

The Significance of Natural Erosion

By DR. L. C. WHEETING

Washington Agricultural Experiment Station

Erosion is a natural process which tends to produce a level land surface and with this surface—stability. In geological parlance, this process is known as peneplanation. Whenever a land surface is thrust up above the general level, it is subjected to erosive forces in an effort to bring it into line with its surroundings. In this process wind, and especially water, are dominant factors. This is beautifully illustrated by portions of the book "Seasoned Timber" by Dorothy Canfield, in which Professor Dewey, while pointing to a hollow in the granite of a mountain, which had been filled with water by recent showers, explains how the water, though soft and yielding and apparently strengthless, would in the end get the better of the hulking rock carcass of the mountain.

Natural erosion as a process is necessary and good. By this means the fertility of soils are constantly renewed. But, like many other things, including motor cars, accelerated erosion is not good because it destroys what Nature, in its normal processes, intended to be useful. Let us examine this thought further.

Soil makes up a relatively thin shell on the outer surface of the Earth. It is produced by processes of rock weathering, followed by the incorporation of organic matter. Soil is produced only when organic life has invaded the rock pile. The character of the soil is determined, therefore, not alone by the nature of the parent rock from which it sprang, but also by the processes which produced it. The natural forces of climate not only determine what form of vegetation will inhabit the soil, but also what chemical processes will be active in its formation. In regions of sparse rainfall, solution proc-

esses are at a minimum and the products of rock decay tend to remain in the soil; while in regions of high rainfall, they are removed by leaching. In the first instance, alkaline soils are produced, and in the second case, acid soils develop. The rainfall also affects vegetative acidity and in regions of low rainfall, the amount of plant growth and the volume of plant residue remaining in the soil is low; while in regions of heavier rainfall, plant growth is vigorous and large amounts of organic matter are added to the soil. This leads to a more intense differentiation of soil layers in the wetter climate. The entire soil-formation process must be looked upon as a movement toward an equilibrium between climatic and vegetative forces on the one hand, and the resistance of surface of the earth on the other. It is strange that when equilibrium is reached, an unproductive soil is the result. Natural erosion is the process set up by Nature to forestall this unfortunate ending. By the process of removal of the old, worn-out soil materials, new and fertile mineral matter is constantly being exposed to weathering, and the results are wholly favorable, from the viewpoint of soil productivity and human welfare.

Imagine a perfectly flat earth, where no erosion could occur. The soil-formation processes would reach down into the land surface for several feet. The minerals would be broken apart physically and chemically, plants would remove the parts of them required for growth, and tie up this material in the form of plant products; excess rainfall would leach away the remainder to increase the salts of the sea, and eventually the entire soil would become infertile. Since weathering can proceed only to limited depths and root penetration

is also limited, eventually the completely flat world would become unable to support further plant life (as we know it), and with this destruction of plant life, our own existence would be impossible. How fortunate for us to live in a world with hills, mountains and valleys, with natural erosion constantly exposing new land surfaces on the uplands and periodically blanketing the lowlands with thin layers of fertile silt. The history of our World as indicated by rocks, shows that upheavals of the land surfaces have occurred throughout the ages. Thus, a provident Nature periodically resorts to face lifting to maintain her beauty.

It seems to be natural for the Earth to be covered with vegetation whenever climatic conditions will permit it. This contributes mightily to the stability of the land surfaces, through the binding effect of plant roots, the interference with the driving force of the rain, and through the development of high permeability and water-holding capacity of the soil as a result of the presence of organic residues. When this regulatory factor is removed from land surfaces, serious accelerated erosion often sweeps away the work of many years in a single hour. It is the work of the Soil Conservation Service to overcome this, and through a judicious return to vegetative controls, combined with the necessities of crop production for profit, fine progress is being made. Although engineering control measures must often be employed to assist in establishing the desired vegetations, it seems logical to look to the plant world itself for the final means of natural control of excessive erosion. Before man made large-scale agricultural use of the land, Nature controlled erosion successfully and it is likely that she can do it again if given an opportunity.

The oldest civilizations that left historical evidence of their existence lived mainly in the fertile valleys of the large

rivers, and their history records the beneficial effects of annual flooding of the farm lands. Layers of fertile river silt were spread over the land, the water soaked into the soil to considerable depths, and crops thrived following each flood. Beneficent Nature smiled upon her children. But these children needed wood for their fires, their homes and their Temples. They cleared the land along the rivers father and farther up into the uplands, and slowly destroyed the regulatory action of the forests in the upper watersheds. Can this be the reason for the present-day necessity of digging out the old cities from a deposit of river silt, sometimes 100 feet or more in thickness? At least it is a reasonable supposition to make. Archaeological as well as Biblical evidence indicates that our early civilizations were frequently visited by severe floods which actually destroyed them. And yet, when controlled, such floods brought beneficial results.

Utilization of water and sediment from floods has been made in recent years by some of our own citizens. One of the most interesting examples is that of the Bennett Irrigation and Silting Basin at Wilson Creek, Washington.* A watershed of approximately 475 square miles drains through Nite Creek into Wilson Creek in Central Washington. About 60 per cent of the watershed is covered with Ritzville and Wheeler soils and the remainder is largely scabland. The soils are cropped to wheat in an alternate wheat-fallow system. An earth dam has been constructed across the valley and a cement structure installed for permanent flood gates and spillway. The flooded areas back of the dam is about 345 acres. Since the first flood in 1918, about 1.8 feet of sediment has been collected on

*See report—S. C. S.—Publication SS27. 1938. By Hough & Flaxman.

the cropland in 19 years. This is a little over 2 inches per year. Some years, however, nearly 5 inches have been deposited. The reason why the older civilizations found that flooding renewed their land is shown by a study carried out at the Agricultural Experiment Station in cooperation with the Soil Conservation Service. Five samples of soil were obtained for study:

1. Ritzville soil from a typical wheatfield in the drainage area above the basin.
2. Sediment from the upper end of the basin, consisting of newly deposited, relatively coarse material.
3. Old sediment, taken a short distance above the dam from a depth of 8 to 12 inches below the surface, which represents material that has been farmed for several years and subsequently covered with newer sediment.
4. Sediment deposited in 1936 along the edge of the basin a short distance above the dam, and not tilled prior to the time of its collection.
5. Ephrata very fine sandy loam from the valley floor below the dam.

The mechanical analyses showed that there was much more clay in the sediments than there was in the soil from

which they came, and the following results show the high fertility of this fine material:

Soil No.	Dry Weight 1st Crop Barley	Dry Weight 1st Crop Alfalfa
	gm.	
1	4.9	19.1
2	14.8	18.1
3	7.2	17.7
4	40.8	32.5
5	4.2	12.0

This is an excellent example of the enrichment which occurs on bottom lands as a result of an ordinary flood. Such enrichment, as long as it is the result of natural erosion, can only be beneficial to man. The danger point in the proper control is in the uplands, for which the slow naturally controlled erosion should be sought. Once controlled, one may regard erosion as beneficial, both through exposure of fresh materials in the uplands with the consequent renewal of fertility, and through the slow deposition of rich sediments in the lowlands. Erosion is harmful only when not controlled, and in such circumstances it can threaten the very existence of Man.

With the assistance of their plant allies, the Federal Soil Conservation Service is waging a successful fight for control. We hope for continued success to them in their efforts toward maintaining our great natural asset—the soil.