2. *The use of creeping cover plants.*—In this case the establishment of a cover will probably not be so easy as in a young clearing. After pruning and the application of a pruning mixture would appear to be the most favourable time for planting. Not much information is available as to the effect on tea. A leading planter, with reference to *Indigofera endecaphylla* planted in tea on a low-country estate, writes: " There has so far been no noticeable effect on the yield or appearance of the tea in which the Indigofera is growing. Planting was done by cuttings about 6 ft. apart and a fair cover was obtained in 6 months and a very thick cover in about 15 to 18 months." Ten acres of tea were planted with *Indigofera endecaphylla* on an estate in Dimbulla in the North-East monsoon of 1925, and 10 acres on the Experiment Station, Peradeniya.

Vigna oligosperma has also been tried on low-country tea: the chief difficulty in this case is the smothering of the bushes.

3. *Stone terracing.*—This presents considerable difficulty in old tea since the roots of the tea occupy most of the ground. Useful work has been done on many estates on road and drain edges.

4. *Silt pits.*—Silt pits in the drains are used with good effect on many estates. Digging pits apart from the drains in old tea involves a good deal of cutting of roots.

5. *Modifications of the ordinary weeding practice.*—The remarks made on this subject with regard to young clearings apply also to old tea except that in this case the tea will be better able to withstand competition from weeds.

At the conclusion of the paper, His Excellency proposed that as the next few papers dealt also with soil erosion they should be read and the discussion postponed until they had all been read.

MR. F. DENHAM TILL read a paper on some practical notes on prevention of soil erosion upon estates.

MR. R. SENANAYAKE read a paper on the same subject.

SOME PRACTICAL NOTES ON THE PREVENTION OF SOIL EROSION UPON ESTATES.

F. DENHAM TILL,

Superintendent, Lowmont Estate, Ceylon.

The Director of Agriculture has asked me to describe to you the methods I have adopted in an attempt to provide some practical antidote to the erosion menace on new lands. Erosion itself has been dealt with at such lengths, and is so familiar to all, that I need not refer to its cause or effects. Suffice to remark that our heavy tropical rainfall, although presenting a problem of some magnitude, is not an Abstract Force about which we know nothing, but a Natural Force, following all natural laws, especially the Law of Gravity.

We know that a stated number of inches of rain will represent a given volume of water, falling over a given area, within a given period. It is

consequently well within our power to compute with perfect accuracy the area of the container or containers necessary to hold up this given volume, until its erosive or scouring force is spent, and to control its direction of outlet from our lands in the most convenient way to ourselves. In other words to harness it to our ends.

The experiments I have made to date have all been on these lines, and have been conducted on new lands, as it is on these that the maximum damage occurs in the shortest possible time. The first experiments on two small clearings have been dealt with rather fully elsewhere.

The outstanding features of these clearings are that the earth has been shifted on a carefully thought-out plan, and all terraces are given a definite reverse slope against the hill, instead of being level. The chief reason for this being the need for easing, as far as possible, the pressure of the collected water on the thrown-up bunds, and directing it against the point most likely and best fitted to withstand this pressure. The containing area of the terraces is based on a maximum rainfall in 12 hours of 10 inches, allowing for 25 per cent. being lost through percolation, and evaporation in that period. It is now almost a year since these clearings were opened and as far as growth of plants, improved soil conditions, and their ability to hold the maximum rainfall experienced in Kalutara, they have more than fulfilled all my expectations.

The opening of these clearings immediately revealed one disadvantage, and that was the great number of labourers necessary in the initial stages, which would prove a serious drawback in the case of a large area being opened. It occurred to me that it might be possible in this connection to put to a useful purpose the scouring action of heavy rain, and make erosion take the place, and do the work of some of the labour, and more recent clearings are being opened on a modified plan with this in view.

The object aimed at has been to form an almost similar type of clearing to those shown on the photographs for tea, rubber or coconuts, which would be cheap on steep land, absorb a smaller number of manual labourers, and of course allow of no loss of soil, the work extending over a period of years, instead of being completed in say 6 months.

The method adopted is that shown in the rough diagrams, * and for the sake of clearness, we will take the land as being opened in rubber, spaced 24 ft. by 12 ft., this stand per acre being selected as economical, and allowing of thinning to 24 ft. by 24 ft., later if needed. Diagram No. 1 shows a cross section of an ordinary hill-side slope, and in this type of clearing it does not matter very much how steep the hill is, as little extra cutting is entailed. In fact the steeper it is the quicker the scouring action takes place, allowing the clearing to assume its ultimate form sooner than would occur on gently sloping land.

A perfectly level trench of a depth and width previously ascertained as sufficient when the plants are put in, to contain the maximum volume of water to fall between this trench and the next trench above it, is cut at the base of the hill. The trench is 4 ft. wide by 3 ft. deep. At a distance of

*. Not reproduced.

24 feet from the centre of this trench comes the centre of the next trench above it, cut the same size, and so on right up the hill. This gives the 24 feet spacing. In practice the steeper the land the smaller the trench for any given spacing.

These trenches must of course be dead level, and echeloned where necessary. The surface-soil is thrown to the upper side of the trench, and the sub-soil to the lower side. As the sub-soil removed is usually in the proportions of two or more to one of the surface-soil, a fairly high and substantial bund results on the lower side, and this will rise very nearly a foot and a half above the level of the top of the trench. The trench is not filled by hand, until a week or so prior to planting, as the scouring action of the rains will send a great deal of this surface-soil back into the trench, and save a certain amount of manual labour. It will be noted that the point of maximum erosion happens to be just where the surface-soil is thrown up.

The plants are planted in the trenches themselves, 12 feet apart, thereby giving the other required spacing, and it is obvious that any spacing in the horizontal direction may be employed without extra expense. When the trench is filled prior to planting it should contain 1½ feet of surface-soil throughout its entire length. It is probable that the original depth of surface-soil thrown out of the trench when cutting will not exceed 1 foot, so that further surface-soil should be scraped off the ground above the trench to give the requisite depth of filling. You will now have an area 1½ feet deep by 4 feet wide by 12 feet long containing your best soil for the plant to get away in, as compared with the fairly general 2½ ft. by 2½ ft. hole; in other words 12 times as large a hole. For water-containing area you have the height of the trench, which is taken from the top of the sub-soil bund, and will probably be 3 feet high and approximately 5 feet wide, which is sufficient to hold up 7½ inches of rain if this had fallen simultaneously.

Such falls only being experienced in a cloud-burst, this trench would be safe against anyhow 12 inches in 24 hours, as a large proportion of this fall would be absorbed through percolation and evaporation, probably as much as 6 inches of this need not be calculated for, so that a fairly safe margin of containing area is available. From my own experience of this particular type of contour opening in the last year, I should feel quite safe if 15 inches fell in the 24 hours. It may be remembered that on well-conditioned land, the higher the water pressure, the quicker the percolation up to a point. On the soils upon which these clearings have so far been tried, water-logging is non-existent.

It will be seen therefore that our containing-trench in its first few months of existence, safeguards us against the direct soil-loss due to scouring, all eroded soil being caught-up in the trench. Scouring action is however going on all the time between the trenches, and is therefore gradually eroding, and consequently levelling away the slope of the hill immediately below the bund of each trench.

The earth eroded from this position is deposited in the trench, raising the soil-level of the latter, whilst at the same time levelling off the ground at the back of the trench, so that though the trench itself will contain less

water, the total levelled area will hold it. In other words, though the container becomes silted and decreases in depth, it increases in width, so that its actual capacity does not decrease.

The original surface-soil lying above the trench, fills in the trench, and the sub-soil is then exposed to the elements and to cover crop root action, and finally turns into useful soil capable of assimilation by the planted product. It is quite possible if it be desired, to cut an intermediate trench between every pair of trenches to act as a manure control trench, and if this be done, the original trenches need not be quite so large. The manure trench may be put in later, though I should place four years as the safe limit of time in which this trench should be cut, otherwise root disturbance and damage is likely to take place.

In tea of course the size of individual trenches would have to be decreased, and the number of trenches increased according to the stand of bushes per acre desired. It may be argued that this is likely to cause difficulty in a plucking line, but in view of the precipitous slopes on many estates this argument cannot be fairly advanced. Furthermore, if the yield can be substantially increased and manuring expenses cut down through the better soil conditions, these would more than offset any slight additional plucking costs.

With these clearings no leading or side drains are put in, though should these be found necessary, a modified drainage system allowing for the evacuation of filtered rainwater, could be used, in the wet zone. They are not meant to be irrigated.

The ultimate form this clearing should take up in the course of a few years, mainly due to controlled erosion, is a series of full-contoured terraces. It is possible that six years may elapse before this happens, but it is bound to occur, following as it must a natural Law.

One or two remarks on a small clearing of this kind that I have had under observation for the last year may be of interest. The soil might be termed somewhat " heavy," the product is rubber.

1. Nine inches of rain in 18 hours, caused no waterlogging.

2. Moisture seemed to be well conserved, and young small stumps put in just prior to a critical period of six weeks drought, in September, appeared none the worse for it, although other clearings opened in the same district, in an area of higher rainfall, and planted in June, suffered considerably.

3. Erosion of the bunded sub-soil on a steep slope was far less than one would have expected, in fact the main movement downward of bund soil appeared to be due more to " dry-wash " than " wet-wash."

4. Creeping and other cover crops, such as Vigna, Indigofera, all Desmodiums, and Tephrosia grew much better on the sub-soil bund than I had thought possible.

5. Surface-soil in the trench did not settle or lose level.

6. Sinhalese labour appears to like the work of trench cutting, and on completion of this work asked for as much more as I could give them.

Local small land-owners have started putting these trenches into their clearings on their own initiative, though unfortunately they do not seem to

have grasped the necessity of keeping them level. This shows however that with proper instruction they would be prepared to conserve soil on their small properties, which is a step in the right direction.

The following is an approximate Estimate of the cost of opening an acre in this fashion, exclusive of cost of plants, felling and clearing, superintendence and weeding, which would of course vary.

FIRST YEAR.

Tools ...	Supplied by Trenching Contractor.		
Lining	... ...	Rs.	1.00
Planting	... ...	,,	1.00
Contour Trenching (a Trench 4 ft. by 3 ft. every 24 ft. approximately 30 chains per acre @ Rs. 7.00 per chain		,,	210.00
Fencing	... ...	,,	15.50
Watchmen ...	6 months @ Rs. 20.00 for 155 acres	,,	1.00
Green manure cover crops	... ...	,,	3.00
	Total ...	Rs.	231.50

With regard to weeding, I found that after the initial clearing and contouring, cover crops will cover the inside of the trench, before the weed can get in.

The above Estimate does not include the manure trench between every contour trench, and if this is to be put in, an additional Estimate must be framed accordingly.

From what I have been able to see of these contour clearings up to date, I am very satisfied with their behaviour, but what I am really anxious to know, and have had no opportunity of testing, is how far their moisture-conserving features would assist us to plant tea, rubber and other wet-zone products in a semi-dry zone. There appear to me to be possibilities latent in this connection.

My best thanks are due to Mr. Stoughton-Harris for his kind collaboration and assistance in taking the photographs * of these clearings which are now circulated.

SOME PRACTICAL NOTES ON THE PREVENTION OF SOIL EROSION UPON ESTATES.

REGINALD SENANAYAKE,

Superintendent, Mukalana Estate, Matugama.

Soil denudation had been the subject of enquiry by a Commission as far back as 1904; but it is only within very recent times that the question came to be seriously considered by the Agriculturists of this Country. Soil erosion is the greatest danger that threatens Ceylon Agriculture and the permanency of at least two of its staple industries. We are now all agreed that much of our valuable top soil is being rapidly lost and that our cultivated lands are adversely affected in consequence.

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* Not reproduced.