

## VEGETATIVE PROPAGATION OF THE TEA PLANT—(Contd.)

PROF. T. K. KVARAZKHELIA,  
*THE TEA RESEARCH INSTITUTE OF THE USSR,  
OZURGETI-ANASENLI, GEORGIA, USSR.*

### PROPAGATION BY CUTTINGS

Experiments on propagating tea by cuttings were begun in 1928. There were tested both stem and root cuttings.

Root cuttings were tested in the open, being obtained either by means of uncovering a part of the roots of a tea bush and separating them from the parent plant or by means of digging out a tea bush and cutting its roots into pieces 7-10 cm. long. Further experiments showed that with a well prepared soil and optimal moisture content there may be used root cuttings but 1 cm. long. A tea bush in dependence with its age and vigour may yield 20-160 root cuttings 10 cm. long.

The 7-10 cm. long cuttings were then sorted according to their diameter into thick (diameter 2 cm. and more), middle-sized (diameter—1 cm.) and thin (diameter less than 1 cm.). 200 cuttings of each group were tested in every variant of the experiment. They were planted at the distance of 20 cm. from each other, the soil being prepared in the usual way. They were not watered. In summer the soil was hoed and weeds removed in the usual way. We used to plant them between May 10 and June 20 and always obtained good rootage in 1½ or 2 months after planting (Plate 16).

Thick cuttings gave the best results, namely 52-73 per cent. of rooted plants while thin cuttings gave but 9.5-18 per cent., and middle-sized cuttings gave 37-45 per cent. of rooted plants. In 2-6 months after rooting either in autumn or in spring young bushes were transplanted into the field. Every year some bushes were dug out and their roots examined. It was observed that the development of their root system depended upon the way in which they had been planted — horizontally or vertically. In the first case the roots spread near the surface of the earth, in the second they developed to a greater depth. In both cases

after two or three years (in dependence from the soil conditions) some horizontal roots changed their direction, which became more or less vertical, and penetrated deeper into the soil.

Experiments on propagation by stem cuttings were carried out in hot-houses and solar propagators. There have been tested four, three, two and single eye cuttings and buds, such as are used in summer budding under the bark into a T shaped incision. All of them produced roots. There were tested cuttings of different ages, of one and two years old shoots, of shoots of the current year, hardwood, semi-hardwood and green cuttings, as well as cuttings of different types: with leaves, with one half of a leaf, without leaves, mallet cuttings, heel cuttings, split cuttings. (Experiments showed a feeble rootage of cuttings without leaves and therefore in further experiments this type of cuttings was excluded). Each variant of the experiment was carried out with 200 cuttings.

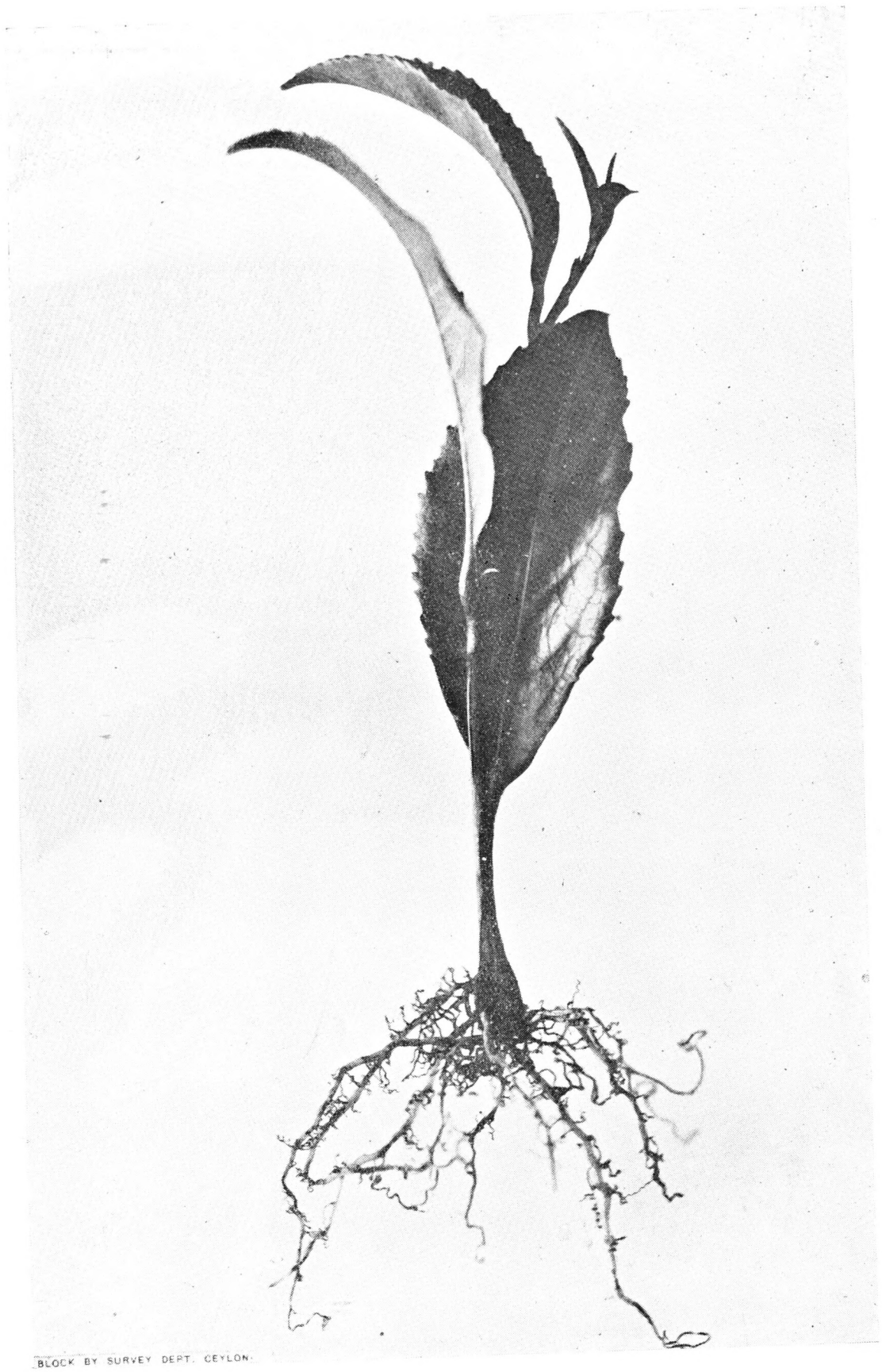
Plucking shoots with 3 leaves (Plate 17) gave but 6-10 per cent. of rooted plants in comparison with semi-ripened and ripened cuttings and were excluded after having been tested 3 times.

*Green or semi-mature cuttings rooted as follows:*

- (a) green cuttings with 4 eyes & entire leaves 31-46%  
(Plate 18).
- (b) do. 3 do. 48.5-65%
- (c) do. 3 eyes and a leaf, 54%
- (d) do. 2 eyes and entire leaves 38%
- (e) do. 2 eyes and a leaf, 42.5-59%
- (f) 1 eye green cuttings with a leaf, 54.5-62.5%
- (g) green buds with a leaf, 35-58.5%

*Brown mature cuttings of shoots of the current season, not older than one growing season, rooted as follows:*

- (a) brown cuttings with 4 eyes and entire leaves 66-70%  
(Plate 19)
- (b) do. 3 do. 55-56.5%
- (c) do. 3 eyes and a leaf, 63-80%
- (d) do. 2 do. 44.5-62%
- (e) brown single eye cuttings with leaves, 44.5-62% (Plate 20)
- (f) buds of brown shoots with a leaf 33.5% (Plate 21)



BLOCK BY SURVEY DEPT. CEYLON.

Plate 17.

A rooted plucking shoot with three leaves.

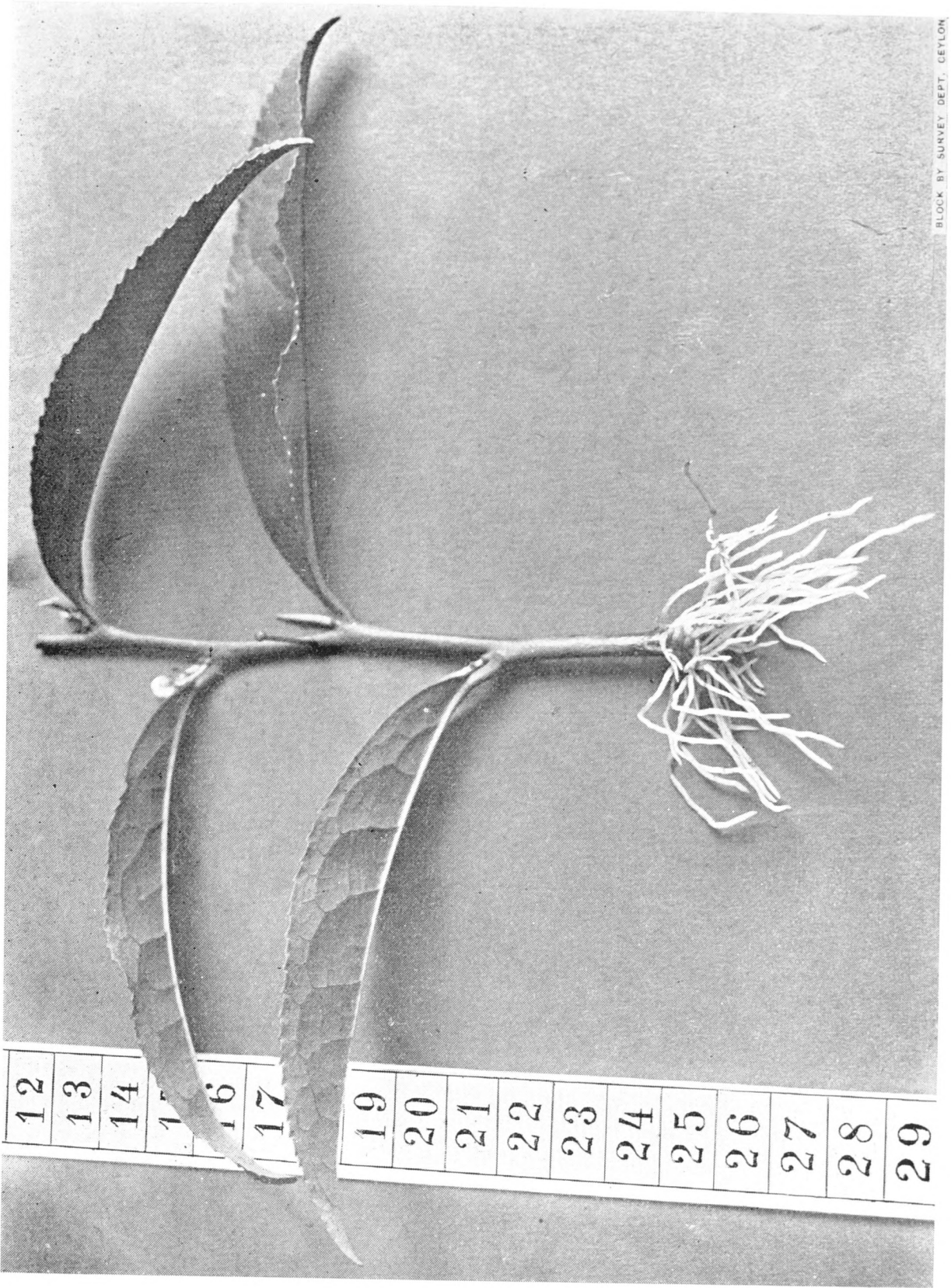


Plate 18.

A rooted green cutting with four eyes and entire leaves.

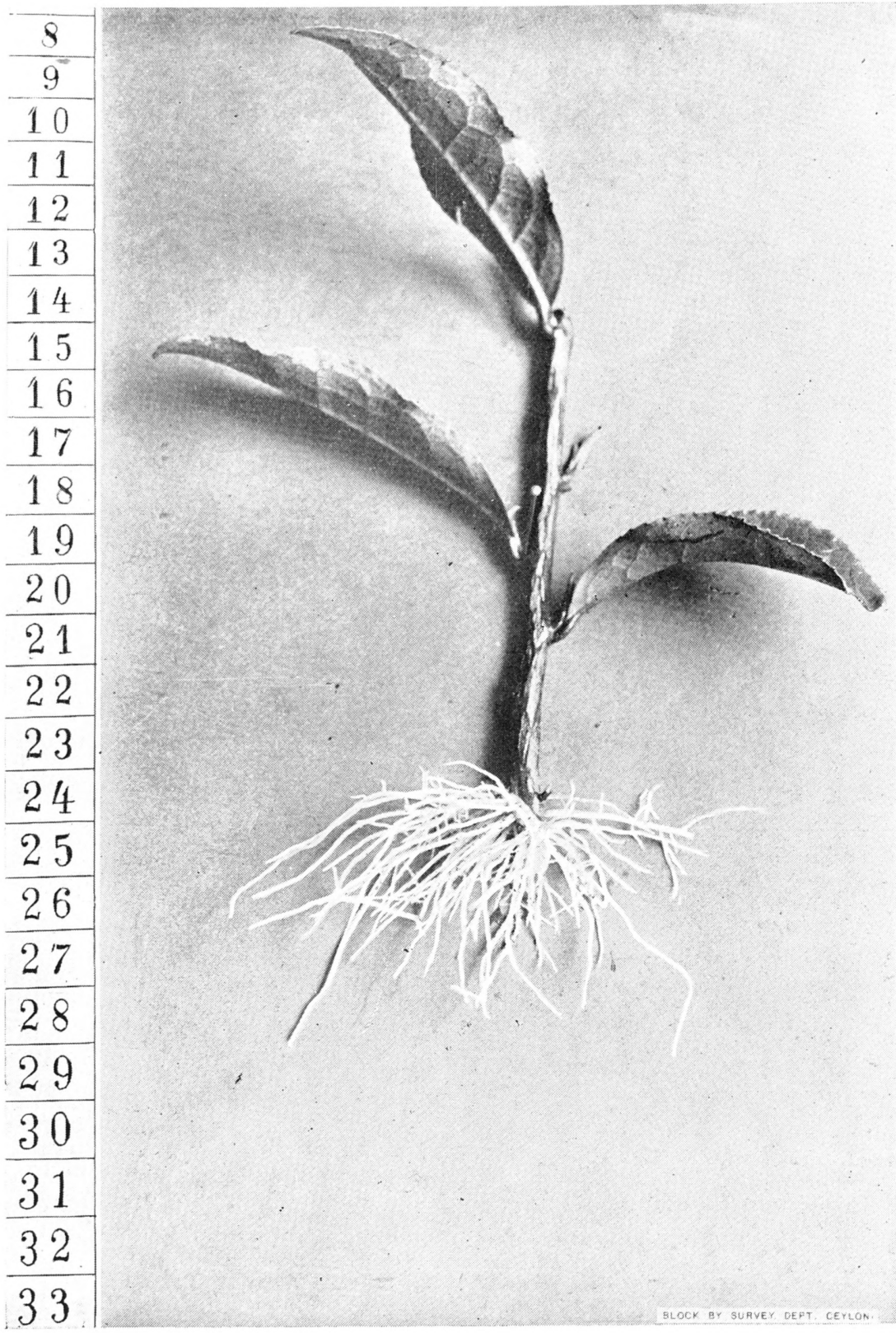


Plate 19.

A rooted brown (ripened) cutting with four eyes and entire leaves.

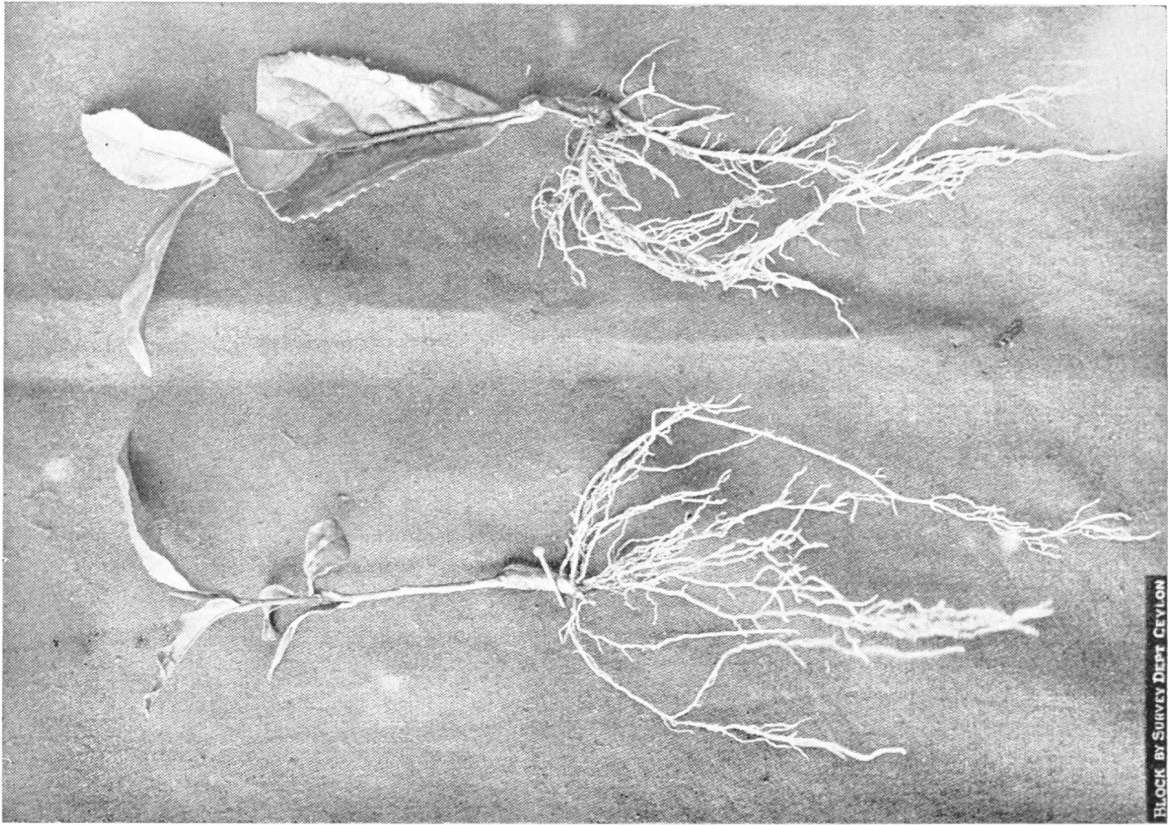


Plate 20.

Rooted brown (ripened) single eye cuttings with leaves,  
half natural size.

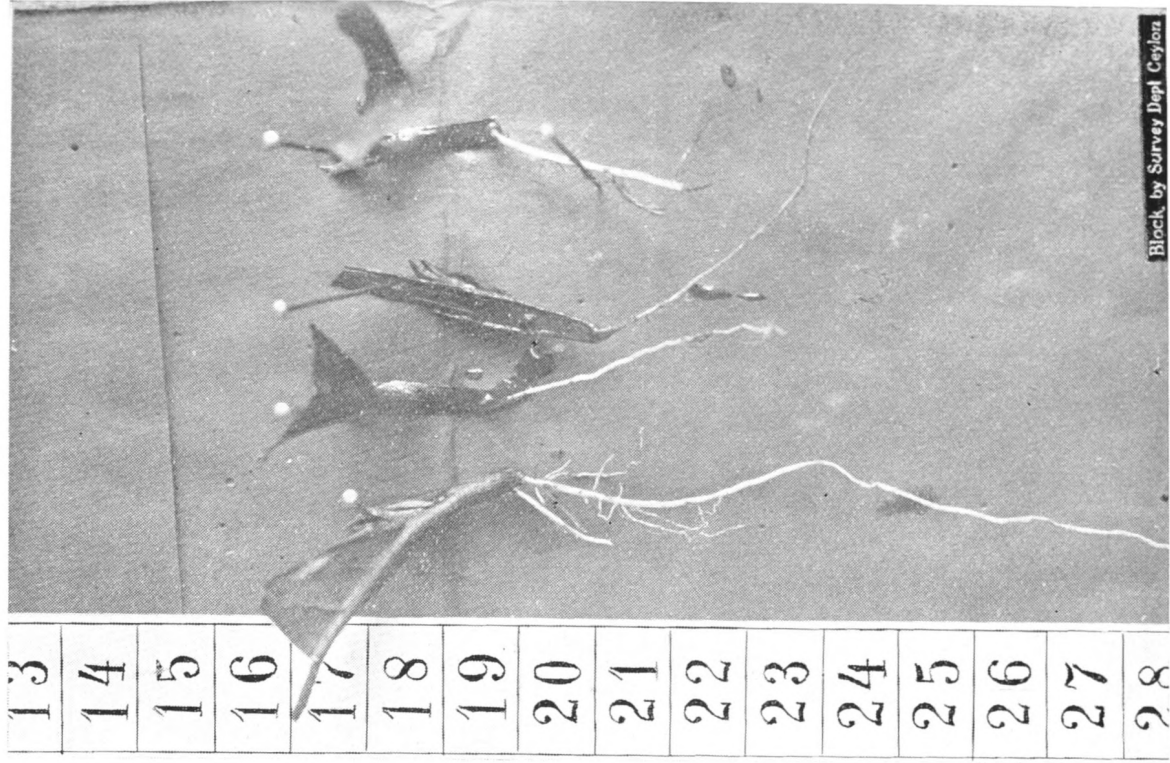


Plate 21.

Rooted brown (ripened) tea buds.





Plate 23.

One year old tea bush, grown out of stem cuttings.

Cuttings made of older shoots do not root as well, the per cent. of rooted plants being the lower, the older are the shoots. Mature brown cuttings of the current year's growth gave the highest per cent. of rooted plants; semi-mature (green) cuttings gave a lower per cent. of rooted plants. The percentage of rooted plants was the lower, the younger were the shoots of the current year's growth. The plucking shoots with three leaves gave the lowest per cent. of rooted plants. Buds of green shoots, (the same as are used in budding), gave a higher per cent. of rooted plants (58·5 per cent.) than buds of hardwood shoots (33·5 per cent.). Two years old mallet-cuttings with leaves gave a higher per cent. of rooted plants (19·27 per cent.) than cuttings of the same age with leaves but without mallet. Heel cuttings with leaves gave a higher per cent. of rooted plants (23·5-32 per cent.) than those with leaves, but without heel. There were tested mallet and heel cuttings of 2 and 3 years old shoots, those of younger shoots not having been tested. Later on testings of mallet and heel cuttings were excluded from the programme of experiments as having no practical importance.

Experiments on propagation by cuttings were carried out in hot-houses and propagators of unsatisfactory types, where both the moisture and the temperature of the air underwent considerable fluctuations. The sand for the experiments, though taken from the seaside, was not sufficiently washed and purified of organic admixtures, thus the medium in which the cuttings were grown was not a sterile one. The technical workers were unexperienced and they often changed. The author of the present paper was engaged in other works and could not pay sufficient attention to the work on the vegetative propagation of the tea bush. Due to these unfavourable conditions the per cent. of rooted cuttings belonging to the same type underwent considerable fluctuations: 16-80 per cent. Nevertheless a great number of experiments (about 100,000 cuttings) brought to notice a certain tendency of one year old cuttings to root better than older cuttings. Among one year old cuttings the ripened (the brown) cuttings root better than the green ones. On the contrary, buds of green shoots root better than those of brown ones. In dependence on favourable or unfavourable conditions for rootage, a tea cutting, after having produced a callus (Plate 22) may remain

alive for a very long time (3, 5 & 6 months) without drying or withering if the sand is sufficiently moist and the temperature does not fall below a certain minimum. With optimal moisture and temperature such cuttings produce roots.

Young plants, grown out of cuttings were transplanted into the field. Those, transplanted directly from pots gave 70-80 per cent. rootage; when first transplanted into a nursery and later on into the field they gave 90-100 per cent. of rooted plants; young cuttings, with tender roots, transplanted directly into the field gave 40-67 per cent. of rooted plants. Rooted cuttings transplanted into the field gave a vegetative season's growth as follows: (1) with stable manure: 14-16 cm. the number of lateral shoots, 4-30 cm. long, being 4-6, (Plate 23). (2) without manure: 15-30 cm. the number of lateral shoots, 2-12 cm. long, being 3-8.

Cuttings with primary roots, transplanted into the field on June 25, 1932, produced a normal root system and normal shoots by October 30, 1932, *i.e.*, in four months' time (Plate 24). Two years later, by June 25, 1934 their root system was still stronger, the roots were thicker and penetrated deeper into the soil. It did not differ from the root system of tea bushes grown out of seeds. Plate 25 shows the development of the root system of a 2 years old tea bush grown out of a one year old ripened (brown) cutting with 3 eyes. The small active rootlets and the deep reaching roots (marked with a cross) were torn off in digging out the bush.

We planted tea seeds at the same time as buds in order to compare the rate of their growth. Tea plants grown out of cuttings and even those, grown out of buds, do not fall in their development behind plants grown out of seeds. Plate 26 represents tea seedlings (26a) and tea plants grown out of buds (26b) planted in spring and dug out and photographed the same year in summer.

On June 25, 1932 we planted some rooted cuttings and buds into pots filled with earth, which consisted of an upper humus layer and sand. Four months later, on October 30 the roots of the plants were washed and showed a vigorous development of small active rootlets. Plate 27 shows such a plant grown out of a one year old cutting with three eyes. The roots of plants, grown in pots continued to increase both



Plate 24.

Rooted cuttings 4 months old. These cuttings with primary roots were planted in the open ground on June 25, 1932 and dug out and washed on October 30, 1932 when this photograph was taken. The dotted line indicates the top of the cutting, above it is new growth.

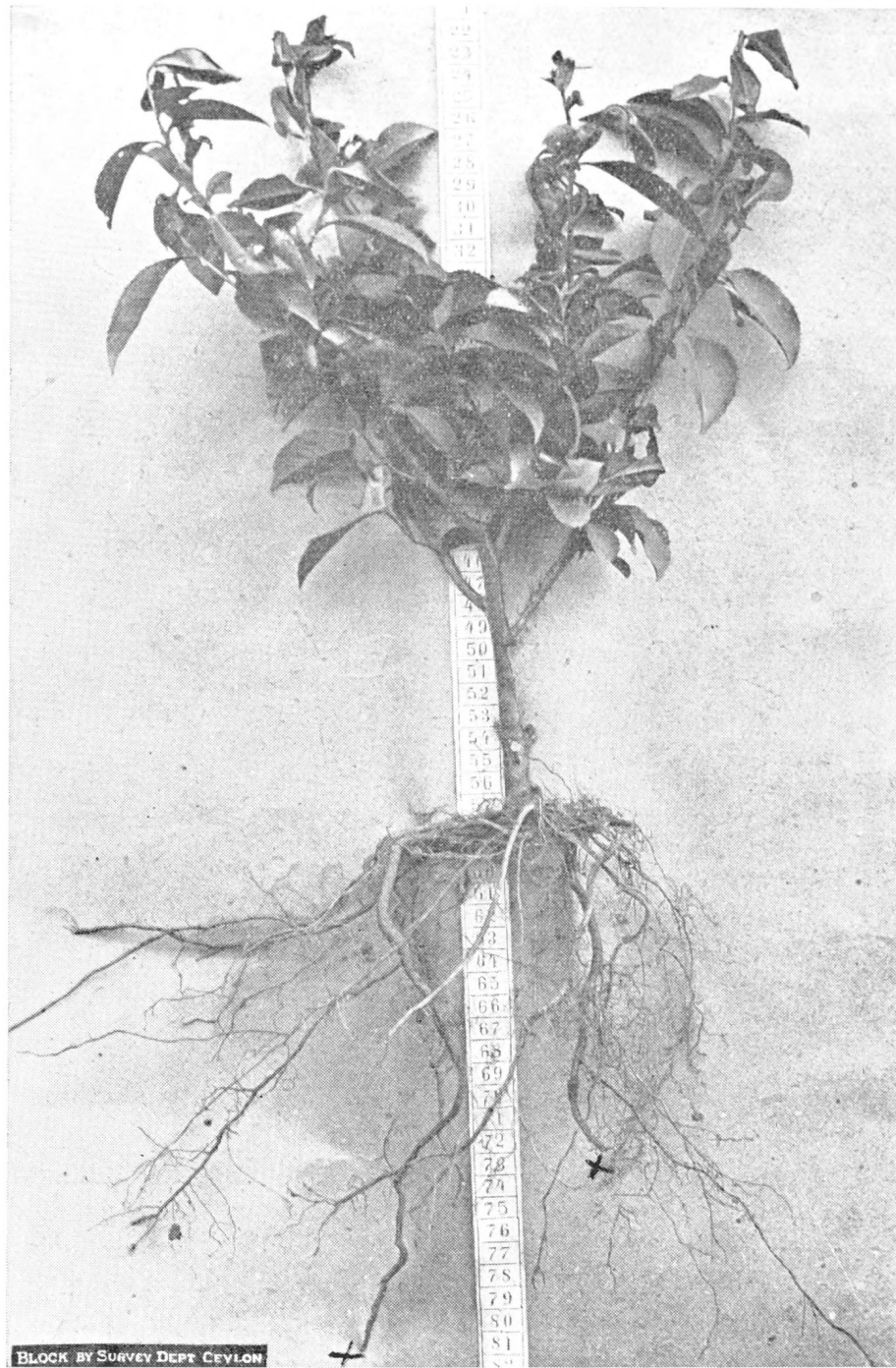


Plate 25.

The root system of a two years old tea bush, grown out of one year old ripened cutting with three eyes.

- x. The points at which the deep reaching roots have been broken.

14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49

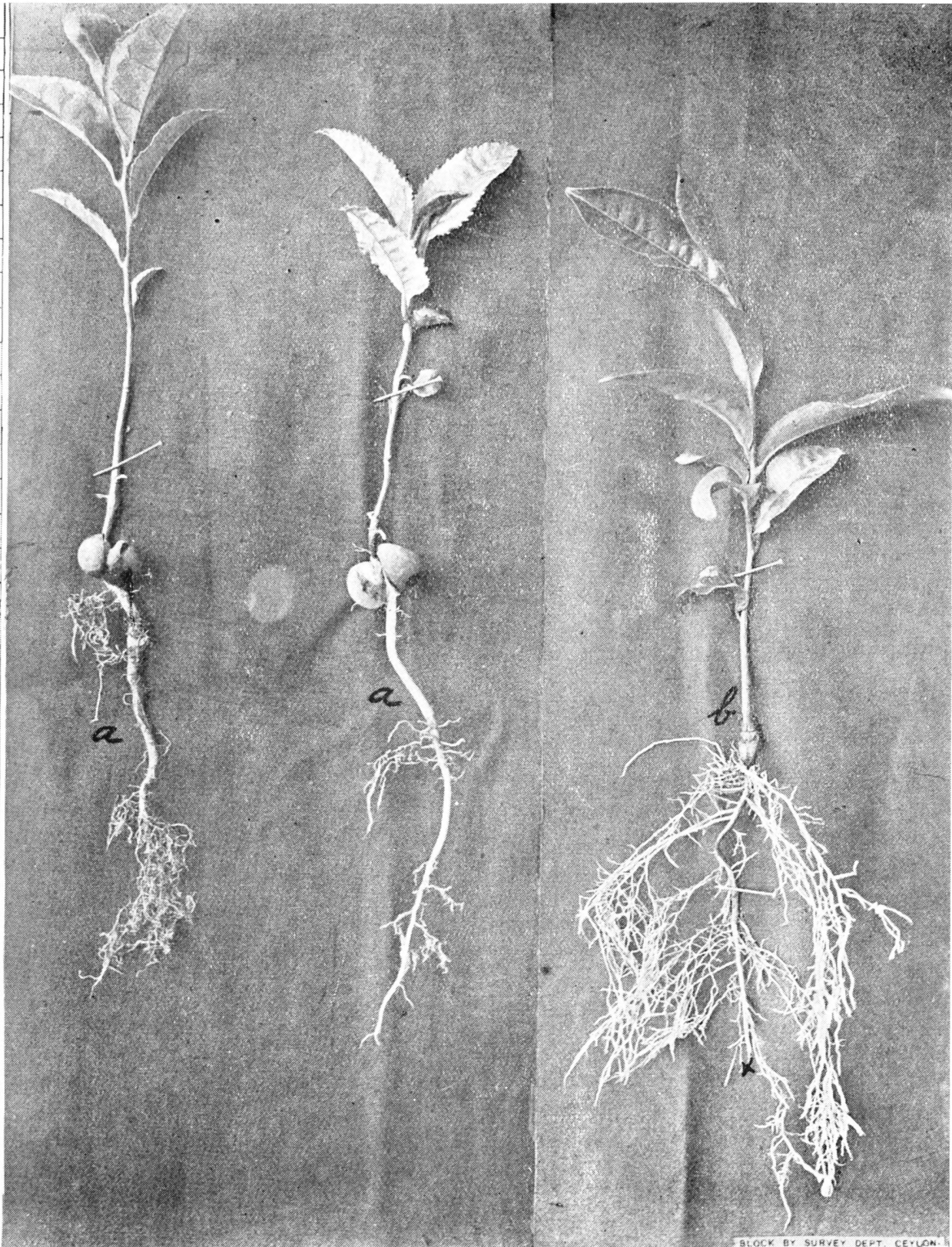


Plate 26.

Tea plants of the same age.

(a) Grown out of seeds

(b) Grown out of buds.

x. The point where the taproot was broken in digging.

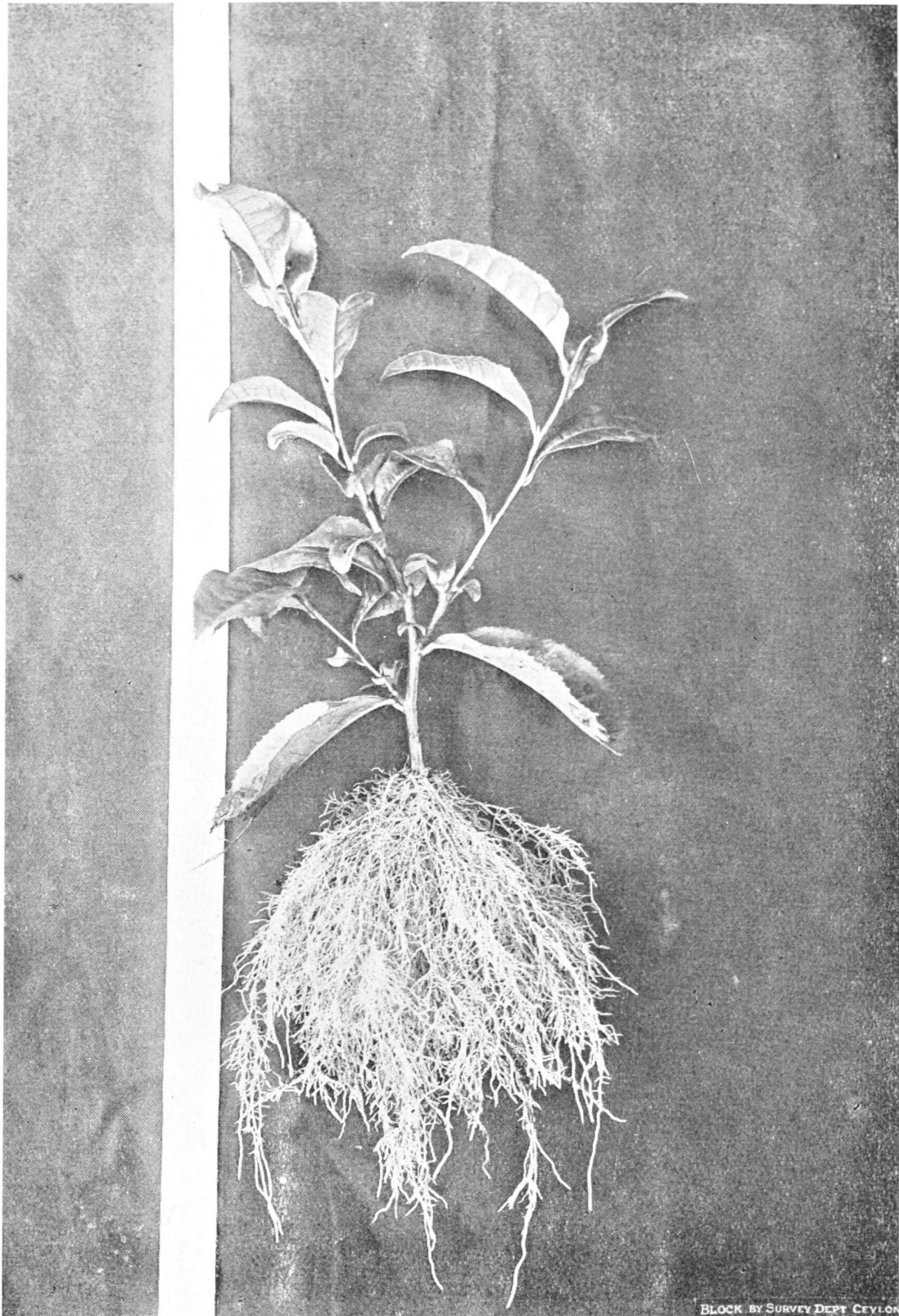


Plate 27.

The root system of a one year old cutting with three eyes, transplanted into a pot with a good soil. The rooted cutting was transplanted on June 25, 1932 and the roots washed on October 30, 1932 when this photograph was taken.



Plate 28.

The root system of a one year old tea bush grown out of a one year old cutting with three eyes. Rooted cuttings were transplanted on June 25, 1932 and the plant dug out and the roots washed on June 25, 1933.

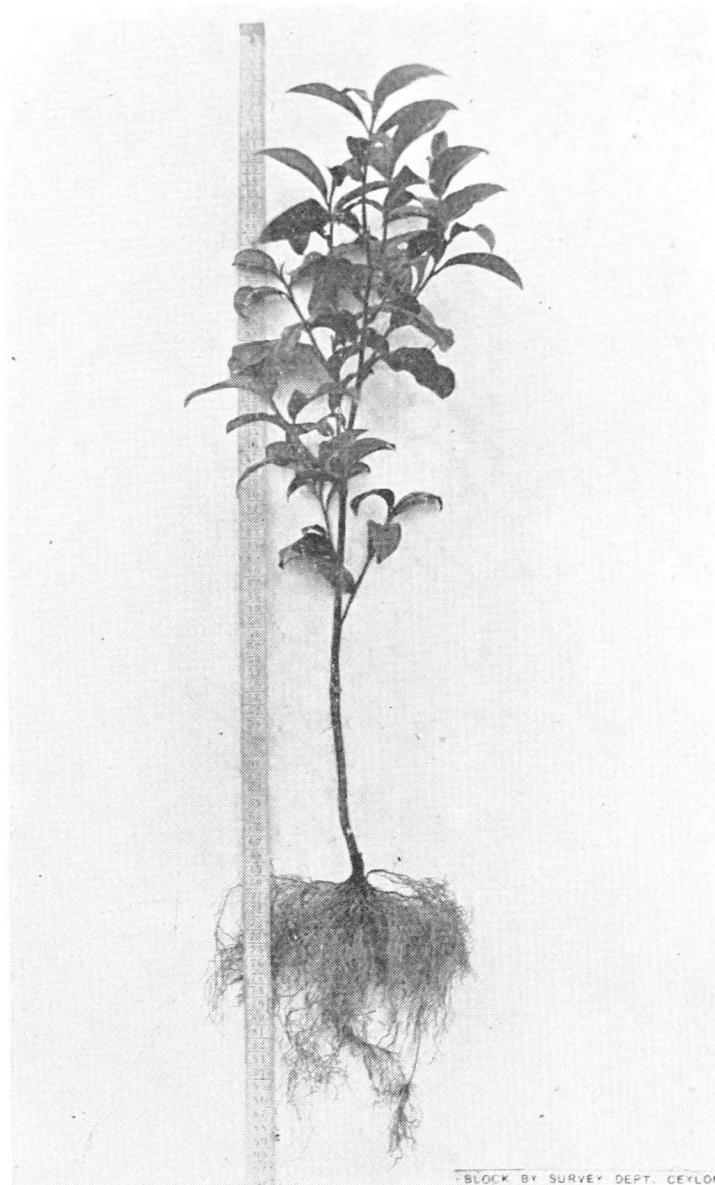


Plate 29.

One year old tea bush, grown out of a rooted  
bud in a pot with good soil.

in their total mass and in their length and thickness, they stopped their growth only in winter, during the resting period of the tea plant. A year later on June 25, 1933 another set of plants were washed and proved to possess roots as shown in Plate 28.

Rooted buds (Plates 21 and 26b) in pots with the above described soil, possessed at the end of the year a root system as represented in Plate 32. The same development of roots is obtained when rooted cuttings are planted in a nursery, where the soil is rich in humus. When transplanted into the field 100 per cent. of plants, possessing such roots take root, while one year old insufficiently branched roots give a high per cent. of failures.

Our experiments lead to the following conclusions:

(1) All sorts and varieties of the tea plant may be propagated by root and stem cuttings.

(2) In the open ground propagation by root cuttings gives the best results. Thick cuttings (2-3 cm. thick) 7-10 cm. long, root better than thinner ones. The thinner and shorter are the cuttings, the lower is the per cent. of rooted plants.

(3) Stem cuttings and buds (parts of a shoot) root best in sterilized and well aerated soil (sand) with optimal moisture content of both the soil and the air (up to 100 per cent.) and optimal temperature (25-30°C). The observance of the above conditions in the open air is difficult, therefore in the open ground we obtain a lower per cent. of rooted cuttings than under cover.

(4) Ordinary hot-beds like those used for seedlings of vegetables are quite sufficient for a good rootage of tea cuttings.

(5) The age of the cutting influences its producing roots. The highest per cent. of rooted cuttings is obtained with cuttings of shoots of the current season's growth. The older are the cuttings (2, 3 and more years old), the lower is the per cent. of rooted ones. Hardwood (brown) cuttings root better than semi-hardwood (green) ones. Plucking shoots give the lowest per cent. of rooted plants. Buds of green shoots root better than those of hardwood (brown) shoots.

(6) The removal of half the blade of the leaf diminishes its transpiration and favours rootage. Both the removal of the whole blade (stoppage of assimilation) and keeping it intact (strong transpiration) diminish the per cent. of rooted cuttings.

(7) The greater are the fluctuations in the surrounding conditions (temperature, moisture, aeration), the slower is the process of rootage; the nearer they are to the optimum, the more rapid is this process. Cuttings with a callus but without roots may live a very long time, rooting slowly in dependence of the fluctuations in the condition of the surrounding medium. For instance in 2·5 months after planting 38 per cent. of cuttings are rooted; in 4 months — 52·5 per cent. (in relation to the original number of cuttings); in 5·5 months — 76 per cent., in 6 months — 80 per cent.

(8) The per cent of rooted tea cuttings corresponds to that of many other trees and bushes, which are propagated by cuttings, and is quite acceptable from the practical point of view.

(9) Propagation by cuttings and buds may be recommended for the purpose of selection of the high-yielding populations of best varieties, for obtaining homogeneous planting material and creating homogeneous tea plantations. Absolutely homogeneous material, obtained from a single parent plant may be planted on experimental plots, and the heterogeneity of experimental plots, and even of plants grown in pots, may be thus avoided.

*(To be continued).*