THE SOILS OF THE GREAT PLAINS*

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If the surface of the earth were a part of a perfectly rigid sphere, the continents would probably have remained as groups of islands, with the lowlands composed of breccia and sand, while the material of which much of the soil is made would have been carried into the sea.

There is much direct evidence, however, which indicates repeated changes of level, showing a certain flexibility of the crust. To this we owe the submergence of large areas during which they received a coating of the rock waste carried into the sea. Much of this rock waste, by a shifting of load or other cause, is now elevated above sea level and underlies the great agricultural areas, so that we may say that the flexibility of the crust, by providing soil for the necessary plant growth, made possible the peopling of the earth other than around the fringe of the continents.

In the northern part, the existence of a soil does not depend altogether on this condition. The latest mantle of soil in most areas is due to the transportation of rock waste by the great continental ice sheet. This material is not, however, a soil-maker of as high grade as the water-borne rock deposited in lake or sea basins.

The plains of North America bear in their underlying rocks the record of long invasions of the sea and these form what seems to have been a very old feature in the history of the continent.

Early History Very Obscure

Much of the early history of North America is very obscure, but we know that at several periods the ocean encroached and almost submerged the continent. The maximum submergence was probably in Ordovician times, represented in Ottawa by the deposits of limestone beneath the city, the same limestones being beneath Kingston and Winnipeg. Later the seas encroaching on the continent became shallow, and the deposits instead of being mostly lime gave place to muds and sands. These were better soil-makers and their decay provided much of the soil for the plains of eastern America.

The western plains received a much later addition of soil-making material beneath a shallow muddy sea. Along the western border of this sea, the rocks were being crushed and ground in the early mountain-building which preceded the final upthrust of the Rocky mountains. Hundreds of feet of very fine grained material, now somewhat hardened to shale, covered the sandstones and limestones of the former plain, which stretched to the old mountains of central British Columbia. The muddy sea, being fairly shallow, was very susceptible to any differential elevation, and at one time, near its end as a sea, it was almost emptied as the water retreated toward the gulf of Mexico. The western border was apparently at all times a shifting one, for the muds are interspersed with wedges of sandy material which, by their extension eastward, show the approximate amount of the uplift of the western edge, for that is where the disturbance of the crust was mainly located. During these periods of tilting, forests and marshes crept eastward, the amount of entombed vegetable matter in the present coal seams marking the length of the intervals of quiet.

Last Addition to Plains

The latest addition towards the building of the plains, previous to the carving of the surface, consists of a mass of coarser grained material which is not definitely sea deposit, and marks not only the retreat of the sea but a nearer source of debris than the earlier muds and sands. This was evidently due to an elevation of the area now occupied by the Rocky mountains, which continued along with a general rise of the whole basin until its progress was halted when the areas under greater strain reached the limit of compression and the crust bent and broke along the folds. The breaks were repeated in parallel series, especially in the Canadian portion near the western edge, and formed the Rocky mountain structure. This was at first probably a very high ridge of very much broken and crushed soft rocks, mostly sandstones, clays and shales.

The carving of the plains then began, and the removal of the debris and the higher part revealed the hard limestone ridges of the present mountains, and the first phase of erosion might be said to include the planing of the slope from the mountains to the lowlands. Along this slope it is conceivable to suppose that much of the debris from the mountains might be scattered. As it was passed along, only the harder material would survive as gravel and boulders, well rounded and reduced in size before reaching the sea.

Second Cycle of Erosion

The top of the Cypress hills and the Hand hills are supposed to be remnants of the old slope, and there we find a great deposit of coarse conglomerate of late Tertiary age, pointing to the probable age of the uncovering of the Rocky mountains. With the removal during this first period of erosion of a vast quantity of material into the sea, probably to the northward, the relief from the load induced a further elevation, and a consequent second cycle of erosion resulted in the great scouring shown in the depression running from the vicinity of Lethbridge eastward, north of the Cypress hills, and in many of the great valleys through the foothills followed generally by the present rivers.

The coming of the glacial period and the movement of the great glacier over the plains altered the general surface slightly. It probably smoothed the surface somewhat. On the melting of the ice, the deposition of its load of clay and boulders and the diversion of streams around its edge, probably, did more toward altering the topography than any planing action that the mass of ice had exerted.

The occupation by the ice of the valleys down the slope toward the northeast, or rather the melting of the ice, which proceeded generally from the southwest, left a moving barrier which seemed to have preserved a northwest-southeast front across the plains. This, as it also provided a great supply of water, not only diverted the streams to the southeast, but by the great flow of water for short intervals, scoured new channels which in depth and area are comparable to the old valleys. Many lakes were formed along the ice front, and in these the rock debris from the melting ice was sifted out, forming to-day much of the fertile lands.

Ridges of Boulder Clay

Where the ice front paused for long periods, great ridges of boulder clay were left. These form a very irregular type of topography and can be traced readily. They are not of equal value as fertile areas with the more gently rolling lands where the surface covering was deposited in water, but from their irregularity provide more ponds for surface water and have a greater value as grazing lands. The most striking example of moraine topography is to be found in the Coteau and its continuation north of the Saskatchewan. It can be traced under different guises, such as sand hills and boulder-strewn hills, to the Buffalo park at Wainwright, and even farther toward the bend of the Athabaska.

Many of the channels cut during the period of retreat are still used and probably account for the peculiar southeast trend of many of our streams, although the direction of slope of the surface is to the northeast for most of Saskatchewan and Alberta. The streams that broke away and got into their old channels may include the two Saskatchewans and the Athabaska.

It is quite possible that the Athabaska for a time had to use the valley of Beaver river and Sturgeon river to Prince Albert, and it is pretty generally conceded that for a time the South Saskatchewan was diverted above the Elbow to the Missouri by way of the Old Wives, Willowbunch and Big Muddy lakes, and later by way of the Souris and Qu'Appelle to the lowlands of the Manitoba plain. These diversions nearly all came by way of impounded lakes in

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