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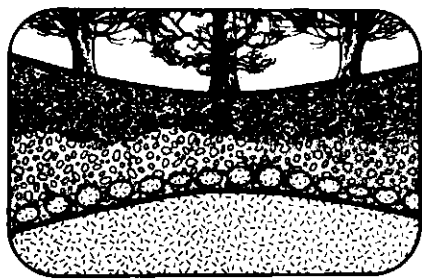
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The Soil Column

Soil Conservation in Canada Today

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When Canada was first settled, and for many years following settlement, some resources were considered an obstruction to the country's development. Over large areas of the country the forests were regarded as an enemy to be destroyed and burned and in other regions the grasses were ploughed down. The soil was left without cover. Our lands were supposed to be illimitable. Suddenly it was realized that this was not the case.

In the United States the recognition that the earth's resources were limited came early in the present century and the idea of conservation became a crusade and ideology under such men as Theodore Roosevelt, Gifford Pinchot and Francis G. Newlands. It was in 1908 that the conservation movement prepared one of its basic manifestos, the "Declaration of Governors for Conservation of Natural Resources". The conservation movement originally involved an enthusiasm for the simultaneous conservation of all resources but this drive soon slackened and conservationists grouped themselves along disciplinary lines each group showing concern for its own particular resource. Canadian interest in conservation was not awakened until the thirties when dust storms in combination with the depression focussed attention on the plight of some of the nation's resources particularly its soils. One of the first moves of the federal government was to pass the Prairie Farm Rehabilitation Act, more familiarly known as P.F.R.A. This act

originated in 1935 to combat problems of drought and soil drifting. At about the same time the federal government arranged to assist some of the provinces with their soil survey programme. The soil survey is a programme of mapping and classifying soils in order to obtain a measure of soil resources. Some provinces had an established programme of soil surveys before the federal government became involved. Others did not get started until sometime after the federal government evinced an interest in providing assistance. Because this is a co-operative programme both federal and provincial governments must indicate their support of the programme before it can get under way.

The provinces also became committed to conservation programmes, but times were difficult and money was short. Most provincial programmes really didn't get underway until 1944. For example, it was in 1944 that the government of Ontario decided to establish a new ministry, the Department of Planning and Development. This department had the responsibility of planning for conservation. Perhaps the greatest involvement in conservation was that of the provincial Departments of Agriculture. Almost all had specialists whose job it was to develop and promote sound land use and soil management programmes but it wasn't until 1954 that agriculturists indicated the state of conservation of Canada farmlands. In a special edition of the Agricultural Institute Review the Agricultural Institute of Canada, by means of its professional members, published papers dealing with conservation practices in Canada. Various methods of erosion control were discussed and the means of improving land use through fertility, crop rotation and mechanization practices were prominent topics. Water conservation was also of concern and a few articles in the Review dealt with drainage problems and flood control but the emphasis was on erosion. Indeed, as far as soil conservation was concerned, erosion problems were receiving world wide attention. The Food and Agriculture Organization had produced a soil erosion map of the world and Canadians supported its preparation by supplying maps of erosion levels on lands in Canada. It seems clear that soil

conservationists believed that soil was being used up too quickly by erosive processes and were taking steps to halt soil losses.

By the middle and late 1950s soil erosion in Canada seemed to be under control or at least was not a serious problem except in some local areas. Improved soil management practices had reduced wind erosion losses in the west and farmers were avoiding the rolling and hilly land in the east making it no longer necessary for them to practise contour strip cropping. Soil conservation slackened momentarily. In 1961 the Agricultural Rehabilitation and Development Act (A.R.D.A.) was passed which was to have a profound effect on soil conservation in Canada.

Among other things A.R.D.A. supported the taking of a natural resource inventory. The inventory shows where the best physical sites are located for agriculture, forestry, wildlife and recreation, and of course where the poorer sites are. As the inventory progressed there came the realization that certain regions had very small amounts of land available for certain purposes. This was particularly noticeable for agriculture especially in provinces where land was being removed from farming to be used for other purposes. Other uses were suffering losses too and the need for planning was evident. This need set a whole new direction for soil conservation. Conservationists were still going to take special steps to prevent depletion of the resource but the steps were different because the problem had changed.

Canada's Soil Resources

Most of Canada's soils are too shallow, too steep, too cold or too stony to be highly productive, but there are regions where high quality land occurs. Generally the poorest land occurs in the mountainous Cordillera, in the Canadian Shield, in the Appalachian region and the lowland around the south shore of Hudson Bay. The soils in these regions are stony and shallow and rock exposures are common except in the valleys of the Cordillera and the clay plains of the Canadian Shield and Appalachian region. The valleys and clay plains often contain deep soils of higher capability than those of the uplands. In Arctic and Sub-arctic regions the soils

are frozen at comparatively shallow depths for all or most of the year. This condition is a serious limitation to biological production. High water tables and consequent saturation of the muskeg in the Hudson Bay Lowland and other parts of Northern Canada are hazardous to use. But mountainous slopes, muskeg, permafrost and stones do not affect all the land in Canada. Some areas of high quality soils do exist even though they do not occupy the major proportion of the land.

In British Columbia high quality soils (classes 1 and 2) and a temperate climate have made the Okanagan Valley famous for fruit growing and in the east the high quality soils are used for potatoes (Prince Edward Island) and apples (Annapolis Valley). In the west are some of the best soils in the world and these are located in the Dark Brown and Black soil zones occurring in the more southerly parts of the prairies.

Although many of the Gray Luvisolic soils of the Interior Plains region are of high quality their use is limited by cool climates. The industrialized eastern part of the country has made full use of the high quality soils in the Great Lakes-St. Lawrence Lowland. Here demands are made on the same land for urbanization, agriculture and recreation and conflicts among uses often occur. Indeed, with the bulk of Canada's population concentrated along the Canada-U.S. border the demands for land are greater here than any other section of the country.

Despite its 2,272 million acres, Canada has a small amount of high quality land. Estimates have placed the total amount of arable land at something a little over 200 million acres (1971 census) but this estimate probably includes a large amount of marginally arable land and the actual amount is considerably less. Table I shows the actual amount of arable land and the

estimated amount. Over 91 per cent of the total land area consists of hilly, rocky or swampy terrain which limit its use. Obviously Canadians must make their land-use decisions very carefully. There is no room for misuse.

Some idea of the amount of high quality land for food production can be gained from Table II which shows the class 1, 2 and 3 land available in various parts of Canada. It seems obvious from all the data that we did not have a large amount of land available for food production to begin with. In addition the land requirements for urbanization, recreation, transportation and communication also place constraints on the amount of land available for food production.

In the Atlantic Provinces the non-resident land owner takes more and more land from farming. Farms along the Cape Breton shore are being sold for recreation. In 1971, 12 per cent of the Bras d'Or shoreline owners were non-Nova Scotian; 6.3 per cent of Prince Edward Island is owned by non-residents and it is estimated that half the island's area would be owned by non-residents within 30 years.

In Ontario and Quebec prime agricultural land is going to the rural non-farm dweller. He is the fellow who just wants a place in the country to get away from the city pace and pollution. He may be a part-time farmer but in most cases he only wants an acre or two on which to build a house, a swimming pool and a few formal gardens. To satisfy his needs more and more farms are subdivided often into blocks of land too small to ever farm economically again. It has been said that prime farmland is disappearing at the rate of 26 acres an hour in Ontario but no one is really sure. All that is known is that something must be done to halt the loss.

Of course, one of the reasons that the amount of land for food production is decreasing is due to the drift of farmers off the land. Some leave because of low incomes and others because of the long hours. One Ontario farmer leaves the land every two hours and 48 minutes but in Saskatchewan the government is trying to reverse the trend.

The hobby farmer and the "small lot suburbanite" are also responsible for losses of agricultural land in Alberta and British Columbia. However, like Saskatchewan, most losses in Alberta

Table I
Developed and Undeveloped Land in Canada (Census of Canada, 1971)

Territory or Province	Developed Arable Land (In millions of acres)	Estimated Undeveloped Arable Land (In millions of acres)
Yukon and N.W. Territories	—	.4
British Columbia	5.3	2.0
Alberta	49.0	10.3
Saskatchewan	65.4	1.0
Manitoba	19.1	3.8
Ontario	17.8	8.0
Quebec	12.9	1.0
New Brunswick	1.8	—
Nova Scotia	1.8	—
Prince Edward Island	.9	—
Newfoundland	.05	—
Canada	174.05	26.5

Table II
CLI Capability Classes

	1	2	3	Total	Improved Land (1971 Census)
British Columbia	Arable Land			4.6	1.8
Alberta	1.9	10.0	15.4	27.3	28.5
Saskatchewan	2.5	13.1	21.3	36.9	46.4
Manitoba	0.5	5.9	5.2	11.6	12.8
Ontario	4.9	5.7	5.0	15.6	10.9
Quebec	Arable Land			9.1	6.5
Atlantic	—	1.6	6.2	7.7	1.4
Totals				112.8	108.3

are due to the trend of people drifting from the farms to the cities.

Land Use Planning

Soil conservation to-day is much more than the development of methods to keep soil in place. It is also a matter of land use planning, of allocating land amongst rival claimants. Canada has a great deal of land but all uses cannot be accommodated in one place.

Various means are used to allocate land among users. In most provinces the land freeze is the method most commonly used or suggested. British Columbia was the first province to use this method when in March 1973 a land bill was passed giving a five-man commission the authority to preserve farmland from developers and place reserves on green belt, parkland and landbank areas. Ontario has several acts which are designed to halt or slow development in designated areas such as the Niagara Escarpment, the Provincial Parkway or Greenbelt and the Bruce Peninsula. Indeed a committee studying classification of farmland in Ontario recommended that the Minister of Agriculture and Food be given the power to veto expressways, park belts, subdivisions and any commercial or industrial development that would affect productive farmland.

Prince Edward Island passed legislation requiring non-residents wishing to purchase more than 10 acres to get Cabinet approval. But the folks in Prince Edward Island would like to replace the "blunt instrument" approach with some method of farm land preservation which is more palatable to all involved. A Commission has suggested a "minimum maintenance" concept. The notion of minimum maintenance is the concept of stewardship. Minimum maintenance might mean keeping non-productive fields free of weeds. "For each major category of land capability," says the Commission, "a number of management levels can be described." It is possible to say how many days' work would normally be required as well. Such standards would be set by municipal councils, assessors and other officials. Owners who do not maintain their land up to the standards set would be liable to a hefty fine.

This approach, though unique, may not be practicable in British Columbia or

the Prairie Provinces because conditions are so different. Saskatchewan does not seem to be bothered by the rural non-farm dweller but is losing farmers and farmland to a general drift to the cities. As has been mentioned the Saskatchewan government is reversing this trend by the development of a land bank. The land bank principle is not new. It involves the public purchase of land and its use for the public good. In Saskatchewan farmlands purchased are leased back to farmers at roughly five per cent of the land's market value. The rental rate remains constant, as a percentage of land value, for 10 years although the actual amount may fluctuate with periodic reassessments of the land's market value. Farmers can buy their rented land five years after signing their lease. This programme has had the effect of reducing the exodus of farmers from the countryside by making it possible for farmers to work and live on the land without having to pay exorbitant prices for property ownership.

The land bank system is used in other provinces but not to encourage agriculture. In British Columbia it has been used in a minor way to decrease housing costs. Similarly, in Ontario, land banking has been a feature of housing programmes in a few municipalities. In addition, public purchase of land is part of the development of parks and other recreational facilities; but this has been a necessary part of park development at all government levels across Canada.

In addition to various legislative acts controlling land use by "freezing" land, applying development controls and public purchase, there are hundreds of policy statements by civil servants and politicians which serve to direct land use. For example, many municipalities in Ontario have ruled that "all classes 1 and 2 land shall be zoned agricultural and over-riding public need will be the only acceptable criterion for rezoning." And in the same province there is now coming encouragement from the provincial to local planning units to preserve rural conditions and enhance the agricultural industry. This involves several kinds of policy: a) defining hamlets, villages, in which new building will be concentrated, b) establishing certain criteria which must be satisfied before permitting severances of rural land, c) establishing quotas and limits on

the number of severances to be permitted in an area each year, d) setting regulations concerning the standard for sewage waste and water supply, and provision of public services.

There is little need to review the various policies affecting farm lands. Suffice it to say that much is being said but governments have not really begun to cope with the problem.

Erosion Today

Erosion is still of concern in Canada. Indeed, soil erosion losses are probably greater today than ever before. There are a number of sources of erosion that were not so evident 20 or 25 years ago. Intensified agricultural land use, increased urbanization and the building of roads, pipelines and hydro lines have all had their effect.

In most provinces increased numbers of livestock have resulted in greater impact on soil resources. Streambanks have been broken down wherever cattle seek water; soils are compacted and vegetation destroyed wherever cattle numbers exceed the carrying capacity of the land. In Eastern Canada larger acreages of row crops are grown and losses of soil have mounted. The acreage devoted to grain corn in southern Ontario has almost tripled in the last 10 years to 1,175,000 acres. At the same time the number of acres used for oats has decreased from about 1,700,000 acres to 575,000 acres. The change in cropping practice has shown up in the streams where increased sediment loads are evident. Soil erosion losses are also occurring on the potato fields of the Atlantic Provinces, the tobacco lands of Quebec and Ontario and on the specialized farms of British Columbia.

Soil erosion is not just a problem of the farmlands of Canada. If anything, soil losses are more severe on the rapidly urbanizing lands around our towns and cities. The practice of leaving the land without cover during the construction period has created all sorts of problems from increased sediment and nutrient loads in nearby streams to decreased soil fertility at the site. Erosion problems also occur along the roadsides, pipeline rights-of-way and surface-mined areas wherever steep slopes and lack of cover are combined. Thus, urban development exacts its toll on soils and soil materials.

Little is being done to measure the soil losses that occur under various uses. However, study is being devoted to stream and river pollution by soil particles and nutrients from farm fields. Various departments of federal and provincial governments are committed to a program of environmental protection and this includes among other things, soil conservation and therefore erosion control. However, government attempts at erosion control are not always successful. Erosion still occurs because people are not prepared to make the extra effort required to prevent it.

Waste Disposal

At the moment, soil depletion due to the accumulation of wastes is a local problem being most serious around the urbanized sections in Canada. There is no doubt that the soil is a ready-made treatment plant for the disposal of some wastes particularly those of an organic nature. When properly carried out animal and human wastes as well as municipal and some industrial wastes can be disposed of in the soil with no problems. However, certain other wastes may so build-up in soils that they become harmful to living things.

In the parts of Canada where salt is used to keep the roads clear of snow in winter the concentration of salt becomes so great that it affects the adjacent vegetation. Heavy minerals may attain such high levels in soil, and therefore in plants, that they become part of the food chain and affect human health. Potentially harmful minerals have been added to the soil in many ways. Industrial operations can release a number of mineral elements which fall to the ground to become part of the soil composition, and the particulate "fall-out" from automobile exhausts is an important source of lead contamination. Even some fertilizers and pesticides can contain elements such as cadmium, arsenic, mercury and lead. Some soils contain large amounts of minerals naturally. In northern Ontario some soils have a high selenium content and in the eastern section of the province molybdenum occurs in comparatively high concentrations.

With what occurs naturally and what is added to the soil we may create pollution problems that are difficult to overcome. Many political bodies are taking

measures to ensure that the potential of soil for decomposing organic materials is used to the fullest while making sure that contaminants are handled in such a way that human health is not endangered. However, in reaching solutions to waste disposal problems an awakened public is a necessity and we have yet to attain such a goal.

The Future

The future of soil conservation or of any conservation for that matter, depends largely on how we regard its relationship to economic development. Until recently the concerns of orthodox economics have been far removed from environmental costs and the discipline of ecology has maintained a position of lofty disdain for such matters as the price of ecological purity.

Conservation and economic development should ideally be directed towards a common goal - the rational use of the earth's resources to achieve the highest quality of living for mankind. In practice economic development tends to place stronger emphasis on increases of production to enhance the material well-being of people whereas conservation, while concerned with yield, emphasizes the more qualitative aspects of the human environment which add depth and meaning to human life.

Conflict between conservation and development can be minimized if there is an understanding and partnership among those whose main interests lie on either side. For example, developers, on the one hand, must have a due regard for environmental values. On the other hand those concerned with conservation must be equally ready to recognize the political, social and economic forces behind the development drive. There is a growing desire on the part of governments to recognize a conservation ethic but profitability and rapid growth are still of greater concern than the intense environmental impact of many of our actions. The depletion of our land resource represents a long-unpaid debt to nature. What strains will develop in the economy when that debt is called? We will be able to pay that debt and still survive? It seems that society must do something now about conservation. It may be too late if we wait until to-morrow.

MS received April 8, 1976.



Pyroclasts

The XXVth. International Congress

By Ward Neale

The XXVth IGC was a mixture of bright spots and dark spots. Herewith a capsule summary so that you can be happy or sad that you didn't invest at least $\$2.5 \times 10^3$ in it as did some 2500 other geoscientists. As is commonly the case, no two people could completely agree on which were the bright and which the dark aspects.

The Congress was staged at the University of Sydney and it was austere compared to the opulence of Montreal's glittering convention center. This is probably a harbinger of things to come in a less prosperous World. Some like the return to an academic atmosphere. Others regretted the primitive lecture benches that prevented escape during a dull lecture and made it difficult between lectures.

I sympathized with the latter group, never have I heard so many dull lectures, or suffered so much re-heated porridge. Fortunately escape was facilitated by the enormous number of "no shows" on the programme. In contrast Bill Fyfe felt that he had never before made so many informative contacts at a large meeting, his symposium on the Archean was one of the liveliest he had ever participated in, and the information he gleaned on Australian (ANU) ion probe studies of zircon, destined to become a most important advance in geochronology, was the most exciting news he has heard in a long time.

The Governor General when welcoming the Congress expressed his dismay at the lack of mention in the programme of resources and their sociological and political implications.