

himself or arrange with trustworthy agents to do it under his explicit instructions. As far as practicable, supplies should be obtained from localities where the climatic conditions are similar to our own. To ensure reproduction of identical trees seed of *E. Macarthuri* must be obtained from the plantations of Messrs. Reynolds and Gillett. *E. globulus* and *E. obliqua* should be reintroduced from Tasmania.

Many of the eucalypts when allowed to do so will spread very rapidly by natural propagation. The seed germinates and grows freely even among grass or low scrub, and not infrequently young trees may be seen forcing their way through a heavy covering of bracken-fern. If, therefore, suitable seed could be obtained in sufficient quantity, it would seem quite possible to cover large areas with trees by broadcast sowing alone. *Globulus*, *Macarthuri*, *viminialis*, *regnans*, *obliqua*, and other rapid growers would all lend themselves to this method.

Of all timber-trees, the eucalypts, when of considerable size, are perhaps best able to survive a running fire. They may often be seen growing as if nothing had happened after the outer bark has been burnt off their stems. Even young trees when killed to the stump will shoot out and grow again. But of course it is better in every way to protect them from this worst menace to the work of the tree-planter. All large plantations should be surrounded and intersected by fire-breaks. Whether these shall be ploughed, closely grazed by sheep, or planted with umbrageous non-inflammable trees such as oaks is a question circumstances must determine. Methods and details must be left to the practical forester. What the country as a whole needs to take seriously is the necessity for quickly covering sufficient areas with the most valuable hardwood trees that our climatic conditions will permit us to grow.

## No. 2.

### REMARKS ON EROSION OF SLOPES IN NEW ZEALAND.

[By C. A. COTTON.]

THE most obvious difference between deforestation of slopes in the southern Appalachians and in New Zealand is that in New Zealand steep slopes are seldom or never cleared for cropping. Obviously, a growth of grass is of considerable value in checking erosion, especially "sheet-wash" erosion and erosion by parallel gullies. Where, however, land is required for pasture there is a tendency to clear slopes of much greater steepness than would be cleared for agricultural purposes. No doubt the slope on which it is safe to clear is much steeper, but there is a greater temptation to exceed the safe slope.

The slope of safety will probably be found to vary much more widely for grassed than for cultivated land, with varying geological conditions, for erosion of grassed slopes takes place usually by the method of small landslips. In this connection two widespread rock formations in New Zealand may be considered—namely, that facies of the older sedimentaries to which the name "Maitai" rocks is usually applied, and the bluish mudstones of the younger group commonly known as "papa."

In the Maitai rocks, as developed in the Wellington District, clastics of medium grain predominate. Where obtained fresh they are found to be well cemented, compact rocks, but there are innumerable intersecting joints which divide the rock into small fragments. Surface-water readily penetrates, and, large surfaces being exposed to attack, the rock is deeply weathered. On all but the steepest slopes, therefore, there is a thick covering of weathered material in the form of a stony or sandy clay, which is sufficiently porous to allow surface-water to pass readily through it. It is seldom, therefore, that the soil reaches that waterlogged condition which results in a landslip. Slips are rare on the hillsides in the immediate neighbourhood of Wellington, and although the bush has been cleared from all but the steepest slopes it has been replaced successfully by grass, and little destructive erosion has resulted.

On these rocks I have observed small changes in stream grades, which, in my opinion, are directly due to clearing, but none that I have noticed have had important economic results. They are shown by the formation of narrow V-shaped channels, owing to increased rapidity of run-off, upon the floors of gullies, the cross-sections of which show otherwise a broad U-shape. Caving along the banks of the new channels seems to be taking place only to a slight extent, and the damage is inconsiderable.

It would seem that on rocks of this type there is no difficulty in starting, after clearing, a good growth of grass, which is effective in checking erosion on slopes up to 30° at least. On slopes up to 40° or even steeper the grass seems to hold the soil fairly well unless the ground is overstocked.

There is danger of passing the safe limit of slope even on these rocks, however, especially in districts like the Rimutaka Ranges. Very steep slopes are being cleared in places along the eastern coast of Marlborough.

There is, of course, great danger in clearing slopes by way of experiment, for if the attempt to grass the cleared slope is unsuccessful, and the soil is lost by erosion, leaving a bare rock surface, reforestation is by no means easy.

Glenn points out that this danger is especially great on rocks which weather spheroidally. The spheroidal type of weathering is usually associated with certain types of igneous rocks, but in the Maitai elastic rocks it is not uncommon. The higher ridges, for example, in the neighbourhood of Wellington, mark the outcrops of strata of coarser-grained, more thoroughly cemented, less-jointed rock than that already described.

In this rock, which is strong enough to be used as road-metal, weathering of the spheroidal type occurs, and the surface is strewn with smooth rounded masses which in some respects resemble stream-worn boulders, but are really cores resulting from the spheroidal type of weathering.