooo years and more.

It was perhaps in the Valley of the Nile that a genius of a farmer about 6,000 years ago hitched an ox to a hoe and invented the plow, thus originating power-farming to disturb the social structure of those times much as the tractor disturbed the social structure of our country in recent years. By this means farmers became more efficient in growing food; a single farmer released several of his fellows from the vital task of growing food for other tasks. Very likely the Pharaohs had difficulty in keeping this surplus population sufficiently occupied. For we suspect that the Pyramids were the first WPA projects.

On the Trail of the Israelites

We shall follow the route of Moses out of the fertile, irrigated lands of Egypt into a mountainous land where forests and fields were watered with the rain of Heaven. Fields cleared on mountain slopes presented a new problem in farming - the problem of soil erosion, which, as we shall see, became the greatest hazard to permanent agriculture and an insidious enemy of civilization.

We crossed the modern Suez Canal with its weird color of blue into Sinai where the Israelites with their herds wandered for 40 years. They or someone must have overgrazed the Peninsula of Sinai, for it is now a picture of desolation. We saw in this landscape how the original brown soil mantle was eroded into enormous gullies as shown by great yellowish gashes cut into the brown soil covering. I had not expected to find evidences of so much accelerated erosion in the arid land of Sinai.

On the way to Aqaba we crossed a remarkable landscape, a plateau that had been eroded through the ages almost to a plain, called a peneplain in physiographic language.

This peneplain surface dates back to Miocene times, in the geological scale. In the plain now there is no evidence of accelerated cutting by torrential streams and no evidence that climate has changed for drier or wetter conditions since Miocene times. Here is a cumulative record going far back of the ice age, proclaiming that in this region climate has been remarkably stable.

From this plateau we dropped down 2,500 feet into the Aqaba or gorge of the great rift valley that includes the Gulf of Aqaba, the Araba, the Dead Sea, and the Valley of the Jordan. At the head of the Gulf of Aqaba of the Red Sea we found Dr. Nelson Glueck excavating Ezion Geber which he calls the ancient Pittsburg of the Red Sea, or Solomon’s Seaport. Here, copper was smelted 2,800 years ago to furnish instruments for Solomon and his people. The mud brick used for building these ancient houses looked just like our adobe brick of New Mexico and Arizona.

As we climbed out of the rift valley over the east wall to the plateau of Trans-Jordan that slopes toward the Arabian Desert, we came near Amman upon the same type of peneplain that we crossed west of the Araba. Topographically, these two plains are parts of the same peneplain that once spread unbroken across this region. But toward the end of Pliocene times - that is, just before the beginning of the ice age - a series of parallel faults let down into it the great rift valley to form one of the most spectacular examples of disturbances in the earth's crust that is known to geologists.

From Ma'an we proceeded past an old Roman dam, silted up and later washed out and left isolated as a meaningless wall. At Elji we took horses to visit the fantastic ruins of ancient Petra (called Sela in the Old Testament). This much discussed city was the capital of the Nabatean civilization and flourished at the same time as the Golden Age of China - 200 B.C. to A.D. 200. Rose-red ruins of a great city are hidden away in a desert gorge on the margin of the Arabian Desert.

Petra is now the desolate ruin of a great center of power and culture. It has been used by some students as evidence that climate has become drier in the past 2,000 years, making it impossible for this land to support as great a population as it did in the past. In contradiction to this conclusion, we found slopes of the surrounding valley covered with terrace walls that had fallen into ruin and allowed the soils to be washed off to bare rock over large areas. These evidences showed that food had been grown locally and that soil erosion had damaged the land beyond use for crops.

Invasion of nomads out of the desert had probably resulted in a breakdown in these measures for the conservation of soil and water. Also, erosion had washed away the soils from the slopes and undermined the carrying capacity of this land for a human population. Before ascribing decadence of the region to change of climate, we must know how much the breakdown of intensive agriculture contributed to the fall and disappearance of this Nabatean civilization.

The great buildings used for public purposes are amazing. Temples, administrative buildings, and tombs are all carted out of the red Nubian sandstone cliffs. A fascinating story still lies hidden in the unexcavated ruins of this ancient capital. The influence of Greek and Roman civilization was found in a great theater with a capacity to seat some 2,500 persons. It was carved entirely out of massive sandstone rock that now only echoes the scream of eagles, or the chatter of tourists.

And as we proceeded northward in the Biblical land of Moab, we came to the site of Mt. Nebo. We were reminded of how Moses, after having led the Israelites through 40 years of wandering in the wilderness, stood on this mountain and looked across the Jordan Valley to the Promised Land. He described it to his followers in words like these:

For the Lord thy God bringeth thee into a good land, a land of brooks of water, of fountains and depths that spring out of valleys and hips, a land of wheat and barley and vines and fig trees and pomegranates, a land of olive oil and honey; a land w herein

thou shalt eat bread without scarceness; thou shalt not lack anything in it; a land whose stones are iron and out of whose hills thou Gayest dig brass.

The Land of Milk and Honey

We crossed the Jordan Valley as did Joshua and found the Jordan River a muddy and disappointing stream. We stopped at the ruins of Jericho and dug out kernels of charred grain which the archaeologists tell us undoubtedly belonged to an ancient household of this ill-fated city. We looked at the Promised Land as it is today, 3,000 years after Moses described it to the Israelites as a "land flowing with milk and honey."

We found the soils of red earth washed off the slopes to bedrock over more than half the upland area. These soils had lodged in the valleys where they are still being cultivated and are still being eroded by great gullies that cut through the alluvium with every heavy rain. Evidence of rocks washed off the hills were found in piles of stone where tillers of soil had heaped them together to make cultivation about them easier. From the air we read with startling vividness the graphic story as written on the land. Soils had been washed off to bedrock in the vicinity of Hebron and only dregs of the land were left behind in narrow valley floors, still cultivated to meager crops.

In the denuded highlands of Judea are ruins of abandoned village sites. Capt. P. L. O. Guy, director of the British School of Archaeology, has studied in detail those sites found in the drainage of Wadi Musrara that were occupied 1,500 years ago. Since that time they have been depopulated and abandoned in greater numbers on the upper slopes.

Captain Guy divided the drainage of Musrara into 3 attitudinal zones: The plain, 0-325 feet; foothills, 325 - 975 feet; and mountains, 975 feet and over. In the plain, 34 sites were occupied and 4 abandoned, in the foothills, 31 occupied and 65 abandoned; and in the mountains, 37 occupied and 124 abandoned. In other words, villages have thus been abandoned in the 3 zones by percentages in the above order of 11, 67, and 77, which agrees well with the removal of soil.

It is little wonder that villages were abandoned in a landscape such as this in the upper zone near Jerusalem. The soil the source of food supply, has been wasted away by erosion. Only remnants of the land left in drainage channels are held there by cross walls of stone.

Where soils are held in place by stone terrace walls, that have been maintained down to the present, the soils are still cultivated after several thousand years. They are still producing, but not heavily, to be sure, because of poor soil management (fig. 3).

Most important, the soils are still in place and will grow bigger crops with improved soil treatment. The glaring hills of Judea, not far from Jerusalem, are dotted with only a few of their former villages. Terraces on these hills have been kept in repair for more than 2,000 years.

What is the cause of the decadence of this country that was once flowing with milk and honey? As we ponder the tragic history of the Holy Lands, we are reminded of the struggle of Cain and Abel. This struggle has been made realistic through the ages by the conflict that persists, even unto today, between the tent dweller and the house dweller, between the shepherd and the farmer.

The desert seems to have produced more people than it could feed. From time to time the desert people swept down into the fertile alluvial valleys where, by irrigation, tillers of soil grew abundant foods to support teeming villages and thriving cities.

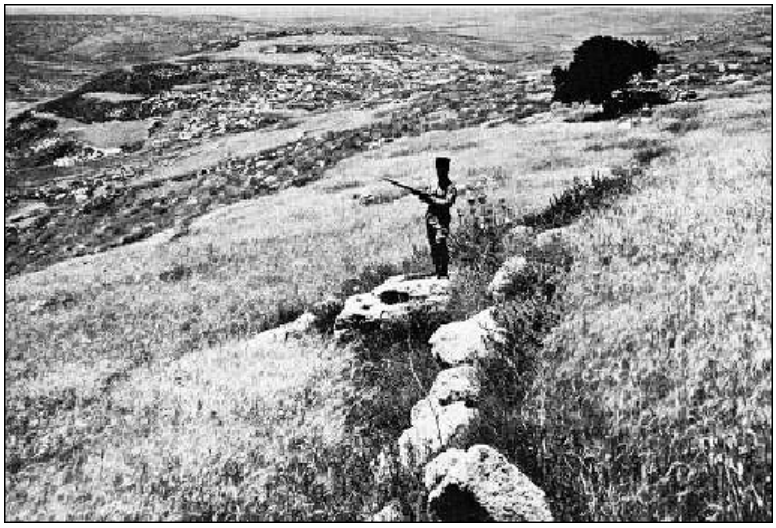

FIGURE 3.This is a present-day view of a part of the Promised Land to which Moses led the Israelites about 1200 B. C. A few patches still have enough soil to raise a meager crop of barley. But most of the land has lost practically all of its soil, as observed from the rock outcroppings. The crude rock terrace in the foreground helps hold some of the remaining soil in place.

They swept down as a wolf on the fold to raid the farmers' supplies of food. Raiders sacked and robbed and passed on. Often, they left destruction and carnage in their path, or they replaced former populations and became farmers themselves, only to be swept out by a later wave of hungry denizens of the desert.

Conflicts between the grazing and farming cultures of the Holy Lands have been primarily responsible for the tragic history of this region. Not until these two cultures supplement each other in cooperation can we hope for peace in this ancient land.

We saw the tents of descendants of nomads out of Arabia. In the seventh century they swept in out of the desert to conquer and overrun the farming lands of Palestine. Again in the 12th century nomads drove out the Crusaders. They with their herds of long-eared goats let terrace walls fall in ruin and unleashed the forces of erosion. For nearly 13 centuries erosion has been washing the soils off the slopes into the valleys to make marshes or out to sea.

In recent times a great movement has been under way for the redemption of the Promised Land by Jewish settlers. They have wrought in draining swamps, ridding them of malaria, and planting them to thriving orchards and fields. These settlers have also repaired terraces, reforested desolate and rocky slopes, and improved livestock and poultry.

Throughout our survey of the work of the agricultural colonies, I was asked to advise on measures to conserve soil and water. I urged that orchards be planted on the contour and the land bench-terraced by contour plowing. We were shown one orchard where the trees were planted on the contour, the land was bench-terraced and slopes above the orchard were furrowed on the contour and planted to hardy trees.

By these measures all the rain that had fallen the season before, one of the wettest in many years, had been absorbed by the soil. After this work was done no runoff occurred to cut gullies down slope and to damage the orchards below. We were told that the man responsible for this had learned these measures at the Institute of Water Economy in Tiflis, Georgia, in Transcaucasia.

Across Syria

We crossed the Jordan again into a region famous in Biblical times for its oaks, wheat fields, and well-nourished herds. We found the ruins of Jerash, one of the 10 cities of Decapolis, and Jerash the second. Archaeologists tell us that Jerash was once the center of some 250,000 people. But today only a village of 3,000 marks this great center of culture, and the country about it is sparsely populated with semi-nomads. The ruins of this once-powerful city of Greek and Roman culture are buried to a depth of 13 feet with erosional debris washed from eroding slopes.

We searched out the sources of water that nourished Jerash and found a series of springs protected by masonry built in the Graeco-Roman times. We examined these springs carefully with the archaeologists to discover whether the present water level had changed with respect to the original structures and whether the openings through which the springs gushed were the same as those of ancient times. We found no suggestion that the water level was any lower than it was when the structures were built or that the openings were different. It seems that the water supply had not failed.

When we examined the slopes surrounding Jerash we found the soils washed off to bedrock in spite of rock-walled terraces. The soils washed off the slopes had lodged in the valleys. These valleys were cultivated by the semi-nomads who lived in black goat-hair tents. In Roman times this area supplied grain to Rome and supported thriving communities and rich villas, ruins of which we found in the vicinity.

In the alluvial plains along the Orontes River, agriculture supports a number of cities, much reduced in population from those of ancient times. Water wheels introduced from Persia during or following the conquests of Alexander the Great (300 B. C.) were numerous along the Orontes. There were hundreds, we were told, in Roman times, but today only 44 remain. They are picturesque old structures both in their appearance and in the groans of the turning wheel as they slowly lift water from the river to the aqueduct to supply water for the city of Hama. These wheels are more than 2,000 years old. But no part of a wheel is that old, because the parts have been replaced piecemeal many times through the centuries.

FIGURE 4.Ruins of one of the Hundred Dead Cities of Syria. From 3 to 6 feet of soil has been washed off most of the hillsides. This city will remain dead because the land around it can no longer support a city.

The Hundred Dead Cities

Still farther to the north in Syria, we came upon a region where erosion had done its worst in an area of more than a million acres of rolling limestone country between Hama, Alleppo, and Antioch. French archaeologists, Father Mattern, and others found in this man-made desert more than 100 dead cities.

Butler of Princeton rediscovered this region a generation ago. These were not cities as we know them, but villages and market towns. The ruins of these towns were not buried. They were left as stark skeletons in beautifully cut stone, standing high on bare rock (fig. 4). Here, erosion had done its worst. If the soils had remained, even though the cities were destroyed and the populations dispersed, the area might be re-peopled again and the cities rebuilt. But now that the soils are gone, all is gone.

We are told that in A.D. 610 - 612 a Persian army invaded this thriving region. Less than a generation later, in 633 - 638, the nomads out of the Arabian Desert completed the destruction of the villages and dispersal of the population. Thus, all the measures for conserving soil and water that had been built up through centuries were allowed to fall into disuse and ruin. Then erosion was unleashed to do its deadly work in making this area a man-made desert.

Looking for the Forests of Lebanon

About 4,500 years ago, we are told by archaeologists, a Semitic tribe swept in out of the desert and occupied the eastern shore of the Mediterranean and established the harbor towns of Tyre and Sidon. On the site of another such ancient harbor town is Beirut, which today is the capital of Lebanon. You can see it from a high point on the Lebanon Mountains overlooking the Mediterranean Sea.

These early Semites were Phoenicians. They found their land a mountainous country with a very narrow coastal plain and little flat land on which to carry out the traditional irrigated agriculture as it had grown up in Mesopotamia and Egypt. We may believe that as the Phoenician people increased, they were confronted with three choices: (1) Migration and colonization, which we know they did; (2) manufacturing and commerce, which we know they did; and (3) cultivation of slopes, about which we have hitherto heard little.

Here was a land covered with forests and watered by the rains of heaven, a land that held entirely new problems for tillers of soil who were accustomed to the flat alluvial valleys of Mesopotamia and the Nile. As forests were cleared either for domestic use or for commerce, slopes were cultivated. Soils of the slopes eroded then under heavy winter rains as they would now. Here under rain farming, they encountered severe soil erosion and the problem of establishing a permanent agriculture on sloping lands.

We find, as we read the record on the land in this fascinating region, tragedy after tragedy deeply engraved on the sloping land. To control erosion walls were constructed across the slopes. Ruins of these walls can be seen here and there today. These measures failed, and erosion caused the soil to shift down slope. As the fine-textured soil was washed away, leaving loose rocks at the surface, tillers of the soil piled the rocks together to make cultivation about them easier. In these cases the battle with soil erosion was definitely a losing one.

FIGURE 5.Rock-walled bench terraces in Lebanon that have been in use for thousands of years. The construction of terraces of this type would cost from $2,000 to $5,000 per acre if labor was figured at 40 cents per hour. Such expensive methods of protecting land are practical only where people have no other land on which to raise their food.

Elsewhere we found that the battle with soil erosion had been won by the construction and maintenance of a remarkable series of rock-walled terraces extending from the bases to the crests of slopes like fantastic staircases (fig. 5). At Beit Eddine in the mountains of Lebanon east of Beirut, we found the slopes terraced even up to grades of 76 percent.

The mountains of ancient Phoenicia were once covered by the famous forests, the cedars of Lebanon. An inscription on the temple of Karnak, as translated by Breasted, announces the arrival in Egypt before 2900 B. C. of 40 ships laden with timber out of Lebanon.

You will recall that it was King Solomon, nearly 3,000 years ago, who made an agreement with Hiram, King of Tyre to furnish him cypress and cedars out of these forests for the construction of the temple at Jerusalem. Solomon supplied 80,000 lumberjacks to work in the forest and 70,000 to skid the logs to the sea. It must have been a heavy forest to require such a forte. What has become of this famous forest that once covered nearly 2,000 square miles?

Today, only 4 small groves of this famous Lebanon cedar forest are left the most important of which is the Tripoli grove of trees in the cup of a valley. An examination of the grove revealed some 400 trees of which 43 are old veterans or wolf trees. As we read the story written in tree rings, it appears that about 300 years ago the grove had nearly disappeared with no less than 43 scattered veteran trees standing.

These trees with widespreading branches had grown up in an open stand. About that time a little church was built in their midst that made the grove sacred. A stone wall was built about the grove to keep out the goats that grazed over the mountains. Seeds from the veteran trees fell to the ground, germinated, and grew up into a fine close growing stand of tall straight trees that show how the cedars of Lebanon will make good construction timber when grown in forest conditions (fig 6).

Such natural restocking also shows that this famous forest has not disappeared because of adverse change of climate, but that under the present climate it would extend itself if it were safeguarded against the rapacious goats that graze down every accessible living on these mountains.

China's Sorrow

Before moving on to Cyprus and North Africa, let's look at China. Civilization here probably arose somewhat later than that in the Near East and was influenced by it. Mixed agriculture, irrigation, the ox-drawn plow, and terracing of slopes are notable similarities in the two regions (fig. 7).

It was in China, where I was engaged in an international project for famine prevention in 1922 - 27, that the full and fateful significance of soil erosion was first burned into my consciousness.

FIGURE 7.These bench terraces in Shansi Province illustrate the extent to which some Chinese farmers have gone to conserve the remaining soil on their hillsides.

During an agricultural exploration into the regions of North China, seriously affected by the famine of 1920 - 21, I examined the site where the Yellow River, in 1852, broke from its enormous system of inner and outer dikes. As we traveled across the flat plains of Honan, we saw a great flat-topped hill looming up before us. We traveled on over the elevated plain for 7 miles to another great dike that stretched across the landscape from horizon to horizon. We mounted this dike and there before us lay the Yellow River, the Hwang Ho, a great width of brown water flowing quietly that spring morning into a tawny haze in the east.

Here in a channel fully 40 to 50 feet above the plain of the great delta lay the river known for thousands of years as "China's Sorrow." This gigantic river had been lifted up off the plain over the entire 400-mile course across its delta and had been held in this channel by hand labor of men without machines or engines, without steel cables or construction timber, and without stone.

Millions of Chinese farmers with bare hands and baskets had built here through thousands of years a stupendous monument to human cooperation and the will to survive. Since the days of Ta-Yu, nearly 4,000 years ago, the battle of floods with this tremendous river have been lost and won time and again.

But why should this battle with the river have to be endless? Any relaxation of vigilance let the river break over its dikes, calling for Herculean and cooperative work to put the river back again in its channel. Then suddenly it dawned upon me that the river was brown with silt, heavily laden with soil that was washed out of the highlands of the vast drainage system of the Yellow River.

As its flood waters reached the gentler slope of the delta (1 foot to the mile), the current slowed down and began to drop its load of silt. Deposits of silt in turn lessened the capacity of the channel to carry floodwaters and called on the farmers threatened with angry floods to build up the dikes yet higher and higher, year after year.

There was no end to this demand of the river if it were to be confined between its dikes. Final control of the river so heavily laden with silt was hopeless; yet millions of farmers toiled on.

In 1852, the yellow-brown waters of the Hwang Ho broke out of its elevated channel to seek another way to the sea. It had emptied into the Yellow Sea, where it had usurped the old outlet of the Shai River.

This time the river broke over its dikes near Kaifeng, Honan, and wandered to the northeast over farm lands, destroying villages and smothering the life out of millions of humans, and discharged into the Gulf of Chihli, 400 miles north of its former outlet. In its rage it had refused to be lifted any higher off its plain. Hundreds of thousands of farmers had been defeated. Silt had defeated them, valiant as they were.

Silt silt silt! We determined to learn where this silt came from, even up to the headwaters.

In a series of carefully planned agricultural explorations we discovered the source of the silt that brought ruin to millions of farmers in the plains. In the Province of Shansi we found how the line of cultivation was pushed up slopes, following the clearing away of forests. Soils, formerly protected by a forest mantle, were thus exposed to summer rains, and soil erosion began a headlong process of destroying land and filling streams with soil waste and detritus.

Without a basis of comparison, we might easily have misread the record as written there on the land. But temple forests, preserved and protected by the Buddhist priests, gave me and my Chinese associates a remarkable chance to measure and compare rates of erosion within these forests and on similar slopes and soils that had been cleared and cultivated.

In brief, my Chinese scientific associates and I carried out a series of soil erosion experiments during rainy seasons of 3 years. In these experiments we measured the rate of runoff and erosion by means of runoff plots within temple forests, out on farm fields under cultivation, and on fields abandoned because of erosion. For the first time in soil-erosion studies, we got experimental data for such comparisons. Here too, we found how the Yellow River had become China’s Sorrow, for we found that runoff and erosion from cultivated land were many times as great as from temple forests.

It was clear that if the farmers of the delta plain were ever to be safeguarded from the mounting perils of the silt laden Yellow River, the source of the silt must be stopped by erosion control.

Farther west in the midst of the famous and vast loessial deposits of North China, we found in the Province of Shansi that an irrigation system first established in 746 B. C. had been put out of use by silt. Here again silt was the villain.

We sought out the origin of the silt that had brought an end to an irrigation project that had fed the sons of Han during the Golden Age of China. This origin was found in areas where soil erosion had eaten out gullies 600 feet deep (fig. 8). It was while contemplating such scenes that I resolved to challenge the conclusions of the great German geologist, Baron Von Richthofen, and of Ellsworth Huntington that the decadence of North China was due to desiccation or pulsations of the climate.

FIGURE 8.These huge gullies indicate the severity of soil erosion in the deep, and once fertile loessial soils of northern China. Millions of acres have been cut up like this and are now almost worthless.

Temple forests gave the clue. They demonstrated beyond a doubt that the present climate would support a generous growth of vegetation capable of preventing erosion on such a scale. Human occupation of the land had set in motion processes of soil wastage that were in themselves sufficient to account for the decadence and decline of this part of China, without adverse change of climate.

It was in the presence of such tragic scenes on a gigantic scale that I resolved to run down the nature of soil erosion and to devote my lifetime to study of ways to conserve the lands on which mankind depends.

Soil Waste in Ancient Cyprus

Let's now go back and follow the westward course of civilization from the Holy Lands through North Africa and on into Europe. In Cyprus we found the land use problems of the Mediterranean epitomized in a comparatively small area.

In the plain of Mesaoria is a telling record in and about a Byzantine church. The church on the outskirts of the village of Asha in eastern Cyprus is surrounded by a graveyard and its wall. The alluvial plain now stands 8 feet above the level of the churchyard as we measured it. On entering the church we stepped down 3 feet from the yard level to the

floor of the church. Inside we noted that low pointed arches were blocked off, and new arches had been cut for doors and windows.

The aged vestryman told us that about 30 years ago a flood from the plain had filled the church with water and left 2 feet of silt on the floor. Rather than clean it out, a new stone floor had been laid over the silt deposit. Thus, 8 plus 3 plus 2 equals 13 feet, the height of the present alluvial plain above the original church floor. From these measurements we concluded that the plain had filled in, not less than 13 feet, with erosional debris washed off the drainage slopes.

Across North Africa

Along the northern coast of Africa into Tunisia and Algeria we read the record of the granary of Rome during the empire by surveying a cross section from the Mediterranean to the Sahara Desert, from 40 inches of rainfall to 4 inches, from Carthage on the coast to Biskra at the edge of mysterious Sahara.

In Tunisia we found that it rains in the desert of North Africa in wintertime now as it did in the time of Caesarin 44 B. C. Caesar complained of how a great rainstorm with wind had blown over the tents of his army encampment and flooded the camp. It rained hard enough to produce flash floods in the wadies. At one place muddy water swept across the highway in such volume that we decided to wait for the flash flow to go down before proceeding.

We stood on the site of ancient Carthage, the principal city of North Africa in Phoenician and Roman times the city that produced Hannibal and became a dangerous rival of Rome. In 146 B. C. at the end of the Third Punic War, Scipio destroyed Carthage, but out of the doomed city he saved 28 volumes of a work on agriculture written by a Carthaginian by the name of Mago.

Mago was recognized by the Greeks and Romans as the foremost authority on agriculture in the Mediterranean area. These works of Mago on agricultural subjects were translated by such Roman writers as Columella, Varro, and Cato. The translations tell us that the traditions of conserving soil and water discovered on the slopes of ancient Phoenicia had been brought there by colonists. We suspect these measures furnished the basis of the great agricultural production that was so important to the Romans during the Empire.

Over a large part of the ancient granary of Rome we found the soil washed off to bedrock and the hills seriously gullied as a result of overgrazing. Most valley floors are still cultivated but are eroding in great gullies fed by accelerated storm runoff from barren slopes. This is in an area that supported many great cities in Roman times.

We found at Djemila the ghosts of Cuicul, a city that once was great and populous and rich but later was covered completely, except for about 3 feet of a single column, by erosion debris washed off the slopes of surrounding hills. For 20 years French

archaeologists had been excavating this remarkable Roman City and had unearthed great temples, two great forums, splendid Christian churches, and great warehouses for wheat and olive oil. All this had been buried by erosional debris washed from the eroding slopes above the city. The surrounding slopes, once covered with olive groves, are now cut up with active gullies.

The modern village houses only a few inhabitants. The flat lands are still farmed to grain but the slopes are bare and eroding and wasting away. What is the reason for this astounding decline and ruin?

Timgad, Lost Capital of a Lost Agriculture

Farther to the south we stopped to study the ruins of another great Roman city of North Africa, Thamugadi, now called Timgad (fig. 9). This city was founded by Trajan in the first century A. D. It was laid out in symmetrical pattern and adorned with magnificent buildings, with a forum embellished by statuary and carved porticoes, a public library, a theater to seat some 2,500 persons, 17 great Roman baths, and marble flush toilets for the public. After the invasion of the nomads in the seventh century had completed the destruction of the city and dispersal of its population, this great center of Roman culture and power was lost to knowledge for 1,200 years. It was buried by the dust of wind erosion from surrounding farm lands until only a portion of Hadrian's arch and 3 columns remained like tombstones above the undulating mounds to indicate that once a great city was there.

FIGURE 9.The ruins of Timgadan ancient Roman city built during the first century A. D. The few huts seen in the center background now house about 300 inhabitants, which is all the eroded land will support. Note that the eroded hills in the background are almost as desolate as the ruins of the city.

The French Government has been excavating this great center for 30 years. Remarkable examples of building, of art, and of ways of living during Roman times in North Africa have been disclosed, all supported by the agriculture of the Granary of Rome.

But today this great center of power and culture of the Roman Empire is desolation. It is represented by a modern village of only a few hundred inhabitants who live in squalid structures, the walls of which are for the most part built of stone quarried from the ruins of the ancient city. Water erosion has cut a gully down into the land and exposed an ancient aqueduct that supplied water to the city of Timgad from a great spring some 3 miles away.

Within and surrounding Timgad, we studied remarkable ruins of great olive presses where today there is not a single olive tree within the circle of the horizon.

On the plain of Tunisia we came upon in El Jem the ruins of a great amphitheater, second only in size to that of Rome. (fig. 10). It was built to seat some 60,000 people, but it would be difficult to find 5,000 persons today within this district. The ancient city now lies buried around the amphitheater and a sordid modern village is built on the buried city.

What was the cause of the decadence of North Africa and the decline of its population? Some students have suggested that the climate changed and became drier, forcing people to abandon their remarkable cities and works. But Gsell, the renowned geologist who studied this problem for 40 years, challenged the conclusion that the climate has changed in any important way since Roman times.

FIGURE 10.Ruins of the amphitheater at the former city of Thysdrus, in Tunisia, which would seat 60,000 people. Today, only a few thousand people inhabit this area. The small flock of sheep in the foreground are a fair indication of the land's ability to support life.

So Director Hodet of the Archaeological Excavations at Timgad decided as an experiment to plant olive trees on an unexcavated part of the city where there would be no possibility of subirrigation. He planted young olive trees in the manner prescribed in Roman literature, watering them in the following two long dry summer seasons. These olive trees are thriving, indicating that where soils are still in place, olive trees will grow today probably very much as they did in Roman times.

On the plains about Sfax, ruins of olive presses were found by early travelers, but no olive trees. Forty years ago an experiment to plant olive trees there was decided upon.

Now more than 150,000 acres are planted to olive trees; their products support thriving industries in the modern city of Sfax. These plantings indicate that the climate of today has not become significantly drier since Roman times.

Other students of this baffling problem have suggested that pulsations of climate with intervening dry periods, sufficient to blot out the civilization of North Africa, have taken place. Such undoubtedly could have been the case. But at Sousse we found telling evidence on this point in an olive grove that has survived since Roman times. These olive trees were at least 1,500 years old, we were informed.

I was interested in the way these trees were planted in basins bordered by banks of earth with ways of leading in unabsorbed storm runoff from higher ground. We passed along this area at a time of heavy rains which showed just how this method had worked since the trees were first planted. If there have been pulsations of climate since Roman times, this grove should show that the drier periods were not sufficiently severe to kill the olive trees. We conclude that it does not seem probable that either a progressive change of climate or pulsations of climate account for the decadence of North Africa. We must seek other causes.

On hillsides between Constantine and Timgad, we found on the land a record that indicates what has happened to soils of the granary of ancient Rome. We found some hills that, according to the botanists, were covered with Savannah vegetation of scattered trees and grass. Vegetation had conserved a layer of soil on these hills for unknown ages.

With the coming of a grazing culture, brought in by invading nomads of Arabia, erosion was unleashed by overgrazing of the hills. We can see here on the landscape how the soil mantle was washed off the upper slopes to bedrock. Accelerated runoff from the bared rock cut gullies into the upper edge of the soil mantle, working it downhill as if a great rug were being pulled off the hills.

The accumulation of torrential flows during winter storms is cutting great gullies through the alluvial plains just as it does in New Mexico, Arizona, and Utah of our own country. The effect of this is to lower the water table, bringing about the effects of desiccation without reduction in rainfall.

In this manner has the country been seriously damaged, and its capacity to support a population much reduced. Unleashed and uncontrolled soil erosion is sufficient to undermine a civilization, as we found in North China and as seems to be true in North Africa as well.

The Dry Lands of North Africa

We traveled across North Africa southward toward the Sahara Desert into zones of less and less rainfall. Beyond the cultivated area in Roman times was a zone devoted to stock raising on a large scale. Thousands of cisterns were built in Roman or pre-Roman

times to catch storm runoff from the land to store it for outlying villages and for watering herds of livestock during the dry summer seasons.

Many of these cisterns were being cleaned out and repaired by the French Government before World War II, to be used for the same purpose as they were in ancient times. One of the modern cisterns was four times as large as any Roman cistern, with a capacity of 100,000 cubic feet. This cistern was filled in 2 years and now furnishes water for the semi-nomads who inhabit this part of North Africa.

Still farther toward the desert, about 70 miles south of Tebessa, we found a remarkable example of ancient measures for the conservation of water. At some time in the Roman or possibly pre- Roman period, peoples of this region built check dams to divert storm water around slopes into canals to spread it upon a remarkable series of bench terraces.

This area of unusual interest raises a number of questions we are not yet able to answer. If these terraces were cultivated to crops in times past, they are the best evidence we have that climate has become drier since they were first built. But if they were built for spreading water to increase forage production for grazing herds, as the French are using them today, they are not evidence of an adverse change of climate. This evidence alone could leave us in doubt, but other evidence indicates that water spreading was most used here for crops.

It would be interesting to know the date and the reason for building these terraces. They may indicate that with Roman occupation of North Africa the native tribes were driven beyond the border of the Roman Empire and were forced to devise these refined measures for conservation and use of water in a dry area. Or they may indicate that North Africa was so densely populated that it was necessary to use these refinements in the conservation of water to support the population on the margins of a crowded region.

While the land of North Africa has been seriously damaged, as one can see written on landscape after landscape, the country is still capable of far greater than its present production. In Roman times a high degree of conservation of soils and waters was reached with an intensive culture of orchards and vineyards on the slopes and intensive grain growing in the valleys.

All this depended on efficient conservation and use of the rainfall. We find numerous references to such practices in the literature of the time. But, as nomads swept in out of the desert, their extensive and exploitive grazing culture replaced these highly refined measures of land use and let them fall into disuse and ruin. Erosion was unleashed on its destructive course, and the capacity of the land to support people was seriously reduced.

The veteran student of North Africa, Professor Gautier, answered my query as to whether climate of North Africa had changed since Roman times, in the following way:

"We have no evidence to indicate that the climate has changed in an important degree since Roman times, but the people have changed."

We conclude that the decline of North Africa is due to a change in a people and more especially to a change in culture and methods of use of land that replaced a highly developed and intensive agriculture and that allowed erosion to waste away the land and to change the regime of waters.

A Word About Land Use in Italy

The westward course of civilization has left its marks in Italy. We found at Paestum, south of Naples, one of the best preserved Greek temples, located on the coastal plain near the sea. Here, there was no overwash of erosional material or accumulation of dust from wind erosion and no gully erosion in the plain. We walked on the same level as the Greeks who built the temple 2,600 years ago.

But population pressure in Italy, under its smiling climate and blue skies, has pushed the cultivation line up the slopes and caused the building of villages on picturesque ridge points. In Italy there are 826 persons per square mile of cultivated land, while in the United States there are only 208.

This method of comparing population density gives us the advantage because of our vast grazing lands that support great herds of livestock. But if we had the same density of population per square mile of cultivated land in the United States as has Italy, we should have 520 million people. This gives us some idea of the relative densities and pressures of population upon the land and accounts for the intensive use not only of the plains but of the steep slopes.

We do not have space to tell the details of how the Pontine Marshes, that for 2,000 years defied the reclamation efforts of former rulers of Italy, were successfully reclaimed recently. This former pestilential area has been drained and rid of malaria and is now divided into farms equipped with reinforced concrete houses of attractive design, where families are established free from perils of malaria and safe in the security of their land.

Torrent Control in the French Alps

In southeastern France we found the same condition of intensive use of land on valley floors and on steep, terraced slopes. In the French Alps, population pressure on land of the plains has pushed the cultivation line up the slopes into mountains and has denuded grassy meadows by overgrazing.

This excessive use of the mountainous areas in the French Alps unleashed torrential floods that for more than a century ravaged productive Alpine valleys. Erosional debris was swept down by recurring torrential floods to bury fields, orchards, and villages; to cut lines of communication; and to kill inhabitants of the valleys.

So serious became this menace to the welfare of the region that the French Government, after much study and legislation, undertook in 1882 a constructive program of torrent control. Since that time hundreds of millions of francs have been spent for works of torrent control that are remarkably successful.

FIGURE 11.A terraced citrus orchard in southern France. It is believed that terraces of this type were first built in France by the Phoenicians about 2,500 years ago. Modern French farmers are still maintaining and farming such hillsides, however, because of the scarcity of good land.

FIGURE 12.These French farmers are digging up the soil along the lower furrow of their field and loading it into a cart. It will be hauled uphill and spread along the upper edge. They do this job each winter to help compensate for the downhill movement of soil by erosion.

Intensive Land Use in France

We found slopes in southern France cultivated on gradients up to 100 percent with terrace walls as high as the benches were wide. Some of these terraced fields had been under cultivation for more than a thousand years likely much longer, for the Phoenicians are believed to be responsible for terracing in this part of France (fig. 11).

When the soils of these terraces become fatigued, as the French say, they are turned over to a depth of more than 3 feet once in 15 to 30 years as the need may be. Thereafter, a cover crop is planted on the newly exposed soil material for two or more years, followed by plantings of orchard trees or vines or vegetables.

In eastern France we found in various stages adjustments of farming to slopes. In places, terraces were built with rock walls on the contour to reduce slope gradients; elsewhere, rock walls were built on the contour to form level benches. At other places, farmers dug up the soil of the bottom furrow of their fields that were laid out in contour strip crops, loaded the soil into carts, hauled it to the upper edges of the fields, and dumped it along the upper contour furrows to compensate for downslope movement of soil under the action of plowing and the wash of rain (fig. 12). This was done each year. Where the slope was too steep to haul the soil uphill, they loaded the soil of the bottom furrow in baskets and carried it on their backs to the upper edges of the field. In this way these farmers of France take care of their soil from generation to generation.

Figure 13.One of the uncontrolled sand dunes in the Les Landes forest of southwestern France. French engineers have, in the past, brought about 400,000 acres of such dunes under control, and the area is again producing timber.

In southwestern France, in the region of Les Landes, we studied, probably, the greatest achievement of mankind in the reclamation of sand dunes. It is recorded that the Vandals in A. D. 407 swept through France and destroyed the settlements of the people who in times past had tapped pine trees of the Les Landes region and supplied resin to Rome. Vandal hordes razed the villages, dispersed the population, and set fire to the forests, destroying the cover of a vast sandy area. Prevailing winds from the west began the movement of sand. In time, moving sand dunes covered an area of more than 400,000 acres that in turn created 2 1/4 million acres of marshland.

Sand dunes in their eastward march covered farms and villages and dammed streams, causing marshes to form behind them. Malaria followed and practically depopulated the once well-peopled and productive region. These conditions caused not only disease and death but impoverishment of the people as well.

In 1778 Villers was appointed by the French Government to create a military port at Arcachon. He reported that it was first necessary to conquer the movement of the sand dunes, and presented the principle of "dune fixation." About 20 years later Napoleon appointed his famous engineer, Bremontier, to control these dunes.

Space will not permit my telling the fascinating details of this remarkable story of how the dunes were conquered by establishing a littoral dune and reforesting the sand behind, and how marshy lands were drained by Chambrelent after a long period of experimentation and persuasion of public officials. Now this entire region is one vast forest supporting thriving timber and resin industries and numerous health resorts.

Fortunately for comparison, one dune on private land was for some reason left uncontrolled. This dune is 2 miles long, 1/2 mile wide, and 300 feet high (fig. 13). It is now moving landward, covering the forest at the rate of about 65 feet a year. As I stood on this dune and saw in all directions an undulating evergreen forest to the horizon, I began to appreciate the magnitude of the achievement of converting the giant sand-dune and marshland into profitable forests and health resorts.

How the Dutch Farm the Ocean Floor

In Holland we found another of mankind's great achievements the reclamation of the ocean floor for farming.

Holland is a land of about 8 1/4 million acres, divided into two almost equal parts above and below high-tide level. It is inhabited by 8 million industrious people. Its land included the great delta of the North Sea built up with the products of erosion sculptured out of the lands of Germany and Switzerland and northeastern France, brought down by the Rhine and Meuse Rivers. Now 45 percent of the area lies below high-tide level and one-fourth lies below mean sea level. The Dutch from time immemorial have been carrying on an unending battle with the sea. They have become expert in filching land from the grasp of the angry waters of the North Sea.

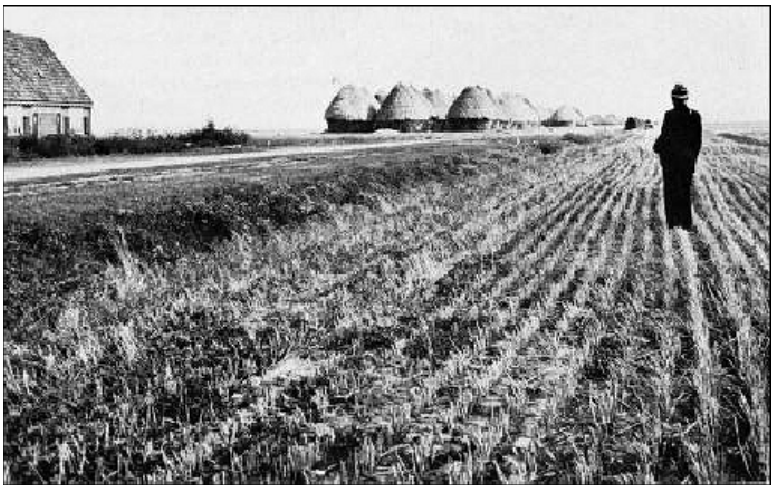

FIGURE 14.A Dutch farm in the Wieringermeer Polder of the Netherlands. Only 7 years before this picture was taken this land was covered by the North Sea.

If the United States were as densely populated per square mile of cultivated land as Holland, the population of the United States would be 1 1/4 billion. The density of population of Holland has called for an increase of its land area.

Rather than to seek additional land by conquest of its neighbors it has turned to the conquest of the sea.

The Zuider-Zee project, two centuries in the planning, is Holland's masterpiece in a 2,000-year battle with the North Sea. This project adds more than 550,000 acres of new land to Holland’s territory, converting the old salt ZuiderZee into a sweet-water lake renamed the Yssel Meer.

The Dutch have built great dikes to dam off the sea and have pumped the water out of the basins with great pumping plants. They have diked-off the sea and dewatered the land, leached it of its salt, and converted it into productive farm land. We stood on fertile farm land that was the floor of the sea only 7 years earlier, but now is divided into farms equipped with fine houses and great barns (fig. 14). At a cost of about $200 an acre, this land was reclaimed from the sea and divided into farms.

The Dutch by this means have created a new agricultural paradise into which only select farmers may enter. Out of 30 applications for each farm, one applicant is selected on the basis of character, the past record of his family, and his freedom from debt. The successful applicant is put on probation for a period of 6 years. If he farms the land in accordance with the best interests of the land and of the country, he will be permitted to continue for another period. If he fails to do so, he must get off and give another farmer applicant a chance.

A Glance at England

In the mild climate of England, we find that tillers of soil have had little difficulty with soil erosion. This is true because rains come as mists, slopes are gentle, and fields are usually farmed to close growing crops. England is well suited to grassland farming and to the growing of small grains. Clean-tilled crops have never been in general use. We found fields in England that have been cultivated for more than a thousand years where the yields of wheat have been raised to averages of 40 to 60 bushels per acre. The maximum yield thus far is 96 bushels to the acre. The principal problems before the farmers of England are rotations, seed selection, and farm implements.

World War II made new demands on the lands of England. Before blockading action by the enemy, the British Isles depended on imports for two-thirds of their total food supply. One-third of their population was fed from their own lands requiring about 12 million acres of cultivated land for this purpose. Fully 50 percent more land was plowed to grow food crops. Pastureland and grassland grassland on slopes were cultivated. Soil erosion may become a problem more serious than ever on slopes were cultivated. Soil erosion may become a problem more serious than ever before in British agriculture, because of the extraordinary demands for the growing of food.

The New World

And now we cross the Atlantic to the new land which was isolated from the peoples of the Old World until civilization had advanced through fully 6,000 years.

The peoples found here, presumably descendants of tribes coming from Asia in the distant past, had been handicapped in the development of agriculture by lack of large animals suitable for domestication and by ignorance of the wheel and the use of iron. They had, however, learned to conserve soil and water in a notable way, especially in the terrace agriculture of Peru and Central America and in the Hopi country of southwestern United States. Some have held that this knowledge was brought across the South Pacific by way of islands, on many of which such practices are still found. In any case, lacking iron or even bronze tools, these peoples for the most part still depended largely on hunting, fishing, and gathering along with shifting cultivation for their livelihood. Thus, the soil resources seem to have been for the most part almost unimpaired.

To the peoples of the Old World, the Americas were a land of promise and a release from the oppressions, economic and political, brought on by congested populations and failures of people to find adjustments to their long-used land.

North America, as the first colonists entered it, was a vast area of good land more bountiful in raw materials than ever was vouchsafed any people. Its soils were fat with accumulated fertility of the ages, its mountains were full of minerals and forests; its clear rivers were teeming with fish. All these were abundant soil productivity, raw materials, and power for a remarkable civilization.

Here was the last frontier; for there are no more new continents to discover to explore, and to exploit. If we are to discover a way of establishing an enduring civilization we must do it here; this is our last stand. We have not yet fully discovered this way; we are searching for the way and the light. Here is a challenge of the ages to old and young alike. Here is a chance to solve this age-old problem of establishing an enduring civilization of finding an adjustment of a people to its land resources.

Our land is like a great farm with fields suited to the growing of cotton, corn, and other crops and with land for pastures, woods, and general farming. In the West, our country has vast grazing lands well suited to the raising of herds of sheep and cattle and fertile alluvial valleys in the arid regions, overawed by high mountains that condense the waters out of moisture-laden winds to irrigate garden lands. Such is the American farm, capable of feeding at least 350 million people when the land is intensively cultivated under full conservation and fully occupied with a complex division of labor that will give us a higher general standard of living than we enjoy today.

The Record of Our Own Land

But now let us read the record of our own land in a short period of 300 years.

In the past 150 years, our occupation of this fabulous land has coincided with the coming of the age of science and power-driven machines.

Along the Atlantic coast in the Piedmont we find charming landscapes of fields with red soils and glowing grain fields. But in their midst we find an insidious enemy devouring the land stealing it away, ere we are aware, by sheet erosion, rain by rain, washing it down into the streams and out to the sea. Sheet erosion, marked by shallow but numberless rills in our fields, is blotted out by each plowing.

We forget what is happening to the good earth until we measure these soil and water losses. More than 300 million acres out of our 400-odd million acres of farm fields are now eroding faster than soil is being formed. That means destruction of the land if erosion is not controlled.

We are not guessing. Erosion experiment stations located throughout the country have given us accurate answers. Let us compare rates of erosion under different conditions of land coverage and use. Measurements through 5 years at the Statesville, N. C., erosion experiment station show that, on an 8-percent slope, land in fallow without cropping lost each year an average of 29 percent of rainfall in immediate runoff and 64 tons of soil per acre in wash-off of soil.

This means that in 18 years, 7 inches of soil (the average depth of topsoil) would be washed away. Under continuous cropping to cotton, as was once the general practice in this region, the land lost each year an average of 10 percent of rainfall and 22 tons of soil per acre per year.

At this rate it would take 44 years to erode away 7 inches of soil. Rotations reduced, but did not stop, erosion for the land lost 9 percent of the rain and enough soil so that it would take 109 years to erode away 7 inches of soil. That is a very short time in the life of our Nation. But where the land was kept in grass, it lost less than 1 percent of rain and so little soil that it would take 96,000 years to wash away 7 inches of soil. This rate is certainly no faster than soil is formed.

Under the natural cover of woods burned over annually, as has unfortunately been the custom in southern woods, each year the land lost 3 1/2 percent of rain and 0.06 ton of soil per acre so that it would take 1,800 years to erode away 7 inches of soil. But where fire was kept out of the woods and forest litter accumulated on the forest floor, the land lost less than one-third of 1 percent of the rainfall. And, according to the calculations, it would require more than 500,000 years to wash away 7 inches of soil. Such a rate of erosion is indeed far below the rate of soil formation.

Here in a nutshell, so to speak, we have the underlying hazard of civilization. By clearing and cultivating sloping lands for most of our lands are more or less sloping we expose soils to accelerated erosion by water or by wind and sometimes by both water and wind.

In doing this we enter upon a regime of self-destructive agriculture. The direful results of this suicidal agriculture have in the past been escaped by migration to new land or, where this was not feasible, by terracing slopes with rock walls as was done in ancient Phoenicia, Peru, and China.

Escape to new land is no longer a way out. We are brought face to face today with the necessity of finding out how to establish permanent agriculture on our farms under cultivation before they are damaged beyond reclamation, and before the food supply of a growing population becomes deficient.

In an underpopulated land such as ours, farmed extensively rather than intensively, there will be considerable slack before privations on a national scale overtake us. But privations of individual farm families, resulting from wastage of soil by erosion, are indicators of what will come to the Nation. As our population increases, farm production will go down from depletion of soil resources unless measures of soil conservation are put into effect throughout the land.

We must be in possession of a certain amount of abundance to be provident: a starving farmer will eat his seed grain; you will do it and I will do it, even though we know it will be fatal to next year's crop. Now is the time, while we still have much good land capable of restoration to full or greater productivity, to carry through a full program of soil and water conservation. Such is necessary for building here a civilization that will not fall as have others whose ruins we have studied in this bulletin.

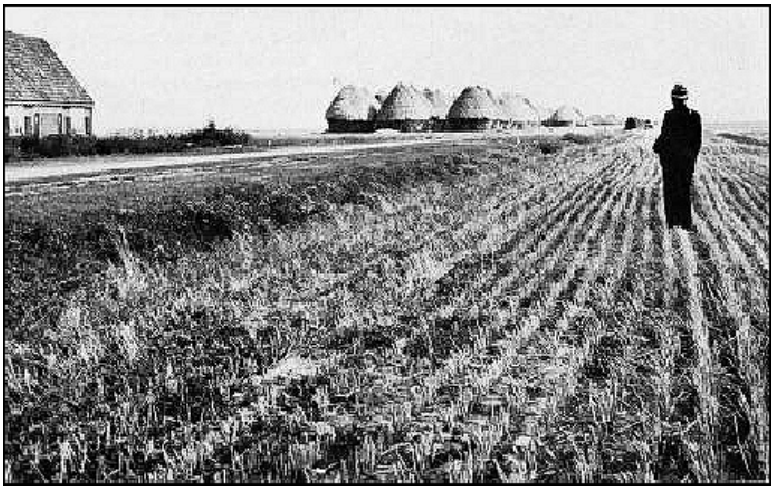

FIGURE 15.A formerly productive field in Virginia that has been cut to pieces by gully erosion. About 50 million acres of good farm land in the United States have been ruined for further practical cultivation by similar types of erosion.

A solution to the problem of farming sloping lands must be found if we are to establish an enduring agriculture in the United States. We have only about 100 million acres of flat alluvial land where the erosion hazard is negligible, out of 460 million acres of land suitable for crops. Most of our production comes from sloping lands where the hazard of soil erosion is ever present. This calls urgently for the discovery, adaptation, and application of measures for conserving our soils.

In the results of the Statesville erosion experiment station we saw how a forest with its ground litter was effective in keeping down the rate of soil erosion well within rates of soil formation. Out of untold ages of unending reactions between forces of erosion that wear down the land and forces of plant growth that build up the land through vegetation, the layer of forest litter has proved to be the most effective natural agent in reducing surface wash of soil to a minimum. Here is clearly our objective for a permanent agriculture, namely, to safeguard the physical body of the soil resource and to keep down erosion wastage under cultivation as nearly as possible to this geologic norm of erosion under natural vegetation.

FIGURE 16.This airplane view shows parts of six different farms near Temple, Tex., where the farmers have banded together to combat erosion as a community problem

A few years ago I came upon a hill farmer in an obscure part of the mountains of Georgia. He was trying to apply on his cornfield the function of forest litter as he saw it under the nearby forest on the same slope and same type of soil.

It was for me a great experience to talk with J. Mack Gowder of Hall County, Ga., about the fields he had cultivated for 20 years in a way that has caught the imagination of thoughtful agriculturists of the Nation. We talked about the simple device of forest ground litter and how effective it is in preventing soil erosion even on steep slopes, and how he thought that if litter at the ground surface would work in the forest it ought also to work on his cultivated fields along the same slope.

Mr. Gowder told me how, as a young man when he bought this steep wooded land more than 20 years ago, he hoped to avoid the soil erosion that was ruining farms on smoother and better land of the country. He planned to do this by stirring his land with deep plowing but without turning the soil.

In this way, he could leave his crop litter at the surface to do the same kind of work that the forest litter does. Gowder chose a bull-tongue plow, only 4 inches wide, to do the trick. He told me that his neighbors laughed at him for such foolish ways of plowing. As

a concession to customs of the region, he put in channel terraces with a slight grade as a precaution against storm runoff from unusual rains. But, thus far, they have not been needed.

Now Gowder is cultivating topsoil on slopes up to 17 percent whereas his ridiculing neighbors have only subsoil to farm. They have lost all their topsoil by erosion.

Leaving crop litter, which is sometimes called stubble mulch or crop residue, at the ground surface in farming operations is one of the most significant contributions to American agriculture. Certain adaptations of the method need to be made to meet the problems of different farming regions, but the new principle is the contribution of importance.

Danger Signs in America

Sheet erosion develops into gullies if allowed to continue unchecked for a few years. Such gullies become numberless gutters, leading off storm waters and flash floods that gouge out miniature gorges and ruin the land for further cultivation (fig. 15). Material washed out of such gullies is swept down into river valleys to shoal streams, filling reservoirs, and destroying water storage for hydroelectric power and for irrigation.

One of the most important findings of this survey of the use of land through 7,000 years is that tillers of soil have encountered their greatest problem throughout the ages in trying to establish a permanent agriculture on sloping lands. We have read the record, as written on the land, of failures from place to place but of few instances of success. This same problem is with us in our new land of America, where millions of acres have been destroyed for further cultivation and abandoned.

The Way to an Enduring Agriculture

Our solution for safeguarding our soils on slopes where soil erosion by water is the hazard is (1) to increase the rainwater-intake capacity of the soil by retaining crop litter at the surface, soil improvement, crop rotations, and strip cropping on the contour and (2) to lead away unabsorbed storm waters in channels of broad-base terraces into outlet channels and into natural drainage channels. We have applied these measures during recent years over millions of acres as you may see from an airplane when you fly over the country.

Near Temple, Tex., in the drainage of North Elm Creek, 174 farmers of bordering farms formed a soil conservation association on a drainage basis, ignoring property and county lines in the same way as runoff water ignores such arbitrary lines (fig. 16). Terrace-outlet channels were laid out to carry water harmlessly through one farm and another to natural drainage channels. One terrace-outlet system may serve in this way as many as 5 farms. By this approach to conservation, it is possible to treat the land in accordance with its adaptabilities and to control storm waters according to hydraulic

principles. This is indeed physiographic engineering that builds a lasting basis for a thriving civilization.

This does not mean that we have yet found the final answer to full control of soil erosion. Our present practices may not yet stop erosion but will reduce it more and more as application of measures is more and more complete. These measures and others will need further improvement and adaptation to the problems as use of land becomes more and more intensive.

Wind erosion is a serious and destructive problem but restricted to a smaller area of the country than water erosion. Wind erosion attacks level as well as sloping cultivated land in semiarid parts of the country. Wind erosion sorts the soil more thoroughly than water erosion, lifting fine and fertile particles of soil aloft and leaving behind coarser and heavier particles that become sandy hummocks, then sand dunes. Such was the case in the so-called Dust Bowl of the Great Plains.

Control of wind erosion is based first upon a suiting of the land's use to its capabilities and conserving all or most all of the rain that falls on it. This calls for contour farming except on flat lands. Appropriate measures include strip shelter belts of crops, tillage practices that leave crop litter or residue at the surface, and rotations suited to moisture supplies in the soil. These, with progressive improvement of soil-management practices, will control wind erosion. It has proved a simpler task, however, to control wind erosion than the less spectacular but insidious water erosion.

Lessons From the Old World

In this discussion on lessons from the Old and New Worlds in conserving the vital heritage of our people, I have laid special emphasis on saving the physical body of soil resources rather than their fertility. Maintaining fertility falls properly to the farmer himself. Conserving the physical integrity of the soil resource falls to the Nation as well as to the farmer and landowner, in order to save the people's heritage and safeguard the national welfare. If the physical body of the soil resource is saved, we as a people are safeguarded in liberty of action. We can apply fertilizer and plant a choice of crops in accord with market demands and national needs.

If the soil is destroyed, then our liberty of choice and action is gone, condemning this and future generations to needless privations and dangers. So big is this job of saving our good land from further damage and of reclaiming to some useful purpose vast areas of seriously damaged land that full cooperation of the individual interest of farmers with technical leadership and assistance of the Government is not only desirable, but necessary, if we are to succeed.

Another conclusion from our survey of the use of land through 7,000 years, where economic conditions have changed for better or for worse more rapidly than climate, is that land after all is not an economic commodity. It is an integral part of the Nation even as its people are and requires protection by the individual owner and by the Nation as

well. Nowhere have we found more telling evidence of this than in California where gold in 1849 lured a host of people to the State, but soils of its valleys have maintained its settlement.

An "Eleventh Commandment"

When in Palestine in 1939, I pondered the problems of the use of the land through the ages. I wondered if Moses, when he was inspired to deliver the Ten Commandments to the Israelites in the Desert to establish man's relationship to his Creator and his fellow men if Moses had foreseen what was to become of the Promised Land after 3,000 years and what was to become of hundreds of millions of acres of once good lands such as I have seen in China, Korea, North Africa, the Near East, and in our own fair land of America if Moses had foreseen what suicidal agriculture would do to the land of the holy earth might not have been inspired to deliver another Commandment to establish man's relation to the earth and to complete man's trinity of responsibilities to his Creator, to his fellow men, and to the holy earth.

When invited to broadcast a talk on soil conservation in Jerusalem in June 1939, I gave for the first time what has been called an "Eleventh Commandment," as follows:

Thou shalt inherit the Holy Earth as a faithful steward, conserving its resources and productivity from generation to generation. Thou shalt safeguard thy fields from soil erosion, thy living waters from drying up, thy forests from desolation, and protect thy hills from overgrazing by thy herds, that thy descendants may have abundance forever. If any shall fail in this stewardship of the land thy fruitful fields shall become sterile stony ground and wasting gullies, and thy descendants shall decrease and live in poverty or perish from off the face of the earth.

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"**State and Private Forestry: Our History, Our Roots . . . at the Turning Point-or Not?**"

By Don Smith, Connecticut State Forester, 2005

Delivered at the National Association of State Foresters 2005 Annual Meeting in Madison, Wisconsin, 3 October 2005

Good morning, Ladies and gentlemen. I truly am honored to be with you all here today in this beautiful city between the lakes.

In the 30 minutes I have before you this morning, I want to talk to you about the people, events and influences that have brought us and the forest we love to this moment. I want to talk some about what the future may bring and the role the State Forester and state and private forest lands may have in that future.

Let's talk about the way it was.

When European settlers first arrived in the New World, it wasn't long before the settlers and their governments assumed an almost religious belief in the "Legend of Inexhaustibility", the idea that this continent's forests would last forever. As the Europeans pushed back from the seacoasts, they found forests that seemed to go on forever.

Explorers were astonished at the vastness of the forest. In 1721, the French Jesuit priest and explorer Charlevoix wrote that "We are in the midst of the greatest forests in the world. They are as old as the world, itself, and there is nothing perhaps in nature comparable to them." For 250 years from the time of Jamestown and Plymouth, the seemingly endless forests of North America fueled the development of a new nation. By the time the 1800's rolled around, the Legend of Inexhaustibility had become a conviction held by the vast majority of the nation's citizens.

As our history has shown time and again, when humans believe something will endure forever, we begin to take it for granted. We become careless with it. As we all know, the few voices of caution heard at the turn of the 19th century were prophetic. Our ancestors were careless in the way they treated this nation's natural resources. But such words of caution fell on deaf ears and were basically regarded as heresy until well into the 1870's.

Our nation's westward push following the Civil War spawned an unprecedented epidemic of railroad building and construction of new cities and towns. The pressing demand for wood stimulated the invention of new harvesting technologies to feed increasingly larger and more efficient sawmills. In short order, the forests of the east, the south and the Midwest were ravaged and the voice of caution quickly grew louder.

In 1873, the American Association for the Advancement of Science held its national convention in Portland, Maine. At that convention, Dr. Franklin Hough of Lowville, New York presented a paper on "The Duty of Government in the Preservation of Forests." His paper was well received and resulted in a petition to Congress for action with regard to the preservation of forests and the cultivation of timber. Many regard Dr. Hough's paper as the first in a chain of events that brought about the creation of what we now know as the Forest Service – and the State & Private Forestry programs within the Forest Service.

Dr. Bernhard Fernow assumed control of the new federal Division of Forestry in 1886 and worked hard to lay the groundwork for the states to create their own forestry agencies. He immediately set the Division to promoting State forestry agencies and providing useful practical assistance throughout the national forestry community.

In his first report, he made a statement about European forestry that I was most impressed with. He wrote: "It is not the control of the Government over private property, it is not the exercise of eminent domain, it is not police regulations and restrictions that have produced desirable effect upon private forestry abroad, but simply the example of a systematic and successful management of its own forests, and the opportunity offered by the government to the private forest owner of availing himself of the advice and guidance of well-qualified forestry officials." Nearly 120 years ago, in 1886, the head of the agency that would become the US Forest Service embraced the philosophy that forms the root of what our State forestry agencies do today. Simply put: "Lead by example - and educate."

Gifford Pinchot took the reins of the fledgling organization and, during his tenure, shaped the framework of the Forest Service to much as we see it today. It was under Pinchot that virtually all the forestry work of the nation was transferred to the Bureau of Forestry, which was re-titled the Forest Service on July 1, 1905.

Henry S. Graves succeeded Pinchot in 1910 and almost immediately established the Forest Products Laboratory here, in Madison, Wisconsin. We all understand and greatly appreciate the astounding advances in wood technology that have issued from the Forest Products Lab in 95 years. These advances have opened new markets for wood products from State and private forests and thus contributed additional incentives for the application of forest management on those lands. I think it is absolutely wonderful that we will be visiting and touring the Lab. The Lab is an integral part of our history – and must be a part of our future.

Graves also saw the landmark Weeks Act signed into law on March 1, 1911. The law authorized the federal government to acquire land as national forests. Initially, eastern lands along navigable watersheds were considered.

As the years progressed however, the Forest Service relied upon the Weeks Law to also enable the acquisition of select western lands. Graves organized the Research

Branch of the Forest Service — the source of the Forest Inventory & Analysis information upon which we depend so heavily today.

During Grave's tenure, the Smith-Lever Act of 1914 established a Federal-State Cooperative Extension program to provide education for the public in agriculture and natural resources. Today, this educational system includes professionals in each of America's 1862 land-grant universities, in Tuskegee University and in sixteen 1890 land-grant universities. All of us in this room appreciate just how immense a contribution the Cooperative Extension system has made and continues to make to the future of our nation's privately-owned forest lands

William B. Greeley was appointed chief in 1920. During his 8 years at the helm, the Clark-McNary Act of June 7, 1924 broadened federal/state cooperative efforts to include producing and distributing tree seedlings and providing forestry assistance to farmers. The Clark-McNary Act also provided a strong incentive to States to establish and support State forestry agencies. Most of us sitting here today owe the existence of our state forestry agencies to the Clark/McNary Act.

Ferdinand A. Silcox was appointed Chief of the Forest Service in 1933. Especially significant during his 6 years in office was his success in focusing public attention on the conservation problems of private forest land ownership.

It was during his turn at the helm of the Forest Service that the Civilian Conservation Corps and the Works Progress Administration lent so monumental a hand to the then and future management of the nation's federal and state forests. Each State Forester - in fact, every American citizen - owes a debt of gratitude to Chief Silcox, to those who worked under him and to the men of the CCCs and the WPA who worked in the woods. The accomplishments of that army of conservation workers are of historic proportion, far reaching and far, far too numerous to relate here today.

A flurry of government incentives for private forestlands were spawned in the 1950's and 60's as the Cooperative Forest Management Act, the Soil Bank Program and the McIntire -Stennis Cooperative Forestry Research Program all came into being.

The Cooperative Forest Management Act of 1950 gave authority to the U.S. Forest Service to work with private landowners through state agencies and formed the basis of State administration of federal forestry programs for private lands and forest-based industries for decades to come.

Good fortune continued to smile on state and private forestry programs through the 1970s and beyond. The Cooperative Forestry Assistance Act of 1978 re-wired and juiced up the old CFM for the modern era of forestry.

Since then, the various Farm Bills of 1985, 1990, 1996, and 2002 have built upon the array of programs initiated by the CFM Act of the 1950's.

A seminal event occurred in the latter half of the 20th century that caused a fundamental shift in the theater of public opinion and, thus wrought significant change in the world of North American forestry.

Following World War II, the demand for wood products became ever more intense. The nation increasingly looked to its National Forests for raw materials and in just 25 years, timber production from the National Forest System increased twelve fold.

In the late 1960s, the clearcutting and terracing of slopes on the Bitterroot National Forest became the lightning rod of the clearcutting issue. Protests erupted after a series of sensational articles in the Missoula, Montana, newspaper (the Missoulian). Shortly afterward, a second clearcutting controversy erupted on the Monongahela National Forest in West Virginia, intensifying the debate over clearcutting and forest management.

The extraordinary publicity surrounding the Bitterroot and the Monongahela brought widespread condemnation of the practice of clearcutting. It didn't matter that the vast majority of Americans didn't understand what clearcutting was. In the lexicon of the times, the cutting of ANY tree was regarded as a clearcut – and therefore an anathema.

The public relations damage to the practice of forest management across the United States was almost immediate and certainly long-lasting. Every time a skidder was spotted in the woods some form of protest or outcry was sure to follow. Speaking from my personal experience, in Connecticut, only horse logging was spared the lash.

As a consequence of the Bitterroot/Monongahela controversy, in order to ease a landowner's anxiety over forest management, state and private foresters were forced to engage in the long, repetitive process of patiently explaining that there was a difference between the Bitterroot and Monongahela cuts and the type of forest management that was most appropriate for their forests. Gradually, a growing general awareness of both the benefits and adverse effects of various forest management practices on the ecosystem has emerged. And yet, we're still explaining today, some 35 years later.

Gratefully, the state and private forests and their management have evolved and distanced themselves from the early blissful ignorance of the "Legend of Inexhaustibility" and its wasteful, abusive practices. Today, the state and private forests of the United States are served by a sophisticated, ecologically responsive suite of services and programs that echo the twin paradigms of stewardship and sustainability.

The state and private lands successes during the end of the 19th and first half of the 20th centuries came about through a miraculous confluence of forceful, articulate and dedicated national leaders, an unprecedented demand for domestic wood products to fuel the growth of a young nation, a unique set of economic conditions, and the wakening of the American citizen to the place of the American forest in their lives.

Sounds like we've attained a state and private forestry brand of utopia, doesn't it, my friends? Perhaps we can take a break and rest on our laurels for a while...pat ourselves on the back, so to speak.

Well, not so fast. A show of hands, State Foresters:

- How many of you have as many staff as you need?
- How many of you have as many staff as you had 10 years ago?
- How many of you have reason to believe that your staff numbers will grow over the next 10 years?
- How many of you enjoy state-based funding that has grown faster than the rate of inflation over the past 10 years?
- How many of you have fewer programs to administer today than you had 10 years ago?

Shortly after I became Connecticut's 13th State Forester, I was asked to prioritize the programs of the Division of Forestry – in preparation for significant budget cuts that were in the offing. To do that, I had to soberly reflect upon where my Division's meager resources ought best be expended. In preparation for today's talk, I went through a similarly reflective exercise. There are disquieting clouds gathering on the horizon. The hairs on the back of my neck are telling me that a crisis or two are brewing and that the future of state & private forests and their management hangs in the balance.

My conclusions can be distilled down to four basic priorities:

I believe that, as leaders in the field of conservation and responsible stewardship, the first priority of each State Forester and of this organization must be to <u>retain</u> or increase the integrity of our nation's forest ecosystems.

During most of the 20th century, the amount of forest land in the United States remained essentially unchanged.

Recently, however, an increasing amount of forested acres in many states has been lost to development or to a shift from traditional forest to more highly fragmented, more urban forest. This trend is the result of uncontrolled urban expansion, a lack of practicable land use policies, and limited economic incentives to own and manage forest land. Fragmentation, parcelization and urbanization is a cancer that is inexorably destroying the ecological integrity of the forests of America. If our forests are to continue to provide the variety of amenities for life in this nation, we must find a cure for this cancer.

This cannot be an easy task, my friends. The uniquely American lifestyle contributes to the fragmentation of forests. In their drive to own a piece of wilderness, more and more Americans are moving to rural areas and building big houses on large lots.

This human-caused forest fragmentation disrupts many ecological processes and threatens the health and sustainability of forests. It endangers wildlife habitats, plant and wildlife diversity, and water quality. Fragmentation also compromises the economic value of a forest as a recreational or timber resource. When you think about it, fragmentation destroys the very thing that draws humans to live in the forest in the first place. It eats away at the unbroken forests' inherent, natural beauty. People are loving the forests of America to death.

What can we do to address this problem? We are the experts – and we have discussed parcelization, fragmentation and urbanization among ourselves – as experts. We are the trusted servants of the public — and yet we have not seriously tried to raise their awareness of this insidious problem. It is time to sound the alarm and educate, educate, educate!

We must teach a nation in love with its forests to "Love it and Leave it!" People must learn to be content with recreating in the forest in as many sustainable pursuits as may be invented — and then leaving the forest to go home. The drive to own a chunk of our continent's precious forested lands must end.

The future of the forests of America lies in the quality of life in America's cities. If we can make our cities a joy to live in, the demand to carve up the forests of America will abate. Ironically, if we as State Foresters are to protect the integrity of our nation's forests, we must become the strongest of advocates for the renewal of our nation's cities. We need to advocate for more than just our own parochial interest in urban forestry funding. We must be even stronger advocates for all urban quality of life issues — for better services, better public safety, better education, better public transportation, better local recreational facilities.

On the supply side of the equation are those who now own the forest and are prone to subdivide it, carving it into chunks for sale.

In general, Americans believe that a landowner should have the right to do anything on or to his land, provided his actions don't infringe on others. Americans believe that a landowner should have the right to sell all or part of his land if he wants to. Yes, we're all about property rights - and that's fine — in most cases.

But we, as State Foresters, know — or we should know — that there is a difference between property rights and property responsibilities. While a landowner may have the legal right to destroy the forest he owns by, cutting it up and selling it, piecemeal, every landowner has an ethical responsibility to honor the future. Every landowner has an obligation to be a steward of the land for the future.

State Foresters need to become the loud and insistent conscience of today's forest land owner. In today's world, where the seductive lure of profit has become a justification for any action, State Foresters need to shout a counter-cultural message: "Subdivision is

wrong. Your responsibilities as a trustee for the future supersede your rights as a landowner."

I know what you're thinking — it's useless . . . we'll be tilting at windmills and doomed to failure. Maybe - or maybe not. But, it doesn't really matter, does it? It's the truth and we have to say it. We have to say it loud and long. Because, if we don't speak up for the integrity of the forest for the future; we are betraying that future - and betraying our past - and we have no right to call ourselves leaders.

The National Association of State Foresters has tremendous potential to lead in protecting the viability of privately owned forests and strengthening the incentives for forest stewardship. This is truly our turf, and yet, in my 13 years as a member of NASF, this organization has not meaningfully studied the role that federal, state and local taxation systems play in the involuntary liquidation and parcelization of family-owned farms, ranches, and forests. Private forest owners are an endangered species — upon which the well-being of all other endangered species clearly depends. It is time for NASF to call together America's best minds for a comprehensive review of federal, state and local forest taxation policies and practices – and to recommend broad changes at the federal, state and local levels to insure the future of privately owned forests.

I believe our second priority must be to act to <u>protect</u> our nation's existing forest resources from damaging agents that effect broad areas of forested land.

We all know Smokey's mantra by heart. We're also familiar with the more recent messages pertaining to fire in the wildland/urban interface. And, yes, wildfire is a damaging agent for our nation's forests. But, our concern for the safety of the forest must extend beyond the old saw of fire.

We should recognize and act on what may be a greater imperative – that of protecting the forest from poor or abusive management practices. Slipshod pseudo-forestry and flat-out abusive practices have the potential to devastate the genetic characteristics of forest stands. The damage from bad forest practices can take generations to resolve – and, in some cases the ecological and economic potential of the forest will be ruined forever. We, as State Foresters are expected to act to be certain that our management of the public forests in our charge is technically appropriate and environmentally responsive. We must also act to insure that the practitioners of forestry and forest management on private lands do no less.

When European settlers first arrived on this continent, globalization also arrived. Europeans brought new diseases and pests with them – and the New World was defenseless against them. Are things significantly different today? Only in that, thanks to advances in transportation, the spread of new diseases and pests can occur in the span of hours rather than months or years. For our forests, the threat of non-native invasive insects and plants – and exotic diseases – has never been more immediate and our forests are, essentially, defenseless. The Asian Long-horned Beetle, Emerald Ash Borer, and Sudden Oak Death are all poster children for what's wrong with the

regulation of interstate commerce. The prospect of any such pest arriving in your state through infected shipments is not only bad for the forest, it is bad for commerce. It is bad for the nursery industry; it is bad for the timber industry. In the case of Sudden Oak Death, shipments with infected plants or plants exposed to infection were shipped throughout the East Coast - despite quarantine. That kind of quarantine is no quarantine.

It is true that, under the Constitution, no individual state can regulate interstate commerce - but the United States Congress can. The National Association of State Foresters ought to be demanding that Congress better regulate interstate commerce.

Protecting our state and private forests must also include shielding them from extremes in policy or regulation. At one extreme, there are those who advocate for policies that would place unreasonable and non-sustainable demands on the state and private forests of the nation.

At the other extreme, there are those who would bar any use of the state and private forest, sustainable or otherwise, effectively putting our nation's greatest asset in the proverbial "lockbox" and throwing away the key. State Foresters are called to lead policymakers and public, alike, to understand and endorse a balanced approach towards the use and care of the nation's forested lands.

It is a daunting task, my friends – because forestry has a persistent image problem. As Adam Moore, the Executive Director of the Connecticut Forest & Park Association said in a recent speech, the thing about forestry is that we cannot hide the aspects of this business that are ugly and violent. Agriculture doesn't have this problem. Cows grazing in the field look wonderfully pastoral – and steak looks great in the supermarket. But those who enjoy a sizzling steak, hot off the grill, don't see what happens in the slaughterhouse.

Trees also look great as they stand majestically in the woods – and lumber looks great at the lumberyard. But, for the most part, logging is a violent activity that, to the untrained eye looks pretty bad. There is no concealing it. The forestry version of the slaughterhouse is right out there in the open, for everyone to see. The unsightliness of logging has been, and probably always will be, a problem for forestry. There is an opportunity here for us, as leaders, to be frank and honest about that. Honesty in government can be refreshing, nowadays. We have an opportunity before us, the leaders of the profession of forestry, which is conducted in both the public and private sectors, to take a stand for honesty and openness. We can show the public: this is where your lumber comes from, this is where your paper comes from, this is how we do it.

Like the inevitability of death and taxes, debates over appropriate uses of forests will continue to rage – and, in those debates, the State Forester cannot afford to be viewed as anti-environmentalist. The trick is to be a positive force in the discourse that will take place. We need to recognize that whether we are State Foresters, members of

organized environmental groups, or simply members of the common ruck, each of us look for many of the same things in life: clean air; clean water; good jobs; a safe, healthy environment; and healthy, diverse forests. These are reasonable expectations. We simply cannot afford to expend our energy battling with a small number of organized environmentalists over different ways of working toward the same goals. As leaders, we need to think seriously about how we can play a larger, more visible role in achieving these positive societal goals.

I believe that our third priority should be to responsibly and effectively <u>manage</u> our publicly-owned forested lands.

Each of us has been entrusted with the management of forest lands for the public good. Over the past few generations, the citizens of our respective states made conscious decisions to fund the purchase of specific lands and to place those lands under the care of their State government. Good and trusting people with a vision to the future set aside these lands as their loving gift to descendants that they will never know. To honor those expectations, we are called upon to be stewards of these lands for the future.

Finally, I believe that our fourth priority must be to <u>motivate</u> and <u>educate</u> those who own forested lands and those who earn a living from them to embrace the concept of forest stewardship and to employ sound forest management practices on the land.

I spoke earlier about the difference between property rights and property responsibilities as they pertain to forest fragmentation. The concept of rights versus responsibilities also applies to the care of the forest. All forest land owners need to exercise their property responsibilities as well as their property rights. This means approaching their forests not from the perspective of "What is the minimum we can get by with while yet complying with laws and regulations?" but from the perspective of "What do we need to do to honor our responsibilities to our neighbors, to those who depend on the forest for its economic contributions, and to future generations?" This is what forestry is all about. It is all about how to manage and sustainably use forests for human benefit.

It is a sad statement, but true, that there are foresters and forest products harvesters who care nothing for the future. Each of us here could probably relate at least a few instances of abusive forest practices and the ne'er-do-wells that perpetrate them. As leaders of our respective local forestry communities, we should be encouraging foresters and harvesters to recognize that forestry is far broader than just timber sales and inventory. If a trail is to be established in the forest, that is the forester's domain. If warbler habitat is the goal, if scenic vistas are the goal, those, too, are the work of the forester. If there is an endangered plant in the forest, it is the forester's duty – and privilege – to care for that plant. Truly, what an honor it is to be charged with the care and nursing of a species teetering on the brink of extinction. Too many foresters and loggers view endangered species as roadblocks to their limited view of forest management.

If the history of state and private forests in America reveals anything, it is that land and people are intertwined throughout that history. It took 250 years for the Legend of Inexhaustibility to be seriously challenged. Another 100 years of selfless dedication by a series of charismatic and influential national, state and local forest conservation leaders saw the return of the forest and the development of a suite of forestry programs and services targeting our nation's state and private forestlands. In the past 30 years, user demands on State-owned forestland have dramatically increased as have threats to the continued viability of privately-owned forested lands. This is a pivotal time in the history of the state and private forest lands of this nation.

It is a moment that cries out for a new cadre of charismatic and influential national, state and local forest conservation leaders.

Now is the time for NASF to step forward and become the catalyst . . . calling out the visionary, charismatic and influential from within its own ranks and from across the breadth of our nation's forestry community to lay the foundation for the next century of progress.

Those who came before expect it of us - and we owe it to those who are yet to come.

MICHIGAN STATE UNIVERSITY EXTENSION

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