NOTES ON GREEN LEAF SIFTING AND FERMENTATION*

F. R. FRANCILLON.

I was fortunate in enlisting Mr. Whitehead's interest and valued co-operation in the subject matter of these notes. We wish to make it clear that we do not claim to have made any remarkable discovery, but have arrived at certain logical conclusions, which are the outcome of a series of closely reasoned experiments carried out following the installation of a C.C.C. Multiple Green Leaf Sifter. Our object was to arrive at the best possible method of obtaining a bright and even fermentation of dhools.

The machine needs no description as it is well known. As supplied by the makers the top tray was fitted with No. 5 mesh throughout, while in the lower tray the upper half was fitted with No. 6, and the lower half with No. 8.

After charging two rollers with 432 lbs. of withered leaf and rolling for five times, the first day's shifting gave the following results.

Over	No. 5	95 lbs.	or	22·09%
Through	,, 6	232	,, ,,	53·96%
Through	,, 8	12	,, ,,	2·79%
Over	,, 8	91	,, ,,	21·16%

*The Institute does not necessarily endorse the views expressed in papers contributed by persons not members of the Staff.

The material falling through No. 6 was very uneven, and contained all the smaller, as well as a large percentage of the larger, particles of leaf and long ends. The material falling through No. 8 was more even, being composed chiefly of medium sized fragments with a number of long ends.

It was the heaped up uneven dhool below No. 6, and the mere sprinkling of dhool No. 8, that led to a series of experiments, a précis of which is given in these notes.

The first point to clear up was whether evenness, and brightness, could be achieved by the conditioning of the air over, and around, fermenting dhools, or whether the only way this could be obtained was by the separation of tender from mature leaf.

This led to experimental plucking in the field which was undertaken and closely supervised on two estates on the following lines: the tip and first leaf only were plucked and put into one basket, while the remaining second leaf and stalk were plucked and put into a second basket. A normal pluck as a control was also undertaken. In both instances the brightness and evenness of the resulting dhools and infusions were most remarkable as regards the tip and first leaf manufacture. The second leaf and stalk, as was to be expected, were not so bright, but again evenness was a definite characteristic. Infusions from the control pluck were mixed — containing bright young leaves and dull olive green older particles.

Having demonstrated to our satisfaction that the separation of tender from mature leaf is essential to bright and even infusions, it was next considered as to how this could best be effected.

The cost of plucking as described is prohibitive. It was found that in a field where the normal average would approximate 25 lbs., it was only possible for a good plucker to bring in a maximum of 4 lbs. of bud and first leaf. The problem, therefore, resolved itself into the improvement of roller battens, and methods of sorting in the green stage prior to fermentation.

No claim is made as regards roller battens though "Pictures" made it abundantly clear that some are preferable to others — though to what extent this can be attributed to wither, or type of leaf, it is hard to prove or disprove.

"Pictures" are taken as follows; the method being that developed by Mr. Lamb at St. Coombs: A fair sample of approximately 1 ounce of dhool is placed in a tea cup, or similar receptacle, which is filled with boiling water. The dhool, or leaf, is left until all twist has been removed, and it has attained a maximum degree of flaccidity. From this a small fair sample is taken, thoroughly dried on blotting paper, and every particle of leaf carefully unrolled and spread out on white paper. It is essential that *all* particles, however small, are included in order that a true picture of what has taken place can be made. The evenness, or unevenness, becomes apparent immediately, and such pictures can be preserved for comparison by covering them with a piece of glass.

A definite claim is made, however, that by the careful grading of dhools a distinct improvement can be effected.

We must now revert to the experiments in dhool separation conducted on the Multiple Sifter. Frequent changes in the sizes of mesh were made until eventually it was concluded that the best arrangement as far as we were concerned was:—

Upper Tray No. 5 Mesh.

Lower Tray Top or 1st Quarter No. 10, 2nd Quarter No. 8, 3rd Quarter No. 7, 4th Quarter No. 6 Meshes.

Two rollers were charged with 493 lbs. of withered leaf and rolling continued for six periods. The resulting dhools were:—

Over		No. 5 Mesh	72 lbs.	or 14·64%
No. 1	through	No. 10 ,,	111 ,,	,, 22·56%
,, 2	,,	,, 8 ,,	61 ,,	,, 12·40%
,, 3	,,	,, 7 ,,	93 ,,	,, 18·90%
,, 4	,,	,, 6 ,,	50 ,,	,, 10·16%
Through ,, 5	over	,, 6 ,,	105 ,,	,, 21·34%

The figures given above are not an absolute instance, but have been closely duplicated on numerous occasions. It will be noted that the dhools under Nos. 1, 3 and 5 approximate to one another reasonably closely in weight, while the same can be said of Nos. 2 and 4, and tests showed that the grading was definite, and each even in itself.

These tests were conducted on the following lines. For clarity the finest grading through No. 10 Mesh is called No. 1; the next finest through No. 8 Mesh No. 2; through No. 7 — No. 3; through No. 6 — No. 4; over No. 6 — No. 5. A picture was taken of the grades in each of the five positions mentioned.

No. 1 comprised small even particles of leaf. (Plate I).
No. 2 contained slightly larger, with a few smaller particles (Plate II).
No. 3 was distinctly bolder and even. (Plate III).
No. 4 was very similar to No. 3. (Plate IV).
No. 5 was appreciably bolder, with some long stalks. (Plate V.).

These dhools were fermented separately, and fired separately. Infusions were duly compared with our standard *par excellence* — that of the bud and first leaf manufacture.

The small even particles of No. 1 from the first roll compared even more favourably than we had expected. The infusion was exceptionally even and bright, and it was only on closer searching through a magnifying glass that an occasional duller, olive-green particle could be found. Our inference here was that as far as the first roll was concerned, the fall-through under No. 10 was chiefly composed of tip and first leaf.

Under No. 2, as was to be expected, dhools were slightly longer, though here too a fair percentage of smaller particles was found. Infusions were again even and bright.

No. 3 was distinctly bolder, but the infusions were still bright and even.

Infusions of No. 4 were also bright and even, but here a few duller particles of leaf were easily noticeable.

The bolder character of No. 5 resulted in a bright though mottled infusion.

The same method was applied to the second roll. The dhools closely approximated to the corresponding dhools from the first roll, but infusions were a shade less bright throughout, and an increased number of maturer particles was noticeable from No. 3 to No. 5.

This was followed on similar lines by the 3rd, 4th and 5th rolls, and in each of these it was easily noted that the infusions as the rolls progressed were each a shade inferior as regards brightness, though *evenness* was a distinct characteristic. From this we inferred that considerably greater *evenness* of fermentation could be effected by the separation of dhools into as many grades as is practicable.

Having concluded that for our purpose 5 dhool grades were necessary, steps were taken to ensure that, after our special grading of leaf-particles, there should be no subsequent mixing or handling. For this purpose we eventually arrived at a series of superimposed trays, which slid into a suitably designed frame which was set beneath the lower tray of the sifter, to which minor additions had to be made to ensure dhools falling accurately on to the trays. Diagram I illustrates this.

The superimposition of all receptacles for leaf and/or dhools is necessary so that when the upper tray is removed leaf does not fall to the floor.

The type of tray is important, the reasons being:—

1. Cost.
2. Durability.
3. Lightness.
4. Suitability for fermentation.

Experiments carried out at the Tea Research Institute show that these trays can be constructed of either wood, asbestos, aluminium, or galvanised iron sheeting without any difference from a ferment on concrete being detected.

It was with reluctance that the idea of a mesh base had temporarily to be abandoned owing to our not having been able to find a suitable metal which would stand up to cleansing and rough-handling, at a price which was not prohibitive. It is hoped eventually to overcome this difficulty, as it is thought that the circulation of the air under, as well as over, fermenting dhools may be beneficial. The benefit of such aeration has not yet been proved, but on the other hand it has also not been disproved. The Tea Research Institute has expressed willingness to investigate in this direction.

As it was intended that all dhool should receive a *minimum* of handling, it now became obvious to us that the trays could be fitted into suitably constructed racks, and thus become the fermenting table.

The most suitable size for these trays was found to be 4 feet by 18 inches by 2½ inches; and this allows for a depth of leaf up to 2 inches during the period of fermentation. The frame beneath the sifter is fitted with the necessary strikers to level off dhools as trays are withdrawn prior to weighing and placing in position on the fermenting racks. 2 inches is of course an arbitrary height, and frames should be made higher or lower to suit conditions, or individual requirements. A tray of the size given holds approximately 15 lbs. of dhool.

In this method it will become at once apparent:—

1. That there can be no mixing of graded dhools.
2. That a more even ferment must follow.
3. That a large number of handlings of leaf have been avoided.

An additional advantage is that the leaf and dhool do not come into contact with any roll breaker or sifter parts that require lubrication, and, therefore, there is no possibility of contamination with oil. Further, the use of unhygienic absorbent jute hessian is avoided, and the drying out of dhools is reduced in consequence.

Once on the rack it now becomes a simple matter to judge the ferment of any individual tray of dhool, which can be removed *therein* to the drier, thus obviating yet another handling.

More hygienic methods of manufacture in the rolling room are long overdue, and similar superimposed trays under all roll breakers were found not only to keep leaf off the floor, and minimise handling, but also to accelerate the transport of dhools from the roll breaker to sifter.

The principle has also been extended to capturing all leaf passing over roll breakers, and the top tray of the sifter.

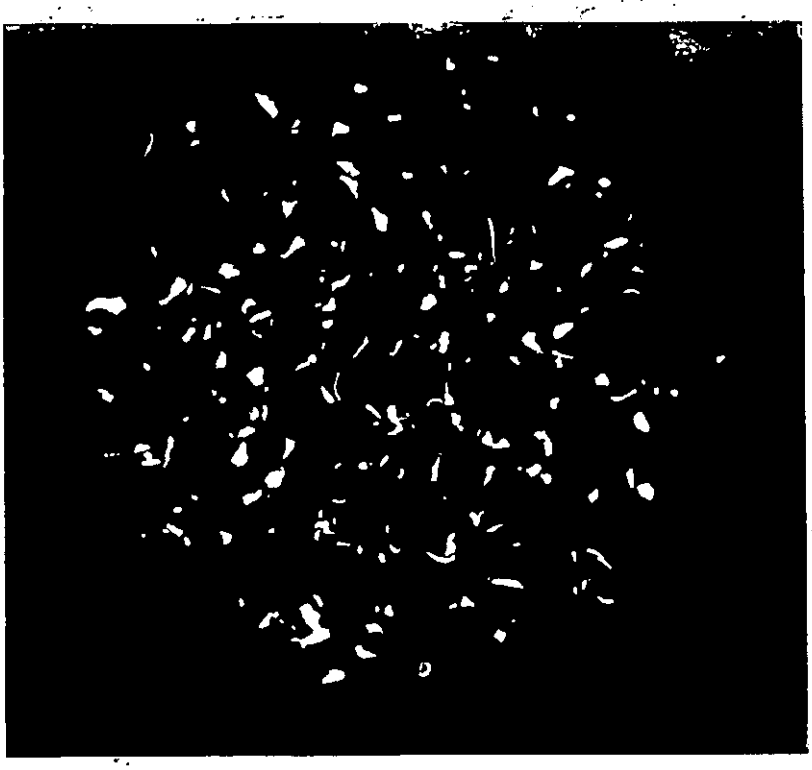

PLATE I.

Dhool I from No. 10 mesh

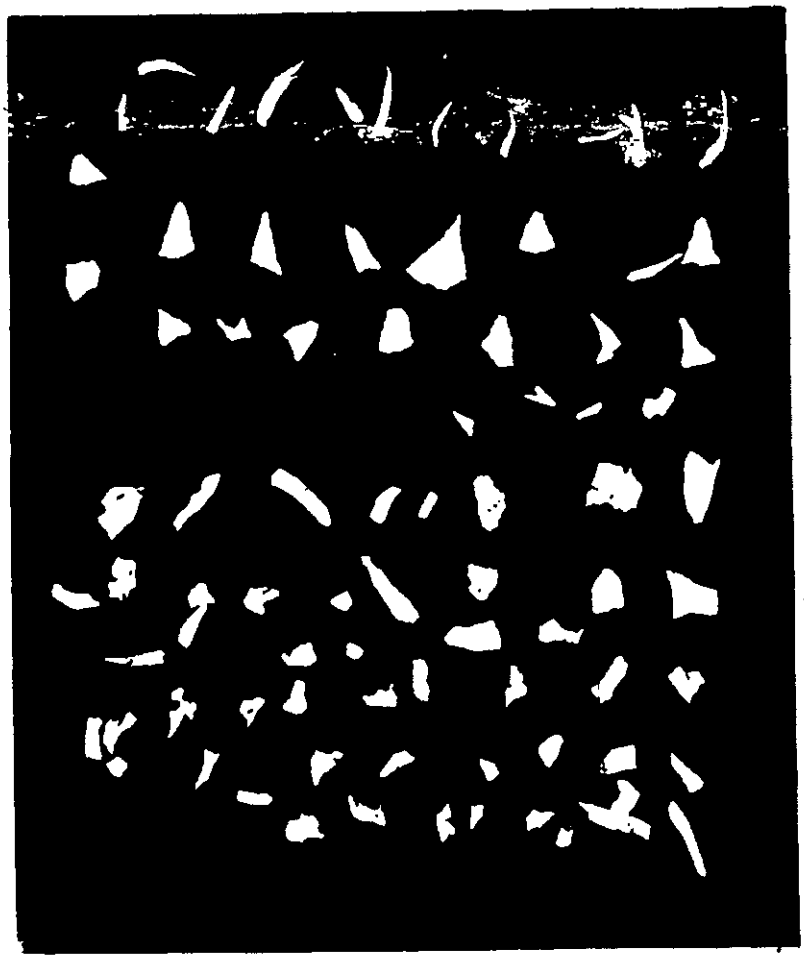

PLATE II

Dhool II from No. 8 mesh

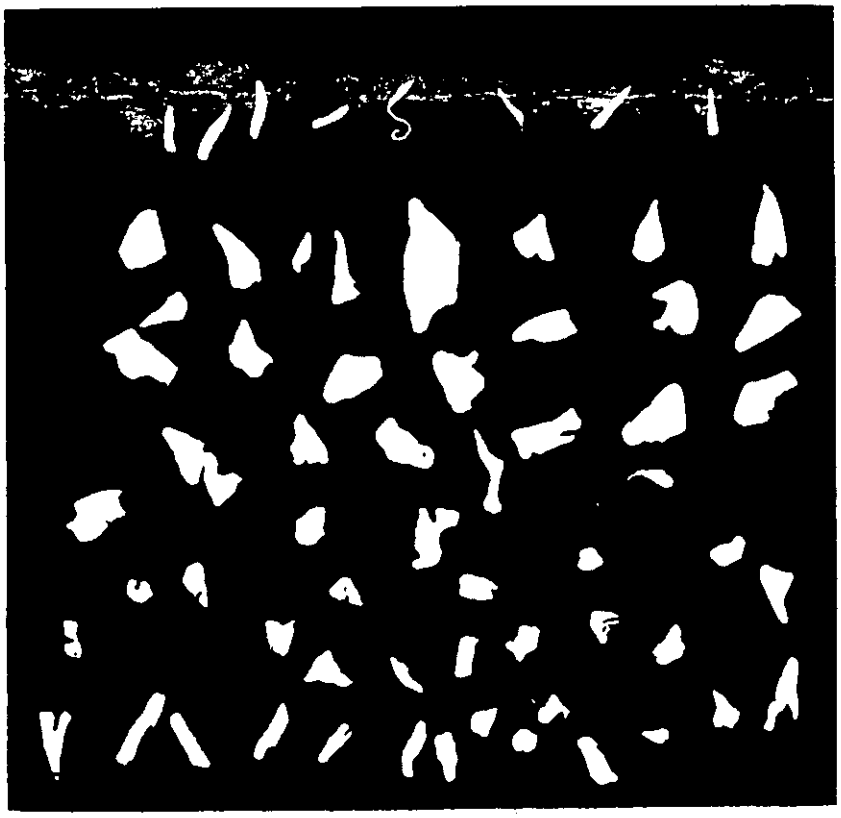

PLATE III.

Dhool III from No. 7 mesh

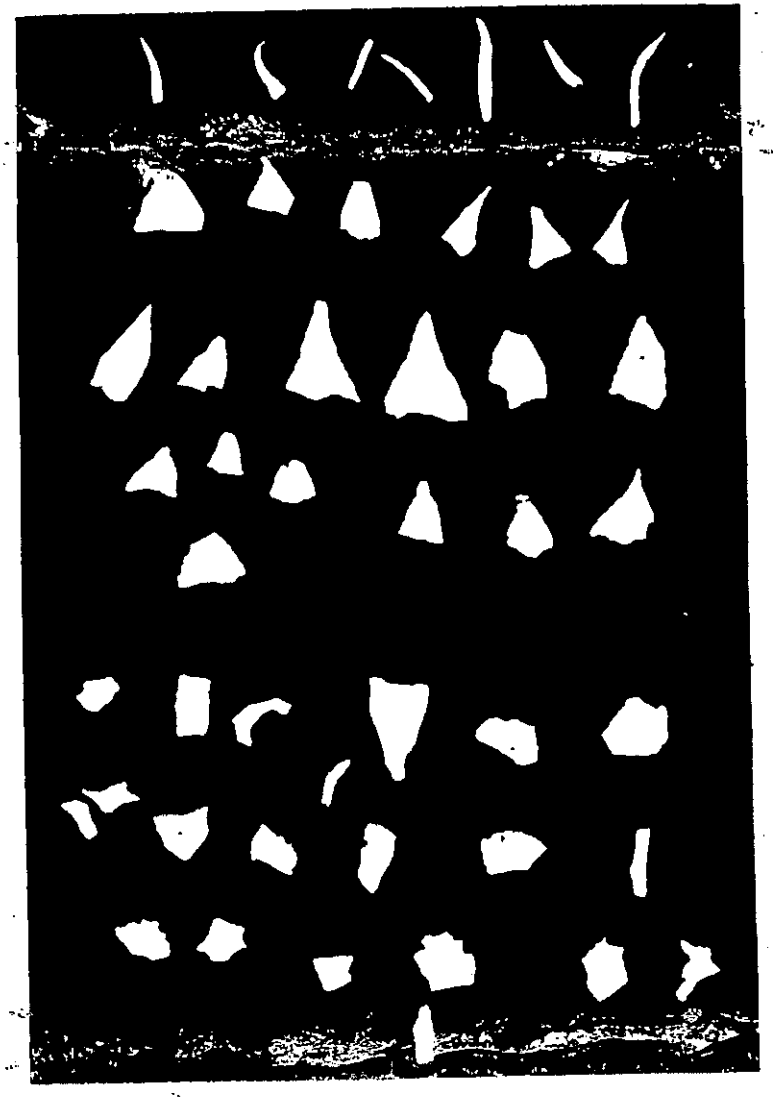

PLATE IV.

Dhool IV from No. 6 mesh

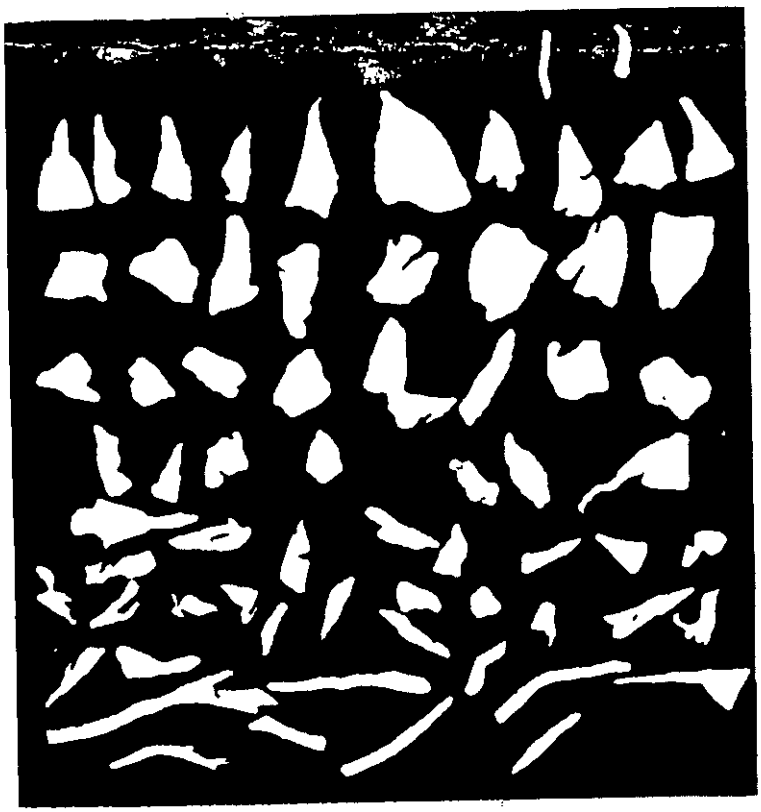

PLATE V.

Dhool V passing over No. 6 mesh

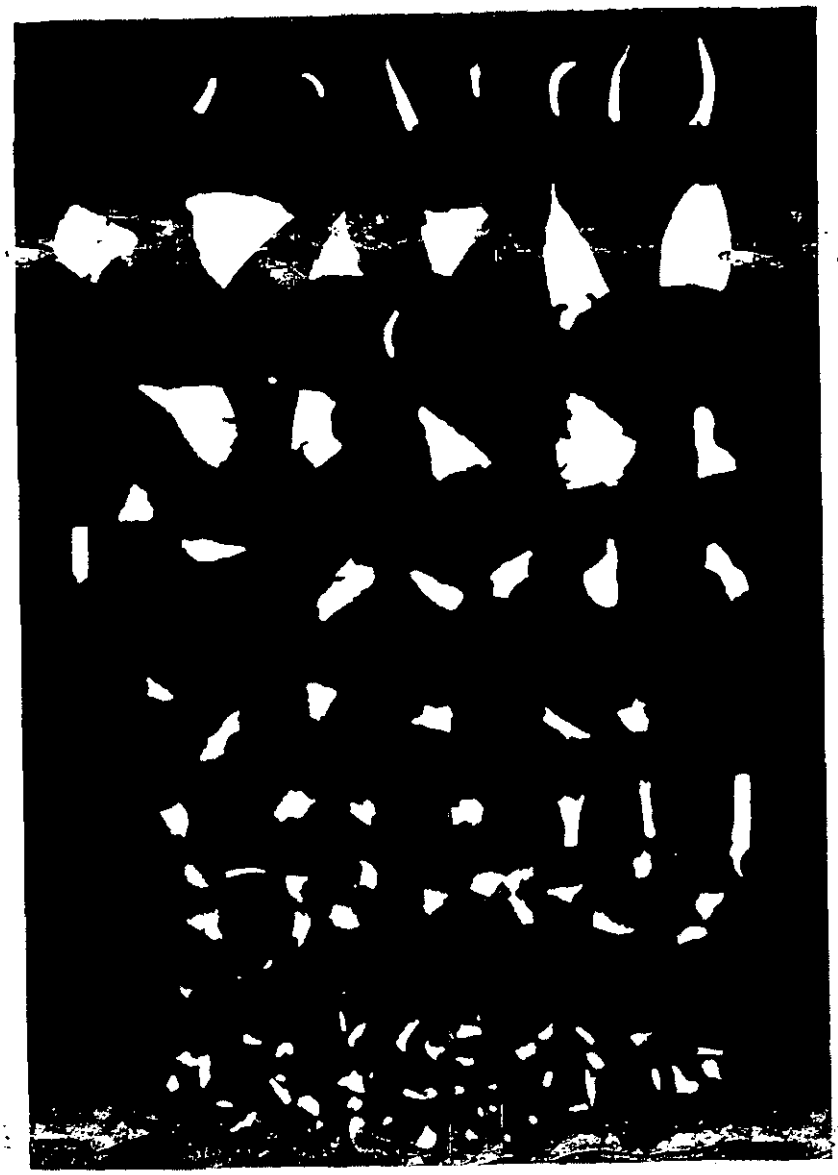

PLATE VI.

Leaf passing through No. 5 mesh in ordinary roll breaking

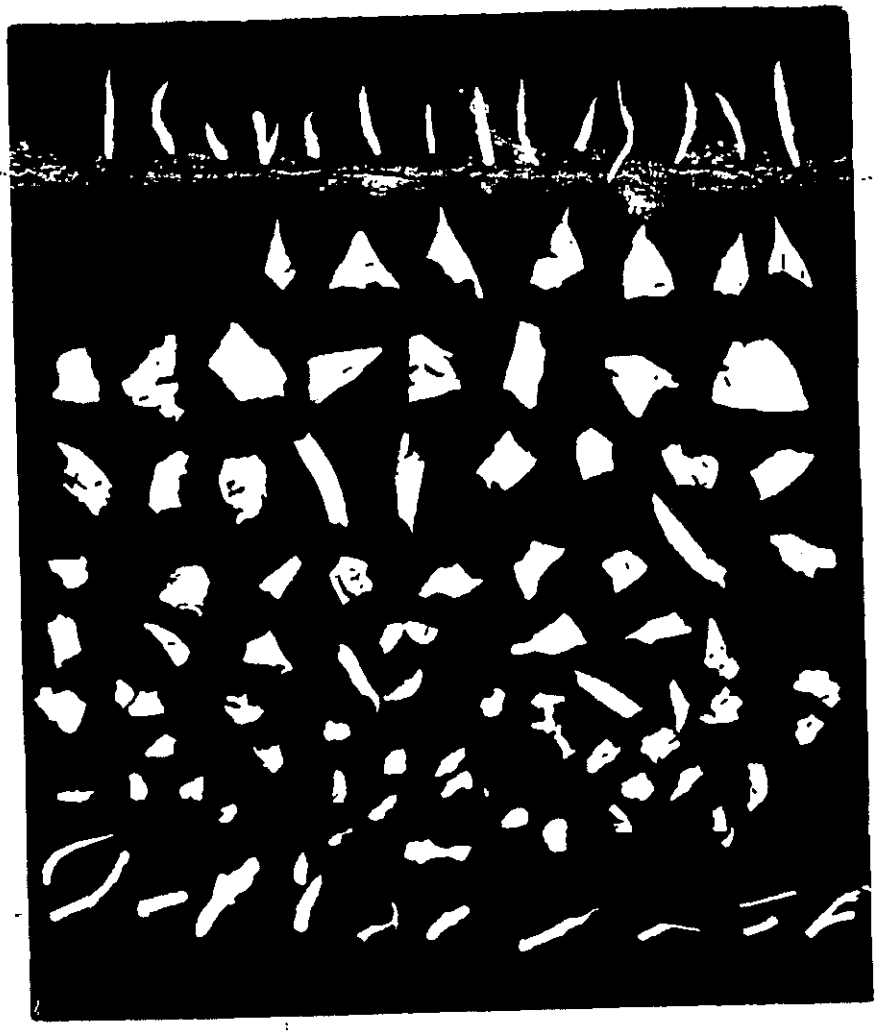

PLATE VII.

Leaf from No. 6 mesh in ordinary roll breaking

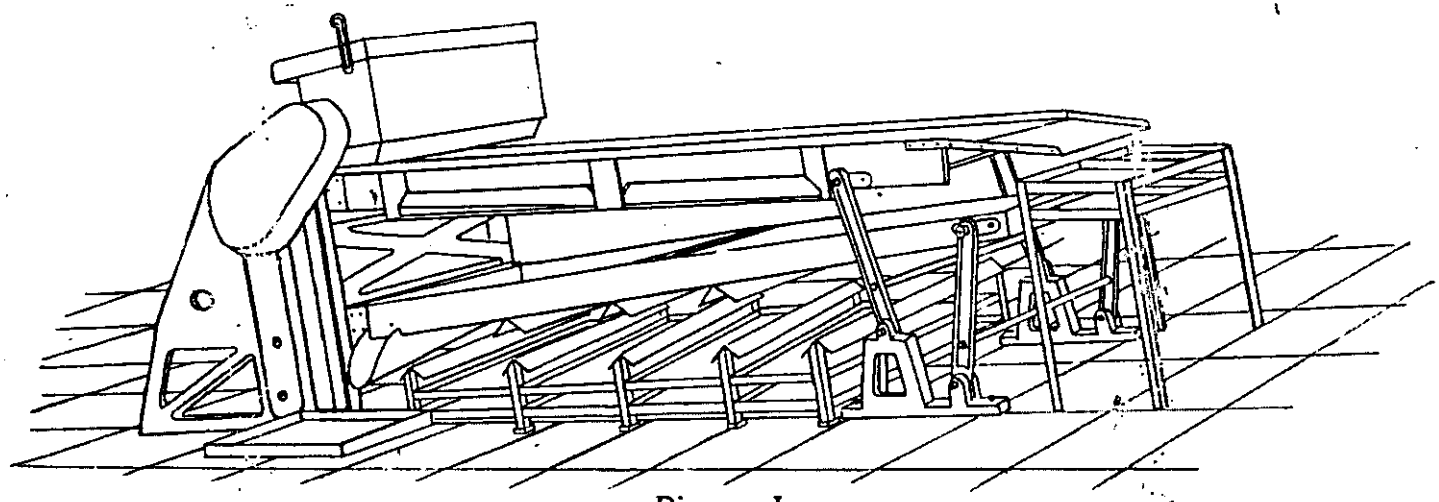

Diagram I.

All frames for holding trays under sifters and roll breakers should be so constructed as to render their removal at any time a simple matter, should it be found necessary to sweep underneath. In actual practice, however, this should be unnecessary if they are suitably designed.

It is regretted that these experiments had to be conducted in anything but a modern up-to-date factory, but we hope sufficient interest will be aroused for our modest start to be carried to greater lengths by those who are equipped with better facilities and modern machinery throughout.

It is claimed:—

1. That no great expense would be incurred in adopting the system.
2. That comparatively a very small quantity of leaf actually comes in contact with the factory floor.
3. That the tendency is towards a reduction of cooly labour.

Before concluding, a point I would wish to stress is that it is a great pity after all the grading that has been done in the green state that teas should be mixed again when firing. This is unavoidable at present, but where new factories are being planned it would appear thoroughly well worth while considering the idea of putting in several small firing machines with suitably designed chambers in order that each one could be fed by a similar grade of dhool.

This, however, in no way mitigates the value of the graded fermentation which has been undertaken. It should be possible for an expert teamaker to take each tray to the firing machine at the correct time, and, therefore, *each* tray in itself should have an even ferment. This cannot be lost, even though the mixing of dhools under present conditions, is unfortunately unavoidable.

We wish to record our thanks to the Tea Research Institute for allowing Mr. Lamb to take the necessary pictures, and also to Mr. Whiteman of Messrs. Brown & Co., Ltd., and Mr. de la Mare of Messrs. the Colombo Commercial Co., Ltd. for their kind assistance over the construction of trays.

APPENDIX

J. LAMB

Mr. Francillon has invited me to add a few notes to the preceding paper with special reference to the plates showing the composition of the different dhools.

Rolling experiments have been in progress for some time at St. Coombs in the course of which methods of standardising and measuring the pressure, speed, and work done by the experimental rollers have been devised in order that the effect of these factors and of batten design on dhool production may be investigated.

In the course of this work it soon became evident that some means of obtaining a permanent record of dhool composition was required so that the result of different treatments could readily be compared.

Ultimately it was found that the most convenient way of doing this was to soak an average sample of the dhool in water until all the particles were completely untwisted. The fragments could then be sorted, mounted on paper and a blue print obtained as a permanent record. From such a print the evenness, or otherwise, of a dhool can immediately be seen, and during its production it is possible to trace the origin of many of the particles making up the dhool. The plates which follow and those included in Mr. Francillon's paper have been obtained in this way.

It is a matter of common experience that different parts of the flush require different conditions of fermentation, and unless such constituents can be separated evenness of infusion cannot be expected.

The ideal method would be to manufacture the bud and first leaf separately from the second leaf and stalk. This was tried out at St. Coombs and remarkably fine teas were obtained, evenness of infusion in both cases being a notable characteristic. This finding is confirmed by Mr. Francillon's full scale experiments. Unfortunately such a method is not economically feasible, and it is necessary to rely instead on more efficient sorting of the normal pluck during rolling.

In this direction Mr. Francillon, as his paper shews, has obtained very successful results, and the evenness of the dhool obtained by his method of working is strikingly shewn in Plates I to V.

Before commenting on these Plates it may be of interest to study Plates VIII, IX & X, made from a rolling experiment at St. Coombs which illustrates the way in which the flush breaks up during the first roll.

Plate VIII illustrates a sample of bulk removed from a roller at St. Coombs after it has been in operation for 10 minutes in the first roll. The pluck consisted of a bud and two leaves and was picked over before rolling to ensure that the material was as uniform as possible.

After 10 minutes we see that some breaking up has already occurred; there is one complete piece of flush on the right hand side, but in the majority of cases some of the finer parts have already been twisted off.

Plate IX illustrates the state of affairs obtaining after 20 minutes and Plate X the position at the end of the roll. In both cases a considerable amount of breaking up has occurred, a common feature being the removal of the upper halves of the leaves. The stalks are generally intact.

Plates VI and VII illustrate the separation usually obtained by ordinary methods of roll breaking. In considering all these Plates it should be realised that the dhool appears much more even than the illustration since for the latter the fragments of leaf have been unrolled. It is the twisted form which occurs in the actual dhools so that a comparatively large piece of leaf when tightly rolled may pass through quite a fine mesh. Bearing in mind our object of aggregating fractions of similar origin we see that this is not a disadvantage so long as fragments from the second leaf and stalk are separated from the remainder.

Plate VI illustrates dhool from a first roll which passed through the No. 5 mesh of an ordinary roll breaker in which, for some reason hard to understand, the larger mesh often comes before the finer No. 6 mesh. At the top of this plate we find buds. In the second

row, the second from the left, there is the top of a second leaf, but the other fragments are derived from the first leaf. Lower down there are a few pieces of stalk and at the bottom a collection of very small pieces which when fired would make fannings.

In Plate VII is a representation of material which passed over the No. 5 mesh, but fell through No. 6. At a glance we note that the average size is somewhat smaller and the sample is on the whole much more even. The top row is again buds, but it is difficult to explain why so many should have escaped falling through No. 5 mesh, though of course the whole of the material falling through No. 6 mesh should have passed through the No. 5, if the sifting had been thorough.

From these two illustrations it is quite evident that dhools from ordinary roll breakers consist of a mixture of leaf of widely varying sizes, which means that more sifting will be necessary for the dry tea besides producing the risk of failure to obtain adequate separation of material of different origin.

In Plate I, on the other hand, a marked evenness is evident; this illustrates the type of material which passes through the No. 10 mesh in Mr. Francillon's system after a first roll, and which is practically pure fannings when fired. In the ordinary process of roll breaking we find this in the material passing No. 5, as shown at the bottom of Plate VI.

Plate II shows the type of material passing No. 8 mesh of the green leaf sifter. This is very much bolder than the previous sample, a number of buds are seen in the top row and in the second row a collection of tops of first leaves.

Plate III is similar, but bolder than II. The material depicted passed No. 7 mesh.

Passing on to No. 6 mesh we come to Plate IV. This material is again very even and contains the tops of a number of rather larger leaves

PLATE VIII.

Leaf after 10 minutes' rolling, 1st roll

PLATE IX.

Leaf after 20 minutes' rolling, 1st roll

PLATE X.

Leaf at end of 1st roll

There are very few buds in the coarse material which passes over the No. 6 mesh and is shown in Plate V. At the bottom of the plate an accumulation of stalk will be seen.

Comparing Plates I to V with VI and VII illustrating the dhool from an ordinary roll breaker, there cannot be any doubt of the effect of "Green Leaf Sifting" by Mr. Francillon's process.

I wish to express my gratitude to Mr. F. J. Whitehead for valuable advice and practical help accorded at all stages of our work on rolling and sifting, and to Mr. Francillon for permitting me to co-operate in the production of these pictorial records.