IV.

ON PLANTATIONS OF SCOTCH FIR ON MOORPAN SOIL.

By GEORGE ROSS, Forest Probationer. May, 1872.

MOORPAN presents, in the lowlands of the north of Germany, one of the most formidable obstacles towards the cultivation of the soil as forest land, with which the forester has to contend. It occurs in the sandy low-lying countries as a hard, sometimes solid and compact, formation, often extending great distances without intermission. It is either of a reddish black or of a yellow colour. The depth at which the strata are found beneath the surface varies generally from one to two feet, but extends even to four feet. The thickness of the strata varies from a half to 12 inches and even more, but is, as a rule, between three and six inches.

Moorpan is composed principally of sand (80 to 90 per cent.), which is firmly cemented by heather humus. It contains also a slight percentage of iron sesqui-oxide and of aluminium silicate, and there are also traces of phosphoric acid. These, with the large percentage of sand already stated, constitute its component parts. The nature of the layer differs very widely; sometimes it is so hard that it is necessary to use the pickaxe to break through it, at other times the spade is sufficient, and if the stratum does not lie too deep, the plough can often be employed with success.

After the moorpan has been brought to the surface and exposed to the influence of the weather, particularly that of frost, it resolves itself into earth, sometimes within the space of a year; but when the layer is very hard and massive, the process of "weathering" may last for several years. For instance, we saw in the forest of Nienburg, where the ground had been trenched, the moorpan still lying upon the surface quite "unweathered" after having withstood the atmospheric influence for three years, while in other places in the same forest, cultivated at the same time, the "weathering" had taken place so thoroughly that the presence of moorpan could only be detected by the brown colour of the sand.

Moorpan belongs to the present geological period, and is being formed, if the circumstances admit, to this day. In the neighbourhood of Nienburg there are great numbers of ancient tombs, which are often dug up in the process of cultivation, and the urns which are found in them are all encrusted with moorpan.

Moorpan is only to be found in a sandy soil where heather is growing or has grown, and never in a loamy soil, even if heather has grown upon it for centuries.

Moorpan is found in the more elevated as well as in the lower situations of the plains, but principally in the former, where, on account of the dryness of the soil, the heather humus is even harsher than usual.

As a rule, the moorpan is only to be found where the common heather (*Calluna vulgaris*) grows, but it also occurs in some places where the bog heather (*Erica tetralix*) thrives. Tracts from which the heather has been for a long time cleared, to be used as manure, have generally a thinner stratum of moorpan than those on which it has been allowed to grow unmolested.

As a rule, a yellow coarse-grained sand lies underneath the moorpan; it is therefore easy to check the work done, as, if the layer has been thoroughly broken through, this sand must appear.

In some places the moorpan occurs more broken and in patches, and the woods growing upon such ground present in general a very fair growth and appearance, as the roots find their way through the crevices and interstices. We had an opportunity to see such a wood in the Nienburg Forest, and although the growth of the trees was good, the formation of the roots seen on some trees torn up by the wind, was very peculiar and had the appearance of a broom.

Forests standing upon really firm moorpan impenetrable for the roots, have, without exception, a perfectly distorted, crippled, and unhealthy appearance.

In districts where the moorpan is kept continually moist and soft through the influence of ground water, the deep searching roots of the Scotch fir are able to penetrate through the stratum, and, as we saw in a neighbouring forest, the trees growing on this sort of soil have such an increase and healthy appearance that is almost impossible to believe that moorpan exists here. In such districts this degree of dampness must be carefully preserved, for experience has shown that in woods of this description, when the soil has been drained the increase of growth has almost immediately ceased, and the trees have assumed an unhealthy appearance.

For all this it is a fact beyond doubt or dispute that wherever moorpan is found, however thin the stratum may be, it always presents an obstacle towards the rearing and growth of trees; and unless the soil has been properly prepared beforehand, the sowing or planting the same may be regarded as more or less useless, especially as the sandy soil, under which alone moorpan is to be met with, is only adapted to the growth of the Scotch fir, whose deep penetrating tap-root is not capable of breaking through the stratum. With few exceptions only cripple and dwarf woods are to be met with on moorpan when the soil has not been properly prepared. Even in its youth the presence of moorpan can be immediately detected by the shrub-like and unhealthy appearance of the Scotch fir, its short terminal shoots, and by the thin and scanty growth of the leaves, which are also of a yellowish colour. Such a wood is the favourite resort of the different species of *tortrix*, and soon falls a prey to their ravages.

In cases of this kind there is no choice left to the forester. He must either cut down the whole wood, trench the soil, and plant afresh, or else he must cut lines of about six feet in breadth and at from six to eight feet apart through the wood, and trench the so-cleared strips. We saw an experiment of the latter method, which had been carried out three years ago. The remaining trees had, through the influence of the air, which had now free access, considerably recovered, their terminal shoots were at once longer and their leaves grew thicker and presented a more normal appearance. In course of time, also, the roots find their way to the trenches, where they are enabled to go deeper down for nourishment.

In the low-lying countries where moorpan occurs it is of the greatest importance that the forester should examine the ground carefully and attentively, especially tracts of heather, before he cultivates. To do this he must let the ground be dug in different places, to ascertain the thickness of the moorpan