

principal cause of its fertility; so that it would seem without a close attention to the proportion, not only of the soluble and insoluble constituents of soils, but also to their gaseous contents and their mechanical aggregation, it must be very difficult to estimate correctly their fertilizing powers.

With respect to the origin of the Tchornoï Zem, much speculation has taken place, and a considerable difference of opinion has obtained. The most prevalent opinion in Russia has been that it is the humus arising from decayed forests or vegetables in former and very remote periods of the earth's history; and in this view a number of eminent scientific men have concurred. "But," observes Sir R. Murchison, "I am obliged to dissent from this opinion, seeing the uniform nature of the soil, and its distribution at all levels without reference to the existing drainage; and also from the fact, that in no part of the empire did my associates or myself ever perceive a trace of trees, roots, or vegetable fibre in the black mass. It is in vain to say that such vegetables may have been entirely decomposed; for in the deep denudations which expose fifteen to twenty feet of this matter, surely some remains of the forests or bogs would be found in the lowest parts of the solid earth, just as we find roots and branches of oak, pine, birch, and hazel in our own peat bogs."

Sir Roderick, finding that in the absence of all fossil remains in the Black Earth, it cannot be compared with any of the many drifts existing on the surface of the earth, asks whether the very peculiar nature of the physical, geographical, and geological conditions of Russia may not help to a solution of the problem? Unlike all great regions hitherto examined, Central Russia is void of rocks of igneous origin or intrusive character, and all her strata deviate from horizontality only by the slightest undulations. From this fact and from the incoherent texture of the rocks, it is clear that her subsoil, which, on account of its marine contents, we know to have been formed *under the sea*, must have been raised and desiccated by very gradual and even movements. Judging from the evidences of geological succession also, and seeing that, without the aid of great fractures or dislocations in the crust of the earth, some of the older rocks of Russia, such as the mountain limestone, are covered conformably by the inferior oolite, whilst the lias and, to a great extent, the new red sandstone are wanting, we see in these facts the proof that, either the former bottom of the sea was raised above the waters and remained dry for

long periods, or that, in this very tranquil region of the earth's surface, the absence of all widely-spreading powerful currents ceased, at intervals, to extend from the neighbouring seas and rivers. Pursuing this mode of reasoning from the more ancient phenomena to those which immediately preceded our own era, we are led by positive evidence to conclude that the whole surface of Central Russia, (however parts of it may have had formerly dividing barriers) was during that period again depressed beneath the level of the sea, in which the marine shells of the government of Archangel and the Southern Steppes were accumulated, and over which the sand, clay, pebbles, and blocks of the north, as we have before described, were deposited."

The writer, after referring to the fact that in no part of the great northern drift is any trace found of the Black Earth, and that it is natural to suppose, when the northern drift ceased to advance, or unagitated by any disturbing force would become covered with fine silt or mud, such as is often found in Mediterranean waters, removed from the action of currents, thus concludes:

"The absence of any marine shells in this fine sediment is, it is true, a negative fact, which, if unaccompanied by some explanation, might indispose my readers to admit this hypothesis. We must, however, bear in mind that, after their emersion, the central parts of Russia, if but slowly and slightly elevated, may have long remained in an intermediate state of mire or slough with little egress for water; so that the remains of delicate testacea (if they existed), may have been entirely decomposed by the alternations of aqueous and atmospheric agency. But whether we adopt this view or not, we cannot, I repeat, look at the very great uniformity of its composition over such vast tracts, and its independence of existing drainage, without rejecting any theory which would account for the production of the 'Tchornoï Zem' by subaerial causes only, and on these grounds we must, I think, account for its origin by aqueous deposit, and the subsequent modifications which it underwent in passing into a terrestrial condition."

We may observe in conclusion, that of late years Russia has manifested, in several parts of her vast territories, a strong disposition to agricultural as well as other improvements. The steam plough has been introduced with marked success, and railroads are in the course of construction through some of the most fertile portions of the Empire. Education is

commencing an important work, while serfdom has been abolished by Royal decree. There can be little doubt that Britain, and other grain importing countries of Europe, will look more and more for their supplies to this immense granary of Central Russia; and we in the Dominion of Canada, and also our neighbours south of the great lakes, will have to improve our modes of cultivation in order to meet successfully this formidable competitor in neutral markets.

Experiment on Deep Subsoil Culture.

Much controversy exists relative to the advisability of deep sub-soil cultivation, or the contrary. To test its utility, during the summer of 1866 I caused about half an acre of land similar in quality to the surrounding portion, in the centre of a fallow field, to be thoroughly and deeply sub-soiled. No manure was or ever had been used, and the field was sown with fall wheat, in the fall of 1866, and the result carefully watched. The land was deep clay loam—so much so that the second plough, following in the furrow of the first, failed to bring up any hard pan or hard intractable soil, nor did it raise the sub-soil to the surface, but only moved it to the depth of 12 or 13 inches, and for the most part allowed the crumbled earth to fall back from whence it was raised.

This was repeated each time the land was ploughed, the second team always following in the rear of the first; thus a second time was the subsoil thoroughly moved and broken up.

The limits were staked out, and as before stated, the result carefully watched. Contrary to expectation, we did not see any marked improvement, or indeed any difference during the fall succeeding the wheat sowing; and as soon as the snow passed away and the thaw would admit, the wintering and growth were carefully examined, but still no amendment was perceptible, and when the crop was harvested, so far as I could notice, no benefit whatever could be traced to the subsoil, nor is there any apparent to the eye to this day, and the land is now sown to clover and has an abundant plant on it. This is rather a remarkable instance, as the facts and results were just as detailed. The situation of the land was tolerably high, so that nothing like a reservoir could have been caused by the deep ploughing, whereby stagnant water could have injured it, and we so constantly hear of the benefit derived from deep culture, that the failure in this instance need form no barrier to future trials, and I would by no means therefore recommend others to allow a single failure, (although ever so well authenticated), to interfere with other trials; but would rather feel that circumstances may, for some reason unexplained, at the time, have caused the experiment to fail,