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TOURISTS find the eroded "hoodoos" of Banff picturesque; they marvel over the wild beauty of the bad lands of South Dakota, the many-coloured pillars of Bryce Canyon in Utah, and the shimmering Jacob's coat of the Arizona desert; but they seldom give a thought to the fact these are *dead* lands. They died because they were unprotected from sun and wind and denuded of water . . . and such may become millions of acres of Canada unless heed is given quickly to conservation.

War against encroachment of the desert is never-ending. Old-time conservation and irrigation schemes were pretty good, considering that the digging of ditches and building of terraces had to be done by hand, but unless the world is to go in for soilless culture of crops it is time for a big new effort using all the knowledge and resources of modern science. The population of the world has increased from 465 million around the year 1650 to somewhere about 2,200 million. That means, if everyone is to have three meals a day, an additional drain on farm land of 1,900,000,000,000 meals out of every year's crop of grains, vegetables, livestock fodder, and all the other things which contribute to human diet.

Talking about meals brings the matter of conservation down out of the clouds of hypothesis, and makes it a matter of immediate interest to every man, woman and child. Destruction of resources — and there is no more important resource than the eight or ten inches of topsoil — is an injury with wide implications. The response people make now to the demand for conservation will spell the difference between food and famine in the next few generations.

While the tragic history of a few decades has focussed attention on sections of the Canadian West, the need for preservation and restoration in Eastern Canada is also pressing. The "Garden Province" is being washed away, little by little. Workmen had to go through 90 feet of mud to reach a solid foundation for bridge piers at Charlottetown, "mud" which was once the fertile topsoil of crop-growing acres. In New Brunswick it is reported that one week of high water in the Saint John River carries down as much silt as would cover more than 3,000 acres to a depth of one inch. Ontario is exercised because not only are good agricultural lands being swept away, adding

new devastation to the abandoned lands which should never have been opened to agriculture, but rivers are being spoiled because silt injures the chances of breeding and feeding fish. Quebec has set aside a ten-year fund of \$10 million to be spent on approved schemes of land utilization.

Since the first period of settlement of the Canadian West, there have been many difficulties, but none greater than drought and erosion. Before that time, three reports had been made, starting with that on the investigation by Captain John Palliser in 1857. He reported unfavourably, outlining "arid plains" extending in a triangle based upon the United States border, running from a point near Brandon and a point near Waterton Lakes, to an apex near Saskatoon. Basing his opinion on the climate, the soil and the lack of fuel, Henry Y. Hind, English geologist, confirmed Palliser's opinion. Fifteen years later, in a period of heavy rainfall, John Macoun reported enthusiastically to the Dominion Government. There were 200 million acres suitable for agriculture, he said. This is about half the total area of what are now the Prairie Provinces. Settlement followed rapidly, without any comprehensive planning. An indication of the fluctuations suffered in this promising land may be had by comparing the wheat crop figures for 1928, a year of bountiful rain, and 1937, a year of drought, with practically identical acreage in both years.

	1928		1937	
	bushels	per acre	bushels	per acre
Saskatchewan	321,215,000	23.3	36,000,000	2.6
Three Prairie Provinces	544,508,000	23.5	156,800,000	6.4

Soil erosion by wind is a difficult problem of the west, and many farms have been abandoned because of it. This is not a new plague. As early as 1887 there was severe drifting at the Indian Head experimental farm. Monarch, in Southern Alberta, made apparently the first determined attempt to control drifting, and such good progress has been made since 1918 that this district is regarded as the most outstanding example in Canada of successful control, even in an area where serious drifting is to be expected almost every year.

Soil does not blow if it is adequately covered by vegetation, and it does not wash out if there are forests to soak up the rainfall on the heights and grass or adequate crops to halt the flow on slopes

or on the level. But one small area on a farm, left unprotected, may be attacked by wind or rain and the damage will spread to neighbouring fields, farms, counties and municipalities.

Soil erosion has been called a "creeping death." It is fatal not only to growth of plants but to the development of man. Concurrent with a farmer's realization that his farm is washing or blowing away, with consequent loss of productivity and revenue, there comes loss of morale. A rural population of prosperous and contented farmers is an asset every country needs, but if morale is destroyed, and farmers become apathetic, the whole country suffers. Prosperity on individual farms brings with it benefit to neighbouring merchants, distant suppliers of farm machinery, and factories all over the Dominion. These successful farmers contribute to the national income, and they provide exportable goods which increase Canada's world trade, with consequent raising of the standard of living throughout the country.

Wasting of capital, in the form of the soil's productiveness, is obviously chief among the hazards to be guarded against. Not many years ago it would have seemed silly to suggest that farms should be "managed" as are business enterprises, and that records should be kept, but times have changed. Farm management studies and records of production acre by acre would show very quickly where attention was needed to retain or restore fertility. The exchange of information and views which such records would make possible would widen the base upon which every farmer could assess his progress and plan his future.

Correction of mistakes made when land was settled, or reparation of the damage done by mistaken usage or neglect of precautions, cannot be accomplished in a month or a year, but it should be started right now. The beginning of a conservation system of land use need not be expensive, and such a system should, in all average cases, prove to be more productive in quantity and quality than are exploitative systems.

Under conditions of low productivity, not only the farmer and his family are affected, but the whole community. A rural municipality, like any other, requires steady taxpayers. The whole countryside suffers through lack of funds for education, road building, bridge construction, and many other necessary and desirable projects, if the tax-paying ability of those who live there is reduced.

The level of employment in manufacturing is affected by the purchasing power of all the people, and farm people make up 27 per cent of Canada's population. If the living standard of 27 per cent of a country's population is at a low level, from whatever cause, it is obvious that the standard of living will be depressed everywhere in the country.

Look at another aspect of this chain of cause and effect. When soils drift, the cost of maintaining railway lines is increased. Road allowances are drifted over. Tumbling weed catches soil, and piles up mounds on which a buggy can be driven over the fence. How much mental upset and weakened morale are due to dust storms is known only to those who

have lived in the west. The strain on housewives is particularly severe. They must endure dirt and soil particles in food, on furniture and drifted over the floor. Erosion affects all of living. Like its own "blow spots" the damage is small at first, but insidious and deadly.

In one small area in Ontario there are 75 farm buildings classed as fair or poor, while 44 buildings have been abandoned or levelled, every one an unwritten story of hope, toil and disappointment. In some cases the land was good to start with, but it was farmed without foresight. The plow made it ready for carrying away by wind and water. Productivity declined. Income decreased. Sons and daughters went away to cities. A farm which housed, fed and clothed a big family only a few years ago supports no one, and is a menace to its neighbours. Once it deposited money in banks, bought machinery, was the mainstay of local retail business and a customer of the mail order houses. It helped feed cities. Today it buys nothing, pays no taxes, produces nothing to add to the national income or the welfare of the country, feeds no one.

Look westward. In 1941 there were more than 4 million acres of abandoned farms in the Prairie Provinces, an acreage which, at the long time average yield of 15.6 bushels per acre, might produce 62,400,000 bushels of wheat a year if the land had been saved.

In view of these alarming facts about the result of erosion upon the well-being of individual farmers, business, community life and the nation at large, it may be worthwhile to examine briefly just what erosion is, how it comes about, and some of the consequences. The two chief causes of erosion are wind and water. The slope of land is an important factor, as are temperature, rainfall, and the physical nature of the soil. The proportion of rainfall which remains usefully available is determined by three factors: evaporation, underground water, and surface or run-off water. In the absence of retarding factors, such as vegetation or mechanically-contrived obstacles like dams, terraces and ditches, the run-off water washes away soil from the surface of the ground, carries it into water courses, and, ultimately loses it as silt.

This sheet erosion is particularly dangerous because it is scarcely noticed. It may go on for years, the farmer not realizing what is happening except that he finds certain spots decreasing in their crop yield. Sheet erosion is not so spectacular as gully erosion, but since it is difficult to see, it is all the more serious. To walk out into an unprotected cultivated field after a heavy rain storm is to walk up against a force of nature as implacable and ungetatable as the Great Boyg:

"mild, invisible, limp, unviolent, pervasive . . .
Neither dead, nor alive; slime and mistiness;
No shape or form."

And, like Peer Gynt in Ibsen's lyrical drama, the farmer is foiled by the apparently unreachable nature of the power that is ruining him so slyly, because "The great Boyg can triumph without any fighting", and the farmer sees nothing concrete that he can battle.

Where the land slopes, or where the surface of the field falls into slight natural channels, small rills are created after heavy rain or when the snow melts. Neglected, the rills form gullies, but gullies may also follow ruts formed by wagon wheels, the trails made by livestock, or even furrows running up and down the slope. These grow like compound interest. There are many gullies a hundred feet or more in depth, carrying off surface soil by the ton.

To realize the importance of doing something *now* in the war on erosion, it is not necessary to go far afield. The beginnings of desolation may be seen within easy reach of every community in Canada. Around Drumheller, in Alberta, farmers have a dramatic object lesson before their eyes day in and day out. Stretches of the valley are gashed with gully erosion, carved by wind and water into fantastic pillars and mounds, grey and dead, useless as land on the moon. The only living growth is an occasional sage or cactus. South, in the foothills, streams which flowed the year round and yielded rich catches of trout thirty years ago now run dry a month after the snow melts. Even far back in the hills the only water to be had from a once-plentiful spring has to be squeezed from mud.

All around these scenes there are millions of acres of still useful land, bearing rich crops; but they must be saved, starting now, or they will go the way of the desert, the badlands, and the dying streams.

In addition to slowing down the wind and the water, reducing their capacity to transport soil, it is necessary to rebuild and maintain fertility. The science of soils is complicated, and they vary greatly from one district to another. It is not enough to keep the soil in place, because what the farmer seeks is not merely to save his land but to have it give secure production, now and later on. Having pinned down the earth so that it does not blow or wash away, conservation will proceed to recharge it with plant food.

The problem is immediate. Two English scientists, G. V. Jacks and R. O. Whyte, joint authors of the book "Vanishing Lands", have reported: "As the result solely of human mismanagement, the soils upon which men have attempted to found new civilizations are disappearing, washed away by water and blown away by wind. Today, destruction of the earth's thin living cover is proceeding at a rate and on a scale unparalleled in history, and when that thin cover — the soil — is gone, the fertile regions where it formerly lay will be uninhabitable deserts." Does it, then, seem far-fetched when the Farm Equipment Dealer reports that about 14 per cent of the land on this continent has already lost all of its crop-growing capacity? Or when Professor A. F. Coventry of the Department of Zoology, University of Toronto, says there are in the agricultural part of Ontario some 5 million acres, about one sixth of the whole, unfit for anything except trees, but lacking the trees? Soil drifted from one acre, to a depth of one inch, is equivalent to the removal of about 700 pounds of nitrogen, 155 pounds of phosphorus, and 5,380 pounds of potash. This amount of phosphorus alone, says a pamphlet distributed by the Dominion Department of Agriculture, is equal to that removed from the soil in the production of 485 bushels of wheat. Dr. Wyatt, of the

University of Alberta, is quoted as saying it would take from \$200 to \$350 per acre in commercial fertilizer to restore these vital minerals.

Do these things seem exaggerated? Let anyone inclined to sneer at the power of water take a look at Marble Canyon, in the British Columbia Rockies. Little Tolumn Creek has worn a cleft in marble walls to a depth of 200 feet. "Drive along Highway 7, north-east from Toronto", is the invitation offered disbelievers by an article in Saturday Night. "Observe the weeds and the uneven growth of grain. See how in nearly every field there are patches where the growth is scanty, like tiny thin spots on a man's pate. In nine cases out of ten the enemy is sheet erosion." When the West Humber River, Ontario, was in flood in 1942, Professor Coventry measured its flow and the load of soil being carried down. The estimated amount of sediment was 2,400 tons an hour.

How long can this go on? Scientists tell us that it takes nature about five hundred years to make one inch of good topsoil, but this precious source of food and living is being washed from beneath our feet or blown into the air at terrific rates. Look at China, where topsoil has become so precious in the washed-out sections that men have been known to slip from their homes during the night to steal soil by the handfuls from neighbours, so as to have enough to grow beans to feed their families.

The millions of tons of Canada's fertile topsoil which have been washed into the ocean cannot be replaced, and certain natural processes of erosion cannot be completely stopped, though the losses can be reduced to moderate proportions. The Palliser triangle will not be safe until dust storms cease there, the land nailed down by the roots of grass and by scientific mechanical usages. There will never be more land, but there is still time to save what we have, if Canadians take notice of the need.

Much good has been accomplished under the Prairie Farm Rehabilitation Act, passed by Parliament in April 1935 to provide for the rehabilitation of the drought and soil-drifting areas in the open plains of Manitoba, Saskatchewan and Alberta. Using all necessary resources of the Dominion and Provincial Departments of Agriculture, and co-ordinating all existing agencies, the P.F.R.A. groups its activities under these headings: cultural work, land utilization, and water development. The cultural work has benefited directly or indirectly more than 12 million acres of farm land, and possibly one million acres by re-grassing. Tree planting as part of home building and providing shelter belts has been greatly stimulated. Individual or small water development work is directly benefiting some 25,000 farmers, while thousands more are being served by community projects. Fifty district experiment substations were established on different soil types and under different climatic conditions, where the success of such measures as strip farming, scientific crop rotation, ploughless fallow, trash cover, cloddy culture, cover crops and types of machinery different from those commonly used could be proven. Irrigation deserves a volume in itself, not only because of its conservation possibilities, but because it adds so much to the earning capacity of certain lands.

Other things are needed, of course. There needs to be afforestation of the upper catchment areas of rivers, with proper and sustained management of both these reserves and other forested lands. Limitation of herds and flocks is needed in accordance with what the vegetation can support. Some people protest because there are so many "do not's" in the reclamation picture. But reclamation must needs have prohibitions, so that all the good work done by one section of a community shall not be wiped out by the thoughtless or selfish actions of another section. Conservation of soil must have dynamic methods. Dust bowls in the west, and washed-out areas in the east, cannot be reclaimed by namby-pamby half measures, nor can the topsoil of Canada be nailed down without sharp tacks and elbow grease.

A farmer who is sold on the idea of conservation of soil would be well-advised to use the facilities afforded him by governmental agencies and by agricultural organizations. The first task is to determine to what use the different parts of his land are to be put, with one eye on the probable crop yield and the other eye on placing crop, pasture and woodland so as to provide the most complete protection against erosion by water and wind. The second task is to determine what to do about conditions already calling for treatment: water washing, leaching, drifting and blowing. The third task is to take the accumulated knowledge and experience from all available sources, and apply them intelligently and energetically.

Canadian farmers during the war stepped up production by about fifty per cent. Operating an industry valued at \$5 billion and turning out \$1½ billion worth of farm products annually, they have come a long way during the past sixty years, it was pointed out recently by L. B. Thomson, President of the Agricultural Institute of Canada. In an article published in the *Agricultural Institute Review* in May, Mr. Thomson gives sage advice and timely warning: "This progress was made possible by the farmer applying his experience and the findings of scientists to the cultivation of farm lands, to the growing of crops, and to the raising of livestock. However, if agriculture is to maintain its position in the Canadian economy and if Canadian farm goods are to be able to compete on world markets, farmers must be able to introduce scientific farming on an ever-increasing scale. It is recognized by all that farming can no longer be done by rule-of-thumb. Scientific agriculture today makes farming a profession."

Preparation of a plan of conservation is a job for experts; carrying out the plan requires scientifically-trained men. At the farmers' level, enthusiastic support of energetic associations will go a long way toward making effort successful, and this is being

given. Implement manufacturers are doing their part to impress farmers with the need for and possibility of betterment in soil conditions. Farm journals seldom appear without at least one article supporting the idea of conservation.

Intelligent, planned, organized attack is required. It might very well stem from the farmers' level and make itself felt in requests for advice and assistance and guidance of government departments. A committee of men and women intensely interested in the well-being of their farms can sit around a table and set forth what they hope for; then look to the experts for details of how it is to be done. Discussion between groups, in an unselfish spirit of sharing knowledge and experience for the good of all, will be effective in keeping down wastage due to misplaced effort or amateurish planning. Consultation between individuals, farmers' associations, universities, county councils, Dominion and Provincial Departments of Agriculture and Agricultural Improvement Associations as to the best way of proceeding should go far toward building effective control programmes and co-ordinating them in a comprehensive plan that will benefit all. The Agricultural Improvement Associations are showing what can be done in studying, deciding, and putting into action the best cropping and tillage practices to control soil drifting and promote the general well-being of agriculture. Study groups in cities, along the lines of "Friends of the Land" in Washington, composed of persons from all business and professional activities, could add weight to the campaign.

It is important that proper perspective should be maintained. It will not do for individuals listlessly to await official action, nor should organizations hold back pending demands upon them. It is no time for complacency. Whatever can be done, starting now, should be begun by farmers and all organizations even remotely concerned. Perspective in time is needed, too. There will doubtless be years of abundant rainfall, timed just right to produce the best crops and hold down the land, bringing consequent temptation to neglect conservation practices, though every thinking farmer knows that the best time to prepare against bad years is during the good years.

A few paragraphs back it was remarked that there is no more land to be had than the earth already provides. This does not mean that there are no new frontiers to challenge the farmer. Soil conservation opens up fresh opportunities like the discovery of a new West. Those who attempt it are transforming nature consciously, according to a plan, not merely taking what nature offers.

The following booklets, available free on application to the Department of Agriculture, Ottawa, should be requested by number:

- 163—Crop Rotation and Soil Management for Eastern Canada.
- 619—Hints on Dry Land Gardening.
- 620—The Summer Fallow in Manitoba.
- 720—Regrassing Abandoned Farms, Submarginal Cultivated Lands, etc.
- 748—Guide for the Selection of Agricultural Soils.

Available from the Forest Nursery, Indian Head, Sask.:
623—Tree Planting on the Prairies.