

Revenue (1897) Department.

MISCELLANEOUS SERIES.

G.O., No. 3270

DATED 29th June

[Despatch Abstract.]

5) Comm. to the Secy. of Secy. of the
Govt. of India on the Admin. report of the
Imperial Forest School at Alora Dur for
the year 1895-96.

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

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GOVERNMENT OF INDIA.

Serial No. 2.

DEPARTMENT OF REVENUE AND AGRICULTURE.

FORESTS.



Current Number 525

RESOLUTION.

Circular No. $\frac{10}{248-2}$ F.

Shelton: Mr. Prose C 2.8

Order miso no. 3270 of 29th June 97
28/6/97

Communicated to

the Board of Res:

W. H. H. 26.6.97

Dated Simla, the 12th June 1897.

10 to the Board of Res: L.B.

B.M. 26.6.97

SUBJECT.

Communicates orders on the Administration Report of the Imperial Forest School at Dehra Dun for the year 1895-96.

G. C. Press, Simla.—No. 424 R. & A. D.—15-6-97.—750.

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Dated Dehra Dun, the 1st April 1897.

From—Dr. J. WALTER LEATHER, *Agricultural Chemist to the Government of India*,
To—The Secretary to the Government of India, REVENUE AND AGRICULTURAL DEPARTMENT.

I have the honour to submit to you herewith my Annual Report for the year ending 31st March 1897.

The Report is divided into three parts.

Part 1. contains a brief resumé of the tours which I have made during the year and their object.

Part 2. Explains in detail the work upon which I have been engaged.

The subject matter is divided under the same main heads as Dr. Voelcker adopted for his Report.

Part 3. Contains a list of the Notes which I have written on Agricultural subjects and the work done for the Forest Department.

PART 1.—BRIEF DETAILS OF TOURS.

2. During the year I have made the following tours.

April 1st to 9th, 1896.—After leaving Poona at the end of March 1896, I was occupied during the first four days of April at the Agricultural College, Saidapet, where I acted as a member of the Board of Examiners in Agriculture, Agricultural Chemistry and Organic Chemistry. From Madras I travelled to Cawnpore where I examined the students of the Agricultural School in Agriculture, Agricultural Chemistry and Chemistry.

November 5th to December 4th, 1896.—During November last I made a tour through some of the Districts of the North-Western Provinces and Oudh in order to enquire whether useful Agricultural work could be commenced on some of the Estates which are under the Management of the Court of Wards. The following Districts were visited, Bareilly, Sitapur Bara Banki, Gonda (Balrampur), Gorakhpore and Gazipore.

When on this tour I took an opportunity which offered itself to visit Rosa, to discuss with Mr. Simmons, Manager of Messrs. Carew & Co.'s Sugar Refinery, the practicability of extending the investigations on sugar cane which have been commenced at Cawnpore.

December 18th, 1896, to February 24th, 1897.—During these two months I made an extended tour in the Bombay Presidency and in the North-Western Provinces and Bengal to continue the investigations which have been commenced on sugar cane.

From December 21st to 26th.—I was occupied at Poona. From there I travelled to Belgaum and Dharwar in the Southern Mahratta country where I analysed the varieties of cane as cultivated in the villages.

Leaving the Bombay Presidency on January 17th, I travelled to Cawnpore and remained at the Farm from 19th until February 1st where the varieties there cultivated were analysed and further experiments made in liming the juice.

February 1st to 6th.—was spent at Dumraon, Behar. February 10th to 13th at Burdwan, and February 14th to 23rd at Becha on similar investigations.

Whilst in Behar, the Director of Land Records and Agriculture, Bengal, requested me to meet him at Agrail near Muzaffarpore to inspect the Pusa Estate with a view to seeing whether it would form a suitable site for an Experimental Farm. February 7th to 10th was devoted to this.

PART 2.—DETAILS OF WORK DONE.

Soils.

3. *Chemical analyses of Indian soils.* The chemical examination of Indian soils, to which I referred in paragraph 4 of my last Annual Report, was pushed on with during last year and is now approaching completion. The work will include the complete analysis of some 80 samples of soils of different types which have been supplied to me by the several Local Governments. Whilst the publication of the results of this work will supply useful information to those who take an interest in the study of Indian Agriculture, it cannot of course be considered to deal exhaustively with the soils of an Empire so large as India.

The object at which I have aimed is indeed merely to show the chemical composition of some of the main types of Indian soils.

An example may here be quoted illustrating the value of chemical analysis in relation to soils. In one of the Dehra Dun Forests young

Special Cases.

growth flourishes very much better in some places than in others, and three samples of soil were sent to me representing ground on which young growth (1) is entirely absent, (2) only poor, (3) is vigorous. The following statement shows the analysis of these three samples, and it will be seen how much poorer in plant food No. 1 is than No. 3, the latter being much richer in every particular.

	No. 1.	No. 2.	No. 3.
Nitrogen (total)	·043	·101	·152
Phosphoric acid (available)	·026	·028	·048
Phosphoric acid (total)	·105	·112	·148
Calcium, Carbonate	·187	·293	·685

On the other hand examples may be given showing how little help one obtains in this manner in some cases.

An "Indian Pioneer's Company" sent some samples of soil through the Provincial Agricultural Department saying they wanted them examined and requested to be informed as to what crops might be grown on the land and in what rotation; what manures would be necessary, etc. As is well known, these matters are determined more by climate and the lie of the land, its water supply and drainage conditions than by anything else, and unless there is considerable variation in the general characters of the soil at different points, the chemical analysis will not help much.

Again, a question touching the exhaustion of soils by certain crops which was submitted to me, will also illustrate that the value of chemical analysis is only limited.

Three samples of soil on which three different crops had been grown were sent for analysis "to determine which of these crops is the most exhausting." In such a case it is clear that so far as mere plant food, such as Phosphoric acid or Nitrogen, is concerned, much depends on the luxuriance and consequent weight of crop obtained. Then, too, the amounts of plant food extracted from a good soil by any one crop are so small in proportion to the amount usually present that the loss would with difficulty be exposed by chemical analysis.

Another question of a similar nature in relation to Til seed cultivation has been submitted to me, the writer asking what ingredient of the soil is exhausted by this crop.

There is probably no part of Agricultural practice so imperfectly understood as this one of an exhaustion of soils.

In the case of some crops, such as cereals and millets, the same crop may be grown for an indefinite period on the same land without any necessity manifesting itself for growing other crops in rotation with them. The amount of produce will depend on the amount of manure applied, but even with no manure at all, these crops will grow for many years in succession on the same land. Examples of this are found in the case of wheat, barley and oats which have been grown for many years on the same land without any addition of manure at all at the Rothamsted and Woburn Experimental Stations in England, and in the case of wheat and maize which have been likewise grown uninterruptedly on the same land for a number of years without any manure at the Cawnpore Experimental Farm.

On the other hand there are certain crops, such as clover and beans in England, which will not grow year after year on the same land, however good the soil or liberal the manuring.

The solution of the difficulty may prove to lie in the application of certain organisms to the soil, an experiment which is being extensively tried at present in Europe.

The case of linseed may be quoted as that of an "Indian" crop which cannot be successfully grown on the same land continuously. Like clover at home, it becomes attacked by a disease and cultivators usually allow a number of years to intervene between two crops of linseed. No means is at present known of preventing it from suffering in this way. It will be clear, however, that since these crops which cannot be grown continuously on the same land take to themselves such plant food as Nitrogen and Phosphoric acid, etc., from the soil just as do the cereals, the mere examination of a soil for this description of plant food will avail nothing.

The subject of soil exhaustion is indeed by no means understood.

4. In paragraph 8 of my last Annual Report I explained the object with which I had carried out some cultivation experiments on artificial

Usar.

quantities of the salts which form "Reh" were mixed. I thought it well to repeat these experiments because not only were the pots employed small but it is always well to repeat such experiments. Accordingly, during last monsoon and the past cold weather, similar experiments were instituted in good sized boxes.

The plants grown were maize, cotton and arhar in the monsoon period and wheat, barley and gram during the cold weather months.

The results obtained do not quite coincide with those of the previous year. The leguminous plants were again much more readily affected than were those of the gramineous order, but of the Salts the Sodium Carbonate proved to be much more pernicious than either Sodium Chloride or Sulphate. 2% of Sodium Carbonate proved distinctly harmful though it did not cause sterility, whilst 4% occasioned sterility. Sodium Chloride appeared to be less harmful than in the first series of experiments and I doubt if 2% does any harm at all. Sodium Sulphate proved to be even less harmful. In fact some of the plants grew perfectly well in presence of over half a per cent. of this salt.

But one of the most interesting results at which I have arrived is the effect of certain salts in these usar soils. It frequently happens that one of their chief characteristics is their impermeability to water. If for instance an usar soil containing Sodium Carbonate is mixed with water the clayey portion refuses to settle clear; indeed some of those which I have examined have formed a creamy mass. If they are put on a filter so as to form a layer of only about 1/4 inch thick, two inches of water often takes days to pass through and frequently they stop filtering altogether. If, however, such salts as Calcium Sulphate or Calcium Chloride which react with Sodium Carbonate to form a neutral Sodium salt are added to the soil and water, the clay particles rapidly subside and water will pass through the soil quickly and quite clear. The action is very rapid and it is probable that gypsum would prove a perfect cure for even bad descriptions of usar. There is much land which contains an abundance of salts in the surface soil, but very much less in the subsoil, in fact this is the normal condition of usar land, and it has long appeared to me to be certain that if these salts could only be disseminated through four or five feet of soil instead of

being accumulated at the surface, their effect would be minimised if not altogether nullified. That is, that it might prove unnecessary to remove the salts altogether but merely to "dilute" them so to speak with soil. This action of such salts as Calcium Sulphate (gypsum) would probably effect this by opening up the soil to water in the manner above indicated.

A complete report on my experiments with usar soils will probably reach you before the date at which this report is due, but in the meantime I have addressed the Director of Land Records and Agriculture, North-Western Provinces and Oudh on the subject and urged that gypsum shall have a thorough trial on a small scale during the coming monsoon. The drawback to the application of gypsum is the expense which would be necessary, but it is in any case desirable to know if in practice it has the same rapid effect which I have found it to possess in my Laboratory experiments. The question of cost could then be more carefully considered.

Well Waters.

5. A case concerning irrigation of certain land from wells in the Champaran District of Behar was submitted to me by the Director of Land Records and Agriculture, Bengal, in December last. The ryots assert that certain lands may be irrigated from their *kuccha* wells whilst other lands must not be so irrigated. Samples of soils and waters from both these areas were supplied to me.

It appeared to be possible, as Mr. Macpherson suggested, that Sodium salts were present either in the soil or the water of the land which the people hesitate to irrigate and an examination of the samples was accordingly made with a view to determine this point. As a result of this analysis it was shown that the soil contained no appreciable amount of salts. The well water which the people will not employ contained more Sodium salts, Carbonate and Chloride, than that which is used for irrigation, but the amount was not as great as that commonly found in other village well waters, which I have examined, and not sufficient to do any harm at all.

A copy of the Report was submitted to you with my endorsement No. 331, dated 7th January 1897.

6. An interesting case was submitted to me through the Reporter on Economic Products to the Government of India concerning the cultivation of some land in Amherst District, Burmah.

The cultivators assert that they cannot cultivate the land for more than a few years at a time, after which the land requires rest. Some hot springs are situated in the neighbourhood, and the water which overflows from them, passes by the land in question. The water from the hot springs contains sulphuretted hydrogen, a gas which is generally very prejudicial to vegetation, and there can be little doubt that this caused the damage complained of. One of the soils was also a very peculiar one, containing over 23 per cent. of Oxide of Iron, over 30 per cent. of Carbonate of Lime, and 1 per cent. of Phosphoric Acid, whilst the insoluble Silicates and Sand amounted to less than 22 per cent.

It is probable that this soil had been altered in composition by the water from the hot springs since the other soils from the neighbourhood were of a more ordinary description. When water of such a nature as that alluded to flows near cultivated land, the best thing to do is to keep it as much to its own channel as possible. The cultivators are probably quite right in wishing to leave such land fallow occasionally so as to expose it fully to the purifying effects of the sun and air.

The occurrence of such hot springs is interesting in itself. I met with another of this nature in the Kaira District, Gujarat.

Manures.

7. With my letter No. 141, dated 12th June 1896 to the address of Sir Edward Buck, I submitted a Note on Manures generally bringing together all the information on the subject which I had been able to collect.

During the past year my time has been principally occupied with other matters, and I have not obtained much more information than what was included in that Note. The matter contained in it was dealt with in paragraphs 10-15 of my last Annual Report. The experiment which was commenced last year at Cawnpore of employing loose earth in the stalls as an absorbent of urine has been perfectly successful. No difficulty has been experienced in employing it.

Dry earth is scattered over the floor of the shed and the wet earth dried daily and replaced again. The experiment is being continued and it will be seen how long it can be repeatedly employed, i. e., how much urine can be absorbed altogether by a given weight of earth. After removal from the stalls it is stored in a pit until required for use in the field.

8. As intimated in paragraph 13 of my last Annual Report the experiments with canal silt carried by the Upper Eastern Jumna Canal which were made in 1895 were repeated during the last year. Owing to the light rainfall during the Rabi period the quantity of silt was very much smaller than usual indeed there was practically none. The calculated amount of silt and fertilising matter such as Phosphoric Acid and Nitrogen contained in the canal water during the monsoon period was however as large as in the previous year and was sufficient for the requirements of a rice crop (the principal kharif crop irrigated by this canal).

The method of calculation adopted this year was however a more correct one than during the previous year, and I think it likely that the amount estimated in 1895 was below the truth and that the amount of silt was below the normal in the kharif of 1896. In any case the results of the experiments are satisfactory showing as they do that this silt supplies fully enough plant food to keep up the quality of the rice lands.

This value of silt is doubtless extremely important because one may assume that it applies to rice lands generally. Muddy water is commonly caused to circulate from higher to lower levels, from field to field, and there can hardly be a doubt that it offers an explanation of the fact, that although rice lands are not usually manured, they retain their power of producing this cereal year by year apparently unimpaired.

Fodder Crops.

9. The Sorghum halipense, seed of which was sent to the Nagpore and Poona Farms two years ago, has been reported upon (*vide* page 19, Nagpore Farm Report, 1895-96, and page 8, Poona Farm Report, 1895-96.

Sorghum halipense.

It yielded poorly at Nagpore, but in reporting upon it Mr. Joshi adds that the plant (after cutting the first crop) which remained in the ground continued sprouting and tillering all the year round and even in the hot months of April and May remained more or less green when other grasses were all parched. At Poona a first cutting of the 2nd year's crop was obtained in the first week of July and a second cutting was anticipated during the season. Thus it seems to have some distinct advantages as a fodder, at any rate on land which is reserved for such crops. I analysed samples of the crop cut at different stages of growth at Nagpore and, for purposes of comparison, likewise similar samples of Juar (Sorghum vulgare), and these analyses are published at page 19 *l. c.* It proved to contain rather more Albuminoids and about the same proportion of Carbohydrates as Juar, but also at the same time rather a higher proportion of woody fibre.

10. Another matter regarding a fodder crop which I have examined chemically is in relation to the Juar crop. In some Districts of the North-Western Provinces the stalks of this crop are

Sorghum Vulgare (Juar).

harvested immediately after the seed is harvested.

In other places the stalks are allowed to remain on the land for some months.

From one half of a field of Juar at the Cawnpore Farm the stalks were harvested in October as soon as the grain was out, whilst those on the other half were allowed to stand until March. From the first half a second cutting of fodder was obtained in March in addition to the first crop. The weight of the fodder cut in October was somewhat greater than that from the other half, which was left standing until March and the second cutting from the first half plot increased the yield to a total of about 30 per cent. more than was obtained from the second half plot. The chemical analysis of these three lots of fodder showed that the stems which were harvested in October at the same time as the seed was collected, contained a much higher proportion of Albuminoids, but a somewhat lower proportion of soluble Carbohydrates, than that which remained standing throughout the cold weather.

The fodder from the first half plot which was obtained as a second cutting in March had about the same proportion of Albuminoids and Carbohydrates as that which remained standing on the second half plot. Thus, judging by this experiment, it would appear to be more economical to cut the stalks of this crop at the same time as the seed is harvested, and if the land is not required for a second crop, to allow the stubble to shoot up again for a second cutting.

Implements.

11. In my last Annual Report I explained what action I had taken in respect of Implements. Since then I have received, through the Commissioner of Settlements and Agriculture, Central Provinces, the results of some measurements which have been made by Settlement officers of the work done by the "Mote" (leather bucket) as worked in certain districts of those Provinces.

The Director of Land Records and Agriculture, North-Western Provinces and Oudh, coincided with the opinion I expressed that in reference to water lifts more information is required of the capabilities of the Dhenkli, Rati and Swing basket and suggested that Junior Civilian might be able to carry out some part of this work. He further pointed out that the Zemindars and cultivators have commenced to buy the Chain Pump, and that the advice of a mechanical engineer should be taken with the object of improving its efficiency, especially for bullock power. A further proof that its efficiency for short lifts is beginning to be recognised by the cultivators is found in the fact that the work people at Cawnpore when paid by "piece work" for irrigation prefer to use this pump rather than the Swing basket. Another implement which is deserving of very extensive practical exhibition in the sugar growing districts is the Hand Centrifugal Separator which Messrs. Burrows, Thomson and Mylne have been gradually introducing into the villages in the neighbourhood of Behea. With this machine half a maund of Rab is separated into its constituent sugar and molasses in about 3 minutes and whilst by the native process of refining the molasses are not fit for human consumption and are used up for mixing with tobacco, that obtained from this Centrifugal is clean and is boiled down to form "Gur" of not at all bad quality.

There is, indeed, much Gur at present made by cultivators from the whole juice which is not so good as that which I saw at Behea prepared from these molasses and which was afterwards analysed.

The manufacture of this turbine sugar in the neighbourhood of Behea may now be valued at lakhs of Rupees and as it is sent as far as Peshawar it is evident that there is much room for the exhibition of this Separator to the cultivators.

- 11a. Touching the matter of exhibition of implements however it is advisable to again point out the necessity for this being done properly.

Exhibiting Machines.

At one of the fairs which I visited this year there were several useful implements on view but of exhibition in the proper sense of the word, practically nothing, and the only use some of the best machines were put to appeared to be the amusement of the small boys who congregated about them and who found much entertainment in spinning the handles round. In the case of this useful Sugar Separator which was among them, it would not have cost much either of money or time to arrange previously to have a few maunds of Rab worked through it daily!

Mr. Mylne mentioned to me that he had to work the Sugar Separator for 10 years in the villages before the first one was bought.

The outcome of patient demonstration such as this is the establishment of a practically new industry, the value of which, as I have said, may be reckoned by lakhs, and this in one district alone!

Everybody acknowledges that that the Indian cultivator is "Conservative", perhaps he is rightly so, but it also follows that unless great patience and perseverance are exercised by those who wish to help him, nothing will ever be done.

Crops & Cultivation

12. In paragraph 25 of my last Annual Report I explained briefly the principal objects with which the experiments on Sugar Cane are being conducted at several of the Experimental Farms and in paragraph 26 I set out briefly the results which I had obtained in reference to the same subject. During the past cold weather I devoted the principal part of my time whilst on tour to the further examination of these subjects. The results of part of this work have been submitted to you with my endorsement No. 5, dated 5th April 1897, and the results of the investigations into the qualities of varieties will follow shortly.

Sugar Cane.

A considerable number of varieties have now been examined in the Southern Mahratta Country, in the North-Western Provinces and Oudh, and in Bengal, and the conclusions arrived at may be stated briefly:—

- The amount of juice expressible by mills seems to depend in a great measure on the thickness of the cane, that is a thin variety gives generally a much lower proportion of juice than a thick variety. This also coincides with the fact pointed out in my last Note (Agricultural Ledger No. 19 of 1896), namely, that the percentage of juice expressed depends on the proportion of crude fibre and is inversely proportional to it. Thin canes have generally a higher percentage of crude fibre than thick ones.*
- The percentage of juice obtainable from any variety, which is growing under conditions to which it has been accustomed, remains fairly constant.
- The general colour of a variety, its shape, girth, length of internodes and percentage of juice remain so constant that these characters may probably be depended upon for the recognition of varieties when met with in different places. Thus in more than one case several lots of cane which had been sent to the Poona Farm under different names from various districts were recognised as one and the same variety.

13. In my note on Sugar Cane (Agricultural Ledger No. 19) I detailed the evidence which had been obtained on the effect which manures have on the quality of the juice. The analyses of the juice of two varieties, which had been grown at Poona and Cawnpore respectively with different manures applied in very varying amounts for two years indicated that no change in the percentage of sugar in the juice had taken place, and it was concluded that manuring had no material influence on it. During the last year another variety has also been grown at Cawnpore with different amounts of manure and again similar evidence was obtained, the quality of the juice remained fairly constant. It happened, however, that in all these cases the varieties were grown with much about the same quantities of manure as that to which they are accustomed, two being thick canes which are usually heavily manured and these were manured heavily at the Farms, whilst the third variety, which was accustomed to light manuring only, was also grown with only small quantities of manure in the experimental plots.

On the other hand, in the case of at least one variety which has been placed during the last year under manurial treatment very different to that to which it is accustomed, a very decided change has taken place. The Matna variety, a thin cane usually grown with only small quantities of manure, had been giving about 45 to 50 per cent. of juice containing about 15 to 16 per cent. of sugar at Cawnpore when grown with small amounts of manure. Last year it was grown with large amounts of manure and it was found on harvesting the crop that the percentage of juice had increased to 60 whilst the percentage of sugar had fallen to about 12. This result was obtained by the accidental circumstance of growing a number of varieties under similar conditions of manure, which happened to be large, and was quite unlooked for. The evidence previously obtained pointed to the fact that manuring does not influence the quality of the juice, but it is probable that this result is not accidental, since there is reason to believe that several other varieties, which have been likewise grown with much larger amounts of manure than they are accustomed to, have suffered a decrease in the percentage of sugar in the juice. The increased percentage of juice expressed is equally noticeable, and it will be interesting to observe if these varieties will gradually regain their normal percentage of sugar under the new conditions.

* Thus for example the "Pundia" Cane of the Southern Mahratta Country has a girth of about 3"—4" and yields from 68 to 73 per cent. of juice. The "Ramra-ali" has about the same girth and yields a similar quantity of juice. The "Betta Kalbu" has a girth of from 2"—2½" and yields 58—62 per cent. of juice; the "Hullo Kalbu" has a girth of 1½"—2½" and yields 55—60 per cent. of juice.

As I have pointed out however in my Note it does not follow that this large allowance of manure is to be condemned, because the weight of cane and of Gur obtained per acre far outbalance any slight loss of sugar which may occur in the juice.

In my last year's note on Sugar Cane I also showed that there was evidence that when cane is transported to long distances the juice suffers change. The two varieties of Mauritius cane, which were imported to Poona in 1933 were examples, so likewise the Poona "Pundia" which had been sent to Cawnpore and Dumraon, was found to contain less sugar. Further evidence of a similar nature was obtained this year at Poona, where some of the Southern Mahratta varieties were grown. Some of these proved to contain much less sugar than I found in the crops grown at Belgaum and Dharwar, whilst conversely two varieties had improved under the changed conditions.

This part of the subject is extremely interesting, and if the experiments be continued sufficiently long, may lead to valuable results. The Mauritius cane has now commenced to improve. The juice of the white variety, which contained only about 13 per cent. of total sugar in 1895, contained nearly 16 per cent. this year, and the juice of the red variety which contained only 12 per cent. of sugar in 1896 contained over 14 per cent. this year.

There is therefore evidence that such change is of a temporary nature. Generally it would seem as though a cane may suffer from either change of climate or of treatment, but there is also evidence that the immediate effect of transporting cane may be a boiling of the juice were continued this year with satisfactory results. The principal innovation had reference to the prevention of "Inversion" or Glucose formation during the use of a colouring matter which appears to be generally present in the juice itself and which becomes yellow when an excess of lime has been added. Thus for example in some of the later experiments one half of the juice was limed until it became yellow, and the other half was then added to render the whole slightly acid. It is probable that future experiments will show that a somewhat larger proportion may be advantageously limed in this manner.

14. The experiments on the prevention of "Inversion" or Glucose formation during the boiling of the juice were continued this year with satisfactory results. The principal innovation had reference to the prevention of "Inversion" or Glucose formation during the use of a colouring matter which appears to be generally present in the juice itself and which becomes yellow when an excess of lime has been added. Thus for example in some of the later experiments one half of the juice was limed until it became yellow, and the other half was then added to render the whole slightly acid. It is probable that future experiments will show that a somewhat larger proportion may be advantageously limed in this manner.

I made some experiments on liming for the cultivators near Behea, the juice being boiled down for Rab and the sugar was subsequently separated in the Hand Centrifugal, when it was found that the treacle of the limed "Rab" left the sugar crystal much more readily than is usually the case and the product was of a better colour.

15. Another matter on which I made experiments was in relation to a practice which prevails in the Burdwan District of planting cane from the top end only. In most parts of India the whole cane is cut up for seed. The amount of juice and of sugar was determined in the top and in the main part of the stem of two varieties, and it was found that the amount of juice expressed from the top end was much smaller than from the main part and that further the juice of the top end contained much less sugar than that of the main part of the stem. Calculations based on these figures showed that by planting the top ends of the cane only was equivalent to a saving of several hundred pounds of Gur per acre.

The question naturally presents itself whether, if a variety be continually propagated from the top ends only, it will become gradually depreciated and produce less sugar in the juice. So far as this point is concerned it may be mentioned that the "Samsara" cane of Burdwan is one of the best varieties I have met with, yielding 70 per cent. of juice at the mill and containing 15-18 per cent. of sugar in the juice, and it has certainly been propagated in the manner described for a long time. Of course it might be otherwise with other varieties, but there is no evidence that such is the case. However, I have suggested that experiments should be made with other varieties to determine this point.

16. With reference to the value of determining the percentage of sugar in the juice of different varieties, it is important to carry out as many determinations as possible. The chemical analysis necessary is however a method which only a trained man can execute. It appeared to me, therefore, very desirable, to suggest, if possible, some means by which at any rate an approximate determination might be made by any careful person who was interested in the subject of sugar cane. One method would naturally be to boil down a certain weight of juice and to weigh the Gur obtained. This process, though fairly accurate, involves a good deal of time and it occurred to me that a very fair approximation might be arrived at from a knowledge of the density of the juice. This is likewise an operation which any careful person can execute. The specific gravity of a solution of sugar depends on the amount of sugar present. In the case of cane juice however other substances are present which influence the specific gravity, and I made a large number of determinations of the specific gravity of juices together with the actual amount of sugar present in them, in order to see if the amount of these other substances was sufficiently constant to allow of a uniform correction being made. From the results of these experiments it would seem that such a correction is quite possible, and as an appendix to my Note I have given tables from which the percentage of total sugar in the juice of any cane may be calculated from the specific gravity.

Distribution of Seed.

17. During my tours I have had one or two opportunities of obtaining information as to the possibilities of assisting the cultivators by the distribution of new seed. During my November tour I found that Jaunpore maize and Gujarat bajra, which have done well at the Cawnpore Farm, had been distributed by Managers of Court of Wards Estates to some of their tenants, and in most cases the people had come again for a further supply of seed, being willing at the same time to pay for it.

Thus at Bareilly, Gujarat bajra had been distributed. The villagers had not come to any decision as to the superiority of the new over their local variety, but intended to try it again. The bajra locally grown in this District appeared to me to be unusually good quality, and there may not be so much room for improving this crop there.

At Sitapore the cultivators, who had received the Jaunpore maize considered it much superior to their own and asked for a further large supply of seed.

In this District I met with a variety of Juar (*Sorghum vulgare*) which appear to me to be far superior to much that is grown in other Districts, some of the heads weighing 6 and 7 ozs. and at Gazipore a red variety of this crop is cultivated which the people consider superior to the white.

In the Sitapore and Bara Banki districts I found that the gram (*Cicer arietinum*) is commonly largely mixed with varieties of Kesari (*Lathyrus sativus*). Although Kesari is extensively cultivated in India, its evil effects are well known, a description of paralysis being attributed to it. Why it should be grown mixed with a valuable grain like gram is not clear, but the difficulty of separating the seeds, which are about the same size, would probably be a reason.

Again, through the agency of the Bengal Farms hill potatoes and sugar cane are distributed to the cultivators in the neighbourhood. At Dumraon the ryots were willing to buy more potatoes last year than were obtainable at the Farm, and Rs 80 worth of one of the imported varieties of cane was similarly disposed of. Again at Behea Mr. Mylne has been instrumental in providing the cultivators with improved sugar cane. In 1894 six cultivators accepted cuttings of the Poona sugar cane which Mr. Mylne thought might prove a better variety than those locally grown, and an area of 5 cottahs was planted. In the following year the area planted was about 20 cottahs and this year the area was considerably greater. These figures may perhaps be described as microscopic, but it is effected and they must not be despised.

Still another example of the different values which may be placed upon varieties of crops may be quoted. At the Nauchandi Fair this year several varieties of maize were exhibited, some ripening early but producing small cobs, others occupying a longer period for their perfection and producing large cobs, others again produced a poor quality of flour.

Thus although such evidence as the above may be deemed but a small collection of isolated cases, it at least all points in one direction showing that there is much useful work which might be done in finding out where the best varieties of crops are grown, and in their distribution to other Districts.

PRACTICAL AGRICULTURAL ENQUIRY.

18. In reference to practical enquiry I may here give one or two instances of the manner in which I have been assisted by others.

As explained in a previous paragraph of this Report it is a most important matter in relation to the sugar cane experiments which are at present being prosecuted at the Experimental Farms, that information should be obtained as to what varieties are grown by the cultivators and what their qualities are. In fact what is wanted is a complete survey of the sugar cane crop.

Before I went on tour in the Southern Mahratta Country, Mr. Mollison deputed one of his assistants to locate most of the varieties. He took notes of the fields where they were growing and generally so far "cleared the way" that in about a fortnight I was able to do the work of establishing the qualities of these varieties more completely than I could probably have done in a couple of months had I been obliged to set to work without this preliminary aid.

In Oudh, too, I received valuable assistance regarding varieties of cane from Messrs. Martin and Ricketts, Managers of Court of Wards Estates in the Sitapur and Bara Banki Districts. When on tour in November I explained to these gentlemen the aims and objects of the experiments at the Farms and how necessary it was to learn more about the varieties as grown by the cultivators, and I received from them valuable data respecting some of the varieties grown in their Districts, contributions which it is all the more necessary to acknowledge when one bears in mind the high pressure under which all have had to work during the past season of famine and scarcity.

These examples serve to illustrate the manner in which an enquiry may be commenced. There are many Special Managers of Wards Estates, there are also in the North Western Provinces and Oudh now a number of passed students of the Cawnpore School. Together, these might readily form a valuable aid to the Agricultural Department in the prosecution of that system of Agricultural Enquiry which Government has so long urged as desirable. There is much work of an agricultural nature, such as comparisons of crops, the execution of which need not occupy much of the time of any individual officer if the plan of the work is first laid out clearly to him.

19. At the Farms the following new experiments have been suggested.

In relation to sugar cane an additional experiment has been commenced to determine the value of planting cane from the top ends only.

Cawnpore.

Also a new series of experiments is to be commenced at this Farm to demonstrate if possible in a field experiment the effect of growing cereals and leguminous crops mixed together. At this farm there have been in progress for some years experiments—

- (a) to illustrate the value of ploughing in green crops, especially leguminous ones, as manure for a succeeding cereal crop (wheat) and—
- (b) to illustrate the value of a previously grown leguminous crop which is removed, in some cases before maturity, in others when fully ripe, for a succeeding cereal (wheat) crop. The third series now to be started will consist in growing certain pulses with non-leguminous crops in the same field together, the cereal or other non-leguminous crop to be compared with another plot of the same crop grown without any admixture of leguminous plant. As is well known, there is reason to believe that the practice of the Indian cultivator in mixing leguminous with other crops in this manner results in an assimilation of atmospheric Nitrogen which may become immediately available to some non-leguminous plant in the neighbourhood. This is a question which has not been studied very closely up to the present, and indeed it is doubtful whether it is possible to experiment successfully on the subject in the form of a field experiment. The general experience is that such questions can be more satisfactorily solved if they are carried out on the much smaller scale of "pot cultures". At present however it is impossible to commence the latter, whilst it is possible to carry out the former, and if there is any likelihood of fairly concordant results being attained at Cawnpore, similar series may be started at some of the other Farms.

At both Cawnpore and Nagpore the Superintendents have undertaken to make some experiments on the weight of soils, the amount of moisture generally present in different soils under varying circumstances and the temperature of soils at certain depths during the year. Although these matters have received attention in other countries, they have been left unnoticed in India and the information obtained will be interesting.

The experiments with potatoes, which are now being conducted at the Cawnpore, Dumraon and Burdwan Farms will probably supply valuable information. For example at Cawnpore there was some evidence that Castor cake, though a most valuable manure, may cause damage to the potato crop. It appeared at Cawnpore at least as though it had prevented many of the sets from germinating whilst those plants which grew, were good enough. A similar experience has been met with in the sugar cane experiments at Poona, where a plot of cane which had been manured with "Bassia" cake refused to germinate at all (1895). On replanting the plot a month later the crop grew all right. It may have been purely an accidental circumstance in these cases, but the point is worth noting, and if similar effects should be met with in future years a more complete investigation must be made of these materials.

At the Meerut Farm, Mr. Wyer, the Collector, has commenced a series of experiments to determine the best weight of wheat seed to be sown per acre. There is perhaps no more difficult question to solve than this, and the experiment will be doubtless watched with interest by the native gentlemen who frequently visit Mr. Wyer's Farm; as mentioned in my last year's Report he has successfully demonstrated the value of the "Gunda Nalla" water as manure and the cultivators have taken the matter up extensively. His experiments with earth saturated with urine and then dried before application to the land will be similarly useful.

Meerut Farm.

AGRICULTURAL EDUCATION.

20. This year, I have again taken part in the examinations of the agricultural students at the Saidapet College and the Cawnpore and Nagpore Agricultural Schools, with the difference that in 1896 I personally examined the students at Saidapet whilst this year Government did not consider it of sufficient importance for me to visit Madras for this purpose solely. At Cawnpore the students were not of quite so well educated a stamp as those who finished the course in 1896, there being a larger proportion of students who entered with only the "Middle English" certificate and fewer of those who passed the "School Final" examination. The latter not only start with a much better command of the English language, but are much better able to assimilate the information given in the lectures. When this school was first opened, it was intended that entrance to it should be restricted to those who have passed the "School Final" examination and the Principal believes that this rule might now be rigidly enforced. As I have pointed out, such a regulation would be the means of collecting a much more uniform class of students and would simplify the teaching. The purely Agricultural part of the works is especially well done, and I feel certain that some good Agricultural work might be done by these students if it were required of them.

In my last Annual Report I mentioned that some sons of Zemindars attend Agricultural Schools purely for their benefit. Similarly this year, 2 out of 20 who entered the Cawnpore School last July fall under this category.

PART 3.

21. List of Notes written on Agricultural subjects.
The Composition of Sugar Cane, Juice and Gur, 1895-96.
The Composition of Sugar Cane, Juice and Gur, 1896-97.
The value and composition of Indian Manures.

Report on the composition of certain soils and well waters from the Champaran District, Behar.

Report on the composition of certain soils and waters from the Amherst District, Burma.

Report on the composition of Mangel Wurzels grown at Aligarh.

Note on Useful agricultural work which might be carried out on Court of Wards Estates in the North Western Provinces and Oudh.

Note on the Cawnpore Agricultural School.

22. List of work undertaken for the Forest Department.

Analysis of four samples of Tannin Materials.

Analysis of three samples of Forest soils.

23. In concluding this report I must testify to the careful manner in which the staff of my office have severally executed their duties.

Mr. Collins has unfortunately twice been seriously ill, during part of April and May with dysentery, and since the end of February of this year with typhoid fever.

Mr. Blyth, the Junior Assistant, is now qualified to execute some of the analytical work with precision.

Circular No. $\frac{10}{248-2}$ -F.

Extract from the Proceedings of the Government of India, in the Department of Revenue and Agriculture (Forests): dated Simla, the 12th June 1897.

READ—

Circular No. 14-F., dated the 19th August 1896, communicating remarks on the Administration Report of the Imperial Forest School at Dehra Dun for the year 1894-95.

READ also—

Report of the Forest School for 1895-96.

Letter from the Inspector-General of Forests, No. 895, dated the 21st October 1896, submitting the above Report.

RESOLUTION.

1. During the twelve months ending 30th June 1896, the School continued under the Directorship of Mr. J. S. Gamble, M. A., with the exception of the period from 6th August to 27th October 1895, during which time he was absent on privilege leave and Mr. A. Smythies, B. A., Deputy Director, officiated for him. The post of Deputy Director was held by Mr. Smythies, and while this officer officiated as Director, and again when he was on privilege leave, Mr. A. F. Gradon Instructor, officiated for him. On the 28th June Mr. Smythies was appointed to officiate as Conservator in Burma, and the permanent vacancy thus caused was filled by the appointment as Deputy Director of Mr. F. Gleadow, Professor of Forestry at the Poona College of Science. The other members of the School staff were Mr. C. G. Rogers, Mr. B. B. Osmaston, and Babu Upendra Nath Kanjilal. The staff was also assisted by the Assistant Agricultural Chemist, the Deputy Superintendent of the Indian Museum, the Superintendent of Forest Surveys, and the officers of the School Circle.

2. The following statement shows the number of students who have attended the School during the past four years:—

				Paid.	Private.	Total.
1892-93	...	...	...	81	22	103
1893-94	...	...	...	73	33	106
1894-95	...	...	...	72	34	106
1895-96	...	...	...	54	29	83

The number of students attending thus shows a marked decrease as compared with previous years. Of the 83 students who attended during the year, 5 of whom however were not present when the course was concluded at the end of the year, 16 were already in the Government Forest Service as Rangers, Foresters or Guards, 35 were stipendiary students, and 29 attended the School at their own expense, whilst the remaining 3 students were deputed from the Native States of Jodhpur and Kashmir.

3. Of the 49 students in the Senior Upper and Lower Classes, none obtained Honours, 34 obtained ordinary certificates, 29 as Rangers and 5 as Foresters, 11 failed to pass, whilst 4 were prevented by various causes from appearing at the final examinations. These results are compared with those of the previous year as follows:—

Year.	Number of students admitted.		Honours.		Certificates.		Failed.		Left from various causes.
	Upper class.	Lower class.	Upper class.	Lower class.	Upper class.	Lower class.	Upper class.	Lower class.	
1894-95	43	8	...	...	34	8	8	...	1
1895-96	41	8	...	...	29	5	8	3	4

It is observed that the report contains no comparison with the results of previous years; nor can it be ascertained, without reference to the appendices, how many of the men who failed were stipendiary and how many were private students. This information should be given, and results compared with those obtained in former years, in all future reports.

4. It is noticed that at the Entrance Examination held in March 1895 64 candidates presented themselves, of whom 31 passed. Of these only 19 were admitted. The report does not fully explain, as it should do, the reasons which led to the exclusion of the 12 passed students and to the subsequent admission of 8 men who had originally failed to pass the entrance examination.

5. With reference to the fact reported that one stipendiary student proved himself unfit for service in the Forest Department and that he was consequently removed from the School, the Government of India consider that the powers conferred on the Director by the School rules 12(ix) and 28 should be made full use of, and that stipendiary students whose progress or conduct is unsatisfactory should have their stipends reduced or withdrawn, and if necessary be removed from the School, rather than be allowed to remain there at Government expense, only to fail at the final examinations.

6. It is noticed that six stipendiary students failed to obtain certificates at the final examinations of March 1896. The important question of the desirability or otherwise of continuing the grant of stipends to students, who may nevertheless fail to obtain a certificate at the final examinations, which was referred to in paragraph 3 of the Government of India's Resolution on the Report for the year 1894-95, is not noticed in the present Report. Nor does the Director give any particulars regarding the practical results achieved during the year, with special reference to the educational and physical fitness of the students for their career in the Forest Service, as asked for in paragraph 4 of the same resolution. It is understood that the present report was written before the above orders were received, but these matters should in any case have been noticed. They should receive particular attention in the Report for the year 1896-97.

ORDER.—Ordered that the above Resolution be published in the Supplement to the *Gazette of India*, and that copies be forwarded, for information, to the Governments of Madras and Bombay, the Local Governments and Administrations noted in the margin, the Department of Finance and Commerce, and the Comptroller and Auditor General; also to the Inspector-General of Forests for information and for communication to the Director of the Forest School and the Superintendent of Forest Surveys.

Ordered, further, that a copy, with copies of the Report, be forwarded to the Foreign Department for communication to the Jodhpur and Kashmir Darbars.

(True Extract.)

Mugul Mahan

Secretary to the Government of India.

P.C.F.

To The Secretary to the Govt of Madras.

When given for copying _____
When copied _____
When examined _____
When signed _____

189.

READ AGAIN G.O., No
189

DATED

CURRENT No.

ENCLOSURES TO G. No.

ORDER OF GOVERNMENT

A A A A A A A

LETTER OF GOVERNMENT.

STATEMENT WITH DITTO.

PAPERS NOT FILED UP, BEING MEANT FOR DESPATCH
IN ORIGINAL.

H.B.—

A = Copy in full.
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