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made and tinned foods to man the inorganic fertilizers in many cases not only do not benefit the crop but adversely affect it. When such a necessity for increased supply of organic matter to a "soil" was established, plant doctors, in this instance, two chemists, Richards and Hutchinson of Rothamsted looked round for a proper remedy and began their researches in about 1919 with the aid of a special grant given by the Food Production Department in England.

Using in their first investigation wheat straw as a basic material and Ammonium sulphate as starter these chemists successfully produced a fermented material, which closely resembles the ordinary Farm Yard Manure in colour and condition and quality.

Since the above manure is produced by direct fermentation without any intervention of cattle, this was named Artificial Farm Yard Manure in contradistinction to the Farm Yard Manure which name is given to the manure which is obtained at the Farmyard by fermenting the droppings of animals with or without urine and litter and for the production of which the intervention of cattle thus becomes necessary. But on account of its name some confusion arose about composition of the artificial Farmyard manure and the farmers thought it was an artificial fertilizer. With a view to remove this misconception, the name was subsequently changed to Synthetic Farm Yard Manure. In 1921, the manufacture of Synthetic Farm Yard Manure was patented by a Company known as the Agricultural Development Co., which marketed their product under the name of "Adco."

The question then arose, if the soil needs organic matter, why not apply any available material in the raw rather than in fermented condition?

About the same time, Hutchinson, the Imperial Agricultural Bacteriologist, Pusa, started the study of fermentation of green manure, in imitation of Indigo *seeth*, the organic refuse left after the extraction of the dye. He used sannhemp—fermented and unfermented—for his experiments and arrived at the conclusion that fermented green manure was better than unfermented material.

Thus it is seen from the above experiments, that what is called Synthetic Farm Yard Manure or Adco is simply organic matter composted in a scientific way i. e., by keeping the decomposition under control.

The answer in favour of fermentation was given for the following reasons.

(1) Raw material when ploughed in unduly opens up the soil on account of its bulk and this material if dry, also draws upon the soil moisture for its own fermentation,

(2) For its thorough incorporation into the soil it offers difficulty in ordinary doses, and this is increased where increased heavy doses have to be applied.

(3) If it is dry or partly dry, it causes the nitrate of soil to be reduced as the organisms responsible for its break down require Nitrogen for their energy.

(4) The raw material forms a medium for the development of white ants.

Previous fermentation of the material overcomes all these difficulties and makes it more easily available to the crop.

Following the lead of Rothamsted the first trial at the manufacture of Synthetic Farm Yard Manure was made at Coimbatore in 1922 in the Pot Culture House of the chemical section using paddy straw and calcium cynanamide. Though we could not have any surplus paddy straw for conversion into manure, this material was selected for the first experiment with a view to under stand the technique of the method by using an easily fermentable substance.

Since (1) optimum moisture, (2) free access of air, (3) supply of easily available Nitrogen in suitable concentration (4) neutral or slightly alkaline re-action and (5) suitable temperature are considered as a *sine qua non* for successful fermentation for the production of well rotted Artificial Farmyard Manure, 1500 lb. of air-dry straw was loosely put into a stack, the required quantity of calcium cyanamide broadcasted on the top of the heap and

watered in. Fermentation started in about 24 hours and in 4 days the heap began to sink in the middle with rise of temperature. Almost daily the sides and top portion of the heap had to be watered to keep them moist and even then fermentation in these portions was scanty and unsatisfactory. On account of the high and dry winds, the exposed portions of the heap could not be kept moist enough for satisfactory fermentation. After 6 weeks when the sinking and fermentation of the heap were found to be uneven it was dismantled and the material was thoroughly mixed up and restacked. After another 3 weeks, fermention was found to have been uniform and a well rotten manure was obtained. In the process however a loss of 47 per cent of organic matter and about 14 percent of Nitrogen was observed.

The next set of experiments was carried out with guinea grass stubble and calcium cyanamide under complete aerobic and semi-aerobic conditions, the latter condition being obtained by mud plastering the exposed surfaces The object of semi-aerobic condition was to see how far the difficulty of having uniform moisture conditions could be overcome. As in the previous experiment the exposed heap had to be continously watered while the mud plastered heap received no water for six weeks. When this was opened it was found to have had uniform fermentation, while in the exposed heap only the central portion had fermented satis factorily. In the laboratory experiment also, the same moisture difficulty occurred. A [illegible] the table below will show the advantages of a pr[illegible] and Organic Matter [illegible] bic fermentation throughout. By the former [illegible] fermentation is secured but the Nitrog[illegible] losses are reduced.

	Laboratory Experiment.		Large scale.	
	Nitrogen.	Organic matter.	Nitrogen.	Organic matter.
	%	37·7%		
Aerobic ...	26·0%	22·2%	59.97%	32·80%
Semi-aerobic ...	9		35·23%	32·33%

, that in aerobic heaps on account of unequal fermentation, as with almost uniform fermentation. Nitrogen is not fixed to the same extent as in semi-aerobic l

In the light of these observations, the following experiments were conducted in 1923 with Ragi straw both in heaps and with various amounts of Nitrogen. Nitrogen was added as Ammonium sulphate or calcium cyanamide respectively at 0·75 per cent and 0·5 per cent calculated on dry matter. In the case of Ammonium sulphate lime carbanate was also added to correct the acidity.

	Ammonium sulphate series.				Calcium Cyanamide series.			
	Higher Nitrogen per cent of loss.		Lower Nitrogen per cent of loss.		Higher Nitrogen per cent of loss.		Lower Nitrogen per cent of. loss.	
	N.	O.M.	N.	O.M.	N.	O.M.	M.	OM.
1. Heap	40·09	43·59 (3)	29·02	46·45 (5)	25·68	36·34 (7)	33·46	38
2. Pit	34·66	33·30 (4)	26·46	23·85 (6)	22·99	29·63 (8)	15·83	27

[Note.—N is Nitrogen. O. M. is Organic Matter].

The loss of Nitrogen from pits experiments was less in every case than that from heaps. In pits it ranged from 16 to 34 per cent and in heaps, from 26 to 40 per cent.

In all the experiments the loss of Nitrogen was very high. It might be that the high per centages of loss were due to the soakage of the liquid portion of the manure into the soil.

The following experiments were designed :—

(1) To prevent absorption, if any, of the liquid portion of manure by the soil.

(2) To find out the effect on fermentation and loss of Nitrogen of a lower amount of Nitrogen than 0·75 per cent the standard fixed at Rothamsted.

(3) Semi-aerobic fermentation from start to finish of the experiment as it was considered likely that the huge loss of Nitrogen and Organic matter occurred when the heaps were changed from semiaerobic to full aerobic conditions. These experiments were therefore conducted in cemented pucca brick tubs, with a drainage pipe attached so as to enable the collection of any liquid portion that might flow out and additions of such effluent to the fermenting material again from time to time.

The material used in these experiments was also Ragi straw with Ammonium sulphate as starter at the rate of 0.5 percent on dry matter. Two experiments were started. In No. 1 the material was covered with galvanised sheets and in No. 2 it was mud-plastered. The following results were obtained.

	Percent loss of Nitrogen.	Organic matter.
No. 1 Pit covered with galvanised sheet	54.05	66.88
No. 2 Pit mudplastered ...	44.12	53.77

Here too the losses of Nitrogen and organic matter were more in the open tub than in the one which was mud-plastered. In both fermentation was not uniform, part of the material (about half) in the open pit, and (about 1/8) in the mud plastered pit remaining unfermented. To a depth of 4 inches from the top surface the material in the unplastered pit was so fresh as at start, owing to the fact that any moisture added evaporated away quickly. With all the care in watering unmoist patches occurred here and there under both the systems, but this was more in No. 1. The greater fermentation in No. 2 shows the advantage of mudplastering the material so as to prevent loss of moisture in the early stages when the material is dry and incapable of retaining any moisture. When once hydration of the material takes place and fermentation starts the material becomes more and more retentive of moisture.

The next set of experiments was carried out in ordinary earthen flower pots, (japanned inside) to find out (1) the optimum starter nitrogen required for active and maximum fermentation and also (2) the rate of loss of nitrogen, when the necessary starter Nitrogen is added (a) in one lot at the beginning and (b) when added at intervals in divided doses.

The materials were air dry Ragi straw and canetrash with calcium cyanamide as starter.

The following results were obtained:—

No.	Details of experiments.	Loss or gain in nitrogen.	Percent average.	Loss or gain in nitrogen.	Percent Average.
1	Control No. starter 1500 grams ...	5·009		48·52	
2	Air-dry Ragi straw only ...	4·232	462	55·28	51·9
3	Basic material 0.25 per cent nitrogen ...	28·10		61·39	
4	1500 grams Ragi Straw. Calcium Cyanamide...	6·56	17·00	55·93	58·66
5	Do. plus 0.50 per cent nitrogen ..	40·22		55·93	
6	Do. do. ...	30·26	35·24	57·50	56·72
7	Do. plus 0·75 per cent nitrogen ...	43·87		55·19	
8	Do. do. ...	29·43	36·65	49 81	52·50
9	Do. plus 1·00 per cent nitrogen ...	48·87		48·80	
10	Do. do. ...	36·64	42·75	45·93	47·37
11	Do. plus 0·5 per cent nitrogen added in 2 lots at intervals ...	12·52	23·00	49·44	53·47
12	Do. do. ...	33·57		57·50	
13	Do. plus 0·75 per cent nitrogen added in 3 lots at intervals ...	45·94	45·94	57·87	56·02
14	Do. do.	45·94		54·17	
15	Do. plus 1·00 per cent nitrogen added in 4 lots at intervals ...	33·16	33·35	50·83	47·04
16	Do. do.	33·54		43·24	
17	Do. plus 1·25 per cent nitrogen in 5 lots at intervals ...	27·96	69.2	46·11	44·03
18	Do. do.	25·26		41·91	

(Continued from Page 405)

No.	Details of experiments.		Percent Loss or gain in Nitrogen.	Average.	Percent Loss or gain in Nitrogen.	Average.
19	Do. plus 0·75 per cent added in one lot at start and the pot buried	...	28·09	23·09	49·72	49·72
20	Do. plus 0·25 per cent nitrogen added as fresh cow-dung	...	23·82	23·82	56·52	56·52
19	Control No. starter	...	31·6		41·3	45·6
20	750 grams air dry cane trash only	...	43·06	37·33	49·6	
21	Cane trash plus 0·25 percent	...	14·29		44·6	39·4
22	Nitrogen Calcium Cyanamide	...	5·16	9·73	34·1	
23	Cane trash plus 0·5 per cent	...	25·04		45·4	47·4
24	Nitrogen	...	32·47	28·76	49·4	
25	Cane trash plus 0·75 per cent	...	31·76		41·0	42·0
26	Nitrogen	...	24·72	28·24	43·1	
27	Cane trash plus 1·00 per cent	...	41·43		46·6	48·0
28	Nitrogen	...	45·34	43·39	49·9	
41	Cane trash plus 1·00 per cent Nitrogen pot buried in soil	...	27·84	27·84	40·0	40·0
42	Cane trash plus 0·25 per cent Nitrogen cow-dung	...	46·21	46·21	36·1	36·1

N. B.—Air dry cane trash, 750 grams in each pot.

Fermentation was quite satisfactory in all, higher or lower concentration of Nitrogen having the same effect on fermentation. Nitrogen loss occurred even with the lowest concentration (0·25 per cent Nitrogen) and this loss was greater with ragi straw than with cane-trash. Though Nitrogen is necessary for fermentation, the above experiments point to the fact that addition of easily available Nitrogen results in loss of nitrogen independent of concentration, but to a certain extent such loss depends upon the nature of the basic material.

In the pots that were buried fermentation was complete and uniform without any water except what was added initially, where as the pots that were kept on surface had to be watered every now and then to keep up the moisture necessary for active fermentation. This indicates the necessity and advantage of mud plastering the material in the beginning so that the necessary moisture for normal fermentation may be retained without resorting to constant watering thus reducing the total amount of water required for complete disintegration of the material.

The next set of experiments was done in pots with "Adco complete mixture" and "Adco Accelerator" two patented chemical starters supplied by Messrs. Shaw Wallace and Co., Calcutta. These were compared with similar mixtures made up in the laboratory which included a phosphate in the form of tricalcic phosphate since the patented mixtures contained also a phosphate. Also the influence of fermentation on Ragi staw of dried and powdered Farm Yard Manure when added in quantity necessary to supply the same rate of Nitrogen as the above mixtures was also tested.

The results are below:—

Air-dry Ragi straw; 1 kilo in each glazed pot.

No.	Details of experiment.	Percent loss of gain in Nitrogen.	Percent average balance of duplicate.	Percent loss of dry matter.	Percent average of duplicates dry matter.
11	Ragi straw only control ...	2·17	0·9	71·99	69·67
12	do. ...	0·384		67·34	
13	Ragi straw plus Adco mixture enoughto supply 0·75 per cent Nitrogen ...	32·99	34·05	65·01	64·90
14	do. ...	35·12		64·80	
16	Ragi straw plus Calcium Cyanamide mixture made up in laboratory enough to supply 0·75% ...	34·31	33·60	64·59	64·5
17	do. (nitrogen ...	32·91		64·48	
18	Ragi straw plus Farm Yare Manure dried and powdered 0·75 nitrogen ...	8·313	12·96	58·83	60·33
19	do. ...	17·61		61·83	

Ragi green: 1 kilo in each pot and Adco accelator.

1	Control-ragi stems and leaves only ...	13·01	12·16	55·41	54·6
2	do. ...	11·31		53·82	
3	Green ragi straw plus Adco accelarator to supply 0·22 per cent nitrogen ...	26·68	29·01	50·00	50·8
4	do. ...	31.34		51·59	
5	Green ragi straw plus Calcium Cyanamide mixture made up to supply 0·22 per cent nitrogen ...	28·48	26·56	50·00	48·57
6	do. ...	31·34		47·13	
7	Green ragi straw plus Farm Yard Manure dried and powdered to supply 0·22 % nitrogen.	31·41	25·48	57·77	55·04
8	do. ...	19·55		52·32	

Though there was slight fermentation in the control pots the resultant product did not attain the plastic condition of Farm Yard Manure. But there was little or no loss of Nitrogen. In the case of treated pots fermentation was thorough and uniform, thus pointing to the necessity of starter Nitrogen. The patented starters were in no way superior to the mixtures similarly made up. either in accelerating fermentation or in lessening Nitrogen loss. Even with an almost inert material as Farm Yard Manure, Nitrogen loss occurred, though fermentation was equally satisfactory. These losses might be due to the higher concentrations of Nitrogen (.75 percent) in the case of day ragi straw whereas green material did not require even 0.22 percent Nitrogen on dry matter. In the case of air-dry straw with 0.75 percent Nitrogen as Farm Yard Manure the loss is only about 13 percent whereas with green material a Nitrogen supply of 0.22 percent has resulted almost doubling the loss (25.48 percent).

The general conclusions from all the above big scale and pot experiments seem to show that

(1) semi-aerobic fermentation for a time in pits, mud plastered for a month in case of straws and for a longer period in case of tougher materials followed by aerobic fermentation, helps in inducing uniform disintegration of material by preventing loss of moisture and reducing loss of Nitrogen by making the dry stiff material more plastic and capable of fixing the added nitrogen.

(2) Active and soluble forms of starter Nitrogen-such as Ammonium sulphate, Calcium cyanamide Urine etc., always end in loss of nitrogen, whereas a slowly available starter such as fresh cattle dung, or good farm yard manure considerably reduces such loss.

(3) With green material no starter Nitrogen is necessary.

It was found from the last set of experiments that addition of phosphates is helpful in bringing out quicker fermentation by stimulating the fermentative organisms to greater activity. This increased activity again enables them to fix the Nitrogen faster and thus Nitrogen loss is much reduced.

The following experimets wore done with a view to test, whether an addition of insoluble phosphate with calcium cyanamide would increase fermentation and reduce Nitrogen loss.

Two sets of experiments were conducted for this purpose one in cement tubs on the Central Farm using paddy straw and the other at the Groundnut Experiment Station, Palakuppam with cumbu straw. On the Central Farm calcium cyanamide and Trichy phosphate were used as starters and at Palakuppam Ammonium Sulphate and bonemeal. The following results were obtained.

	Paddy-straw calcium cyanamide percent loss or gain of Nitrogen.	Trichy phosphate percent loss of Organic matter.
Central Farm.		
Heap Tub (one) open	−5.81	68.32
„ Tub (two) mud plastered	17.24	59.52
	18.62	68.74
Palakuppam	Cumbu straw – Ammo. sulphate–Bonemeal.	
Pit I	26.4	35.9
Pit II	20.2	31.8

As the cumbu straw used was old the organic matter loss is about half of that of prevous experiments. The nitrogen loss also is much less than wha happened in some previous experiments i.e., 50.75 percent.

In the case of paddy straw, there is a decided gain in Nitrogen. In all the previous experiments also carried out with this material the loss of nitrogen was not great. It appears that paddy straw fixes up the nitrogen more quickly and to a higher degree than other materials and that the softer the material, the lesser is the loss of Nitrogen.

When all the above experiments indicated Nitrogen loss in a lesser or greater degree, it was thought that such losses might be due to the active and easily available nature of the starters. To test this point the following 3 sets of experiments using cane trash and varagu straw with and without cactus as basic material and bonemeal as starter were conducted in Palur and in the Chunampet Zamindary with the following results.

PALUR.

	Cane – trash		Cane trash + cactus	
	percent loss of N.	percent loss of O. M.	percent loss of N.	percent loss of O. M.
Pit 1	15.08	69.44	Pit 3 3.60	52.98
Pit 2	10.69	63.88	Pit 4 5.23	55.08

CHUNAMPE.

	percent loss of N.	percent loss of O. M.
Varagu straw + cactus (pit.)	53.13	73.90
Cane trash + cactus (pit.)	30.72	73.40

The Chunampet experiments show a big loss, probably due to over fermentation. In the Palur experiment with trash and cactus the organic matter loss is within limits and the loss of nitrogen is negligible. With cane trash alone fermentation had gone beyond the limit and the loss of nitrogen is more.

In Chunampet the sample was like a lump of clay. The Palur samples were in condition, showing here and there the original structure of the material but breaking to pieces when handled and the material was plastic and soft.

The above experiments lead to the following conclusions:

(1) The loss of Nitrogen can be reduced by substituting Bonemeal and Farm Yard Manure or fresh cattle dung for the quick acting Nitrogenous starters used in earlier experiments.

(2) This loss of Nitrogen depends upon the nature of the basic material soft or tough and on the nature of the starter (active or slow).

(3) When the organic matter is reduced by 50 percent of its original weight optimum fermentation is reached.

(4) Depending upon the nature of the softness or toughness of original material the resulting material is either plastic like Farm Yard Manure or remains fibrous and soft.

(5) The composition of the resulting manure varies a good deal depending upon the nature of the starting material and the time of the year in which the experiment is done. Thus during heavy rains, certain amount of leaching of soluble constituents is bound to occur.

The combined action of cattle dung and bonemeal was tested qualitatively on a large scale on very refractory materials, such as cactus leaves, dry stalks of cotton, of chillies and Bengal gram : and it is gratifying to note that all these fermented quite satisfactorily in 6 to 8 months ; during this period even the hard spines of cactus became soft enough to be handled without fear of pricking. After several trials with various materials in different parts of the Presidency the following technique of manufacture has been envolved.

A pit of convenient size say 12 feet x 6 feet x 3 feet should be dug on high ground. The basic material is uniformly and loosely put to a depth of 9 to 12 inches, and water is evenly sprinked till the whole of the material gets moist, every part of the heap should be carefully watered so that no portion remains unmoist. This is the most important point in the construction of the heap. On many occasions dry patches here and there are noted as a result of imperfect watering, the unmoist and untreated portions remain unaffected, while the moist and treated portion rots.

When the whole material is thus moistened, 1 to 2 lb of fine bonemeal is evenly broadcasted and over this a very thin suspension of cattle dung say 10 to 20 lbs. moist dung in 5 to 10 gallons of water is applied, taking care that this gets into every part of the material. A second layer of the basic material is now put on the first layer, moistened and treated as before. Thus the whole of the material is disposed of till a depth of 6 to 9 feet is reached when the heap is mud plastered. After fermentation has proceeded semi aerobically for 4 to 6 weeks depending upon the nature of the material, the plaster is removed so that aerobic fermentation may proceed. If at the time the heap is found to have sunk unevenly, it indicates that in the unsunk portions there has been non-fermentation due to lack of moisture. To correct the defect fermenting material may be forked once, necessary water added and the heap left to ferment. Forking is done with a view to loosen the material and thus to secure almost free entry of air. Moreover a thorough mixing of the material by forking helps quicker fermentation of the unfermented portion by supplying the necessary moisture; for fermented material is capable of retaining more moisture than unfermented material and gives it up when needed. After forking, the material may be thickly mulched with straw to prevent rapid loss of moisture due to evaporation. In about 3 to 4 months, the raw material reaches

a stage when it could be used as manure. This is so with soft materials but tougher stuff requires 6 months to one year to reach the proper stage. Thus the time of fermentation required for complete disintegration depends solely on the nature of the basic material used.

All the weeds collected from fields could be used for the above purpose and almost any fermentable organic matter dry or green which is otherwise unfit for use barring the highly lignified tissues can with advantage be converted into the much needed organic manure with very little cost, since the process of manufacture needs no materials that are not ordinarily obtained on an ordinary farm. Thus the cultivator is able to increase his stock of organic manure and by its application enrich his fields.

*Summary

The sources of natural supply of manures having been getting less and less with the increase of population and extension of cultivation, the necessity for making good the deficiency arose.

Richards and Hutchinson of Rothamsted began researches in this direction and came to the conclusion that all organic matter largely being wasted on farms could be converted into good manure similar in qualities to the farm yard manure by the adoption of certain processes chiefly by controlling decomposition of organic matter.

Hutchinson, making parellal experiments in India concluded that fermented organic matter proved a better substitute for farm yard manure than unfermented material.

Following the lead thus given by the investigations at Rothamsted and by Mr. Hutchinson, a series of experiments were conducted in Madras, using cane trash and prickly pear (cactus) as material and cowdung as starter with the addition of a phosphate as invigorator in the process.

And the processes evolved as suited to local conditions have been found out to be to subject the material to semi-aerobic conditions in the beginning and full aerobic (i.e. permitting of perfect aeration) conditions later so as to secure optimum fermentation resulting in a good well rotten manure possessing all the qualities of farm yard manure.

Any fermentable organic matter can be used barring substances which have highly woody (ligneous) tissue.

*Paper read at the M. A. S. U. Conference in July 1928.

*Jaggery Making in Hospet and Suggestions for its improvemnt.

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Bellary is one of the foremost sugarcane producing districts in the Madras Presidency. It had 9751 acres (the highest in the Presidency) under sugarcane in 1905-6, Coimbatore and Godavari following with 9689 and 8413 acres respectively. Strangely however, the jaggery into which all the cane grown in the District gets converted is the worst type of cane jaggery produced in the Presidency. The cause of this with the best means of improving the quality of the jaggery was taken up for investigation by the Department last year and continued during the present year. It is proposed in the present paper to deal with the results so far obtained.

Local methods of cane cultivation and Jaggery making :- The sugarcane area in the District lies mostly along the right bank of the Tungabhadra and consists mainly of black clay, although the lighter soils situated higher up the basin consisting of red loams are occasionally also brought under cane cultivation. The water supply through the channels is almost perennial. Cane and paddy are taken by rotation, but not infrequently the same crop is grown for several years in succession. Cane is planted during April—May and harvested 9—10 months later in January —March. The manures ordinarily used are 10—12 cartloads of cattle manure and 60 maunds of castor cake per acre. No wrapping or propping of canes is practised. The usual variety of cane grown is a thick white cane known as Javari Kabbu very similar to Coimbatore Poovan in appearance and quality of juice is perhaps identical with the latter. It is said to have been introduced into the District about 1840 when it ousted the local thin cane. The average out-turn of jaggery is about 300 maunds (3½ tons) per acre.

The usual 3 roller iron mill is used for the crushing and is either owned by the cultivator or land owner or hired for the occasion; but the crushing is done by a set of professional boilers who hail from the North and bring their own working cattle. They come over during the harvesting season usually in batches of eight with four pairs of animals and establish themselves at the

*Paper read at the M. A. S. U. Conference in July 1908.

sional boilers are expected to turn out a certain quantity of jaggery each day for which they are paid partly in kind. The grower usually exercises a certain amount of supervision over the boiling but not being familiar with the technique of the process himself he has no control over the quality of the jaggery produced. The jaggery boiler endeavours to turn out the maximum quantity of jaggery during the day with the minimum amount of trouble and attention. Towards this end he uses huge pans (9 feet in diameter at the top and does no more than two boilings per day each lasting 8-10 hours. The quantity of juice used for each boiling is four tankfuls, the capacity of the tank (which is sunk into the ground close to the mill and receives the juice) being 80-90 potfuls of 40 lbs each (=3200-3600 lbs). This quantity is transferred to the cooking pan not at once but in four instalments as the tank gets filled and the contents of the pan boil down. Lime is added partly at start and partly during the boiling, but no scum is removed. At the right stage the pan is removed from the fire and the contents transferred into date mats spread over rectangular shallow pits in the ground. As much as 450 lbs (17 maunds) of jaggery are obtained from each boiling, but the product is low in quality being dark brown to black in colour and and largely admixed with impurities. Not only no attempt is made to keep the jaggery free from the latter, but impurities in the form of sand and cow dung are said to be at times deliberately introduced.

It was evident even on casual observation that the low quality of the jaggery must be due partly at least to the defective methods of preparation. Part of the investigation therefore consisted in carrying out trial boilings with the same juice as was used by the local boiler but under improved conditions, paying due regard to all essential details of manufacture.

Apart from the method of preparation other possible reasons for the unsatisfactory quality of the jaggery were

(i) The variety of cane grown and the quality of the juice obtained therefrom.

(ii) The nature of the soil and of the irrigation water and the treatment given to the former.

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These also were investigated.

Trial Boilings. The trial boilings were conducted in flat bottomed pans of Samalkot pattern which are of smaller capacity than the local ones and the furnaces were of "Sindwahi" type, the main features of this type of furnace being that it is provided with a chimney for the escape of smoke and not gases, a grid over which the fuel is burnt and an air-hole under the latter. The boilings conducted last year did not differ from the local method in other ways except that the scum was carefully removed and care was taken to prevent the juice from being contaminated with dirt. The jaggeries thus obtained were decidedly better than the local product both in point of colour and purity and their superior quality was generally acknowledged.

Chemical Examination of Cane juice, Soil and irrigation water:—With regard to the other possible factors affecting the colour of the jaggery, examination of the juice of the top and bottom halves of the canes according to the method devised in these laboratories showed that the canes were far from being ripe enough for cutting. The juices all showed a high percentage of glucose (1·6–2·9 per cent), high glucose : sucrose ratio (12-20) and low purity co-efficient (75-82) characteristic of immature canes. It was evident that the canes were being cut much too soon. The boiling trials would doubtless have yielded a still better jaggery had the canes been ripe. Except for their high glucose content and low purity owing to the immaturity of the canes the juices were found to be otherwise normal. (Table III). Neither the soil nor the irrigation water were found on analysis to be such as would affect adversely the quality of the jaggery. It thus appeared from a preliminary examination of the problem that the inferior quality of the jaggery was due in the main to defects in the process of manufacture.

The trial boilings conducted in 1927 showed that by using a smaller pan and an improved furnace, charging the pan only once for each boiling, removing the scum and more careful handling generally, a better quality of jaggery could be obtained. It is probable, however, that in these first trial boilings which were mills, the cultivators utilizing their services in turn for milling their canes and boiling down the juices for them. The profes-

carried out by the Agricultural Demonstrator sufficient attention was not paid to several details in the technique to which a professional boiler might attach particular importance. e.g., liming, regulation of the heat, stirring the massecuite whilst over the fire and after removal from it, timely removal of the pan from the fire etc. It was therefore thought desirable for the proper conduct of the trial boilings which were to be repeated this year, to obtain the services of a professional jaggery boiler thoroughly familiar with the art. They were accordingly entrusted to an an experienced jaggery boiler from Samalkota. At the time the experiments were taken up this year, the canes were found to be quite ripe. The first boilings were conducted at Hospet in flat bottomed pans, over "Sandwahi" furnaces specially constructed for demonstration purposes and at the hands of the Samalkota man they yielded jaggery of excellent colour and consistency and was superior in point of colour to that obtained last year. Jaggery boilings in large local pans attended to by local jaggery boiler were also conducted close by and the difference in the quality of the jaggery obtained under the two methods was most striking. The Samalkot man's methods did not differ very much from those adopted for the trial boilings last year but careful observation showed that he used much less lime than the local boiler for the same quantity of juice. The Hospet trials thus showed that the colour of the jaggery obtained by using the smaller pan and improved furnace could still further be improved by judicious regulation of the quantity of lime added. The local practice was thus faulty in another important respect viz., excessive liming.

Further experiments which were conducted at Kampli had for their object the study of

(i) The effect of lime on cane juices of varying quality and the best quantity to use in each case.

(ii) The influence of the purity of the juice on that of the jaggery.

(iii) The effect of soil conditions on the quality of the juice.

The boilings were conducted as at Hospet in a flat bottomed pan over a "Sindwahi" furnance and in a local pan over local furnace closeby. The first series of experiments were made with the juice of canes cut from the Demonstration plot at Kampli,

varying the quantity of lime added and in the case of the local pan also the quantity of juice used for one boiling. The capacity of the tank in which the juice was collected was 18 potfuls (18 x 40 lb.) so that the quantity of juice used for one boiling was 4 x 18 x 40 or 2880 lb. added in four instalments. Not more than 1 tankful was used for a boiling with the Samalkota pan.

Proportion of lime used by the Local Boiler;—The quantity of lime ordinarily used in boiling down ripe cane juice at Kampli is about 16 coconut shell cupfuls (about 2·5 litres) for one boiling or 2880 lb. of juice. This quantity is of course, only a rough approximation, since the consistency† of the milk of lime is variable within limits, as also the quantity of juice used for one boiling. Sometimes however juices as those from over-ripe or diseased canes do not yield a firm enough jaggery when boiled down with the above quantity of lime. In such cases the jaggery boiler increases the quantity to 20 or even 22 cupfuls. The jaggery in such cases is proportionately darker in colour.

As will be seen from the results of the analysis of four different samples of milk of lime [Table V], the lime suspensions used by the jaggery boilers are apt to differ rather widely in their strengths. Roughly the proportion of lime used for the boiling down of normal juice may be taken as 0.042 of the juice. It must be remembered however that in liming his juice the jaggery boiler is guided not so much by the quantity of lime (no. of cupfuls) actually added as by the appearance of the limed juice.

Small Scale Boilings:—It seemed desirable before carrying out the trial boilings in the Samalkota pan with reduced quantities of lime to conduct tests on a small scale using only one or two potfuls of juice to see how far the reduction in lime could be carried consistently with the production of jaggery of satisfactory quality. The results of small scale boilings carried out with the aid of a small experimental pan placed over a pit dug out in the ground and provided with fuel and air passages (sketch) are set down in table VI.

† The jaggery boiler usually judges of the consistency of the milk of lime by plunging his finger into the suspension and withdrawing it. He considers it to be of right strength if the film of lime is just thick enough to prevent the brown of his finger from being seen through.

It will be noticed from a glance at the table and more readily from inspection of the jaggery samples that the best coloured jaggery is obtained when the juice is limed with two cupfuls for 18 pots (or 8 cupfuls for one boiling with the local pan) also that as the proportion is increased the jaggery darkens in colour.

pH values of limed juices.—The proportion of lime to juice which is used in local boilings and that which according to the small scale boiling has been found to yield the best jaggery have so far been given in terms of weight of CaO to a given weight of juice. This however is not a good way of indicating the degree of liming adopted in each case for two reasons: first because all juices are not equally acid; next because even supposing they were, they respond differently in respect of change in reaction, to the addition of acids or alkalis i.e, they differ in their buffer action. Now liming cane juice is one of those cases where the desired effect depends upon the reaction of the solution so that what we really mean by correct liming is liming to the correct reaction or stage of acidity or alkalinity. The latter cannot be correctly defined by the quantity of lime added because of the varying buffer actions of cane juices. Since the best way of defining the reaction of a solution is to state its H-ion concentration the best way of defining the correct degree of liming (or any degree of liming) is to state what the resulting H-ion concentration of the juice should be.

The H-ion concentration of the juices limed to different degrees in the case of the small scale boiling experiments are given in column 5 of Table VI in terms of pH. In the table which follows are given the pH values of certain bulk juices which had been limed previous to boiling.

It will be seen that the local boiler usually limes his juice nearly to neutrality, while for the production of jaggery of good colour the juice has to be slightly on the acid side. Juice A used by the Samalkota boiler and limed to 5.5 pH yielded jaggery of very fair colour.

Results of trial boilings:—The results of the trial boilings carried out at Kampli and scheduled in Table II may now be considered. The experiments which had to be carried out under considerable difficulties and limitations which it is unnecessary to recount on the present occasion, point to the following conclusions:—

(1) With ripe juice analysing up to 2·5 per cent glucose content, using the Samalkota pan and Sindwahi furnace and with careful boiling it is possible to reduce the usual quantity of lime to one half of that used locally and obtain jaggery of much lighter colour and equal hardness.

(2) The reduction in the quantity of lime cannot be carried out at any rate to the same extent adopting the local pan and local method of boiling without the risk of impairing the hardness of a jaggery. The reason for this appears to be the large amount of inversion as a result of the protracted boiling and carless firing.

(3) By reducing the total quantity of juice employed at one boiling and the number of charges it is possible with careful boiling to obtain a somewhat better coloured jaggery even with the use of the local pan. The local boiler however appears to be incapable of exercing the necessary care.

It would appear from the above experiments that for the production of jaggery from any given sample of juice satisfactory at once in point of colour and hardness, other conditions being equal the right quantity of lime should be used, an excess of lime tending to make the jaggery dark and deficiency to make it soft and liable to run in moist weather; that the jaggery boilers at Kampli invariably err on the side of exeess to avoid partly the risk of making the jaggery soft and this risk is the greater when large pans and large quantities of juice are used and partly no doubt also the extra care necessary to successfully boil down moderately limed juice into jaggery especially when it is of doubtful quality as when obtained from overripe or diseased canes.

Cane variety and Quality of Jaggery.—Analysis of the juices last year showed the presence of a rather high percentage of glucose in ths Kampli canes, most of the juices examined analysing over 2 per cent glucose. As the canes were then still immature this high glucose content, it was thought, was due to their unripe condition. At the time they were examined this year they were found to be quite ripe but they still showed a high glucose value 2·0 to 2·6 per cent as could be seen from the results shown in Table VIII. As such high figures are not usual in mature canes the possibility suggested itself of their being due to

defects in the physical condition of the soils or in the method of cultivation. Enquiry elicited the fact that higher up the Tungabhadra the jaggery produced was of better quality. Whilst Kampli jaggery is admittedly the worst produced in the tract, Hospet was credited with producing jaggery of butter quality The cane at Buksager seven miles above Kampli was said to yield a superior jaggery while the report was current that at Kuruvatti in Harpanahalli taluk, excellent jaggery was being produced from juice which required no liming. These reports lent colour to the suspicion that the high glucose content of the Kampli canes was more the result of bad soil conditions or defective cultivation than a characteristic of the variety. It seemed therefore desirable to test the canes and the soil at these places to see how they differed from each other and if the differences observed would justify the suspected connection between soil conditions or soil treatment and the quality of the juice.

The results of analysis of the juices at Kuruvatti, Hospet and Buksager are set down in Table IX. It will be seen that all the juices except those examined at Kuruvatti which will be discussed separately analyse over 1.4 percent glucose so that the high glucose content of the canes is un-doubtedly a characteristic of the variety. Althongh all show high glucose values it will be seen that they differ fairly widely amongst themselves the juices varying in quality from plot to plot even in the same locality. This variation could only be due to differences in the soil or its treatment and appears to be worthy of closer study. The samples of soil and jaggery collected at these places taken along with the analyses of the juices are expected to throw some light on the subject.

Kuruvatti Jaggery:—Reference has been made to the superior quality of the cane and jaggery produced at Kuruvatti. The only canes grown here belong to Ayappa Baslingappa Chekki, a well-to-do Sowcar or land holder of the place who has been trying sugarcane on part of his land for some years and has installed a plant consisting of a water pump and crushing mill both worked by an oil engine and multiple furnaces for the manufacture of jaggery. He has secured the services of a young man of his community who has had some training at the Manjri station and the plant and method of jaggery boiling adopted here are

on those at Manjiri. The boiling plant consists of two multiple furnaces with four pans each, the last two C. C. which are smaller in size being placed side by side at the same level. In addition there are two single pans DD placed at either end for use when only small quantities of juice are available. When the contents of the pans placed lowest have reached the desired concentrations they are transferred to cooling tanks EE and allowed to cool for about an hour. The massecuite which by this time has turned semi solid is worked by trowels to accelerate crystallization and finally transferred to buckets with perforated bottoms a piece of cloth being interposed between the bucket and the massecuite to enable easy removal of the jaggery. The buckets are then left to drain over night over corrugated iron sheets. When drained sufficiently of the molasses the jaggery is obtained in big blocks by inverting the buckets.

Little or no lime is used during the manufacture, whatever scum rises to the surface during the boiling is thoroughly removed and the boiling juice is splashed about in the pan at intervals, to help the finer suspended impurities to rise to the surface. The unlimed jaggery thus obtained has a clear golden yellow to brown colour, is free from palpable impurities and is crystalline in structure. It is however not as hard as the local jaggery but yields to pressure, crumbles readily and feels moist to the touch.

The Kuruvatti cane it will be seen (Table IX) has rather a low glucose content. This is probably due to the nature of the soil which is a red loam admitting of much better drainage than the stiff clays on which sugarcane is usually grown and also to better cultivation. The jaggery obtained from this juice is in point of colour unapproachable by any prepared elsewhere in the District; but this perhaps is due more to the method of manufacture than to the quality of the juice. For it will be noticed from a glance at Table IX that although the juice as obtained direct from the cane is remarkably pure, that taken from the tank just before being pumped into the boiling pans contains as much as 2.94 per cent glucose, the increase being no doubt due to inversion. Now with regard to the method of manufacture it will be noticed that it differs from the usual method in two important respects viz.,

(i) no lime is added to the juice and

(ii) the massecuite has to be freed from adhering molasses before solid jaggery could be obtained.

The significance of this difference could be best realized from a consideration of the effect of lime on the constituents of cane juice and its use in the manufacture of jaggery and of raw sugar. As it will also serve to explain the reason why the local boiler prefers to err on the side of over liming his juice the subject will be discussed in some detail.

The purpose or at any rate the effect of adding lime to cane juice is three fold viz.,

(i) to neutralize the acidity of the juice and thus prevent inversion which otherwise would occur resulting in loss of sugar on the one hand and increase in uncrystallizable reducing sugars on the other.

(ii) to flocculate or precipitate non-sugars.

(iii) to destroy excess of glucose.

All these three uses are availed of in more or less degree in the usual process of jaggery manufacture. We will consider these three effects separately in the reverse order.

As the destructive action of lime on glucose (iii) is invariably attended with the formation of dark coloured products it is not availed of as a rule except in extreme cases as when much glucose is present. Juices containing only a moderate liming and as in such cases the amounts of glucose and lime present are small, there is not much darkening of the colour produced. Juices richer in glucoe require considerable liming not only to prevent inversion but also to destroy some of the glucose already present. The reacting substances being now present in larger quantities the products of reaction will be in larger amounts also. The jaggery obtained under such conditions will be necessarily dark.

In the case of the juice in question which contained nearly 3 per cent glucose it would hardly have been possible to prevent the formation of dark products if lime even in moderate quantities had been used. The jaggery could not be as light coloured when prepared with addition of lime as without it. The force of the

argument that the good colour of the Kuruvatti jaggery was probably due more to the method of manufacture than to the quality of the juice will now be apparent.

With regard to the other two effects of lime, the local jaggery boiler has no use for (ii) since he does not care to remove the flocculated impurities forming the scum while it is only partly availed of by jaggery boilers in other parts of the Presidency who remove the scum but leave the coarser suspended impurities behind. Only in the manufacture of raw and white sugar where the impurities are removed both by skimming and by filtration is the clarifying action of lime made use of to the fullest extent.

But for the action of lime in inhibiting inversion (i) it would in most cases not be possible to obtain a solid jaggery from cane juice as the invert sugars not only do not set but also prevent some of the sucrose from crystallizing. When no lime is added as in the method in use at Kuruvatti, it is necessary to remove the molasses either by draining or by centrifuging. The losses due to inversion when lime is not added must be considered‡ but this is set off by the complete absence of any chance of the jaggery blackening. It would for this reason be a much safer method to adopt in all cases where the juices have a high glucose content The possibility of the introduction of this system more widely in the District in place of the existing one for improving the quality of the jaggery appears therefore worth consideration. The Kuruvatti jaggery could not of course be compared with that produced at Hospet or Kampli their methods of preparation being so essentially different.

In the light of the explanation given above as to the action of lime on cane juice and its use in jaggery making the tendency in the local jaggery boiler to over lime his juice is easily explained To start with the juice itself contains a large percentage (2-per cent) of glucose. Leaving the cut canes out in the sun, at unwashed mill and tank and protracted crushing tend to add to the quantity originally present in the juice owing to fermentative changes induced and the quantity is still further increased in the pan owing to the prolonged boiling and fierce heating. The jaggery boiler has found out by experience that his only chance as against this large quantity of glucose of obtaining a firm jagger

‡ Dr. Lehmann found these were as high as 30 per cent in the Hadi proess.

is to add lime and if necessary more lime. It is not surprising therefore that he is not able to produce anything better than the vile looking commodity which passes for jaggery in the District.

It has been remarked in the earlier portion of the paper that the local boiler overlimes his juice. The term has been used however in a comparative sense only to denote the fact that he uses more lime than the Samalkota boiler. Compared with the degree of liming practised in the manufacture of raw sugar and of jaggery in other parts of the country which is usually to the point of neutrality, it cannot be said that the local jaggery boiler overlimes his juice for it was found that the local juices are limed no higher than the neutral point. Further it was seen that the proportion of lime ordinarily used in local boiling is about 0·42 per cent of the juice. The quantity used in the manufacture of raw sugar is stated to be nearly 1 lb. per ton of cane which works to ·05 per cent approximately. It would then appear that the low quality of Hospet or Kampli jaggery is to be attributed more correctly to other faults viz. large pan, large quantity of juice etc., in the method of manufacture than those concerned with liming. The former as already pointed out, by impairing the already low quality of the juice render the production of a good coloured jaggery impossible. The use of the Samalkota pan and improved furnace enables a less quantity of lime to be used and a better jaggery to be obtained.

Summary of Results:—To summarise the results of the experiments and the enquiry so far carried out, it has been found that

1. The inferior quality of the jaggery produced in Hospet taluk is due to the following defects in the method of its manufacture.

(i) the use of too large a pan and the large total quantity of juice dealt with at a single boiling.

(ii) the practice of adding more and more fresh juice as the contents of the pan boil down.

(iii) impurities separated by the lime and the heating and rising to the surface on heating not being removed.

(iv) the addition of more lime than the production of a light coloured product demands.

(v) the use of immature and of over-ripe canes and want of care and cleanliness in handling the juice during manufacture.

2. By the use of a smaller pan and improved furnace and avoiding the other existing defects it is possible to obtain jaggery of satisfactory colour and hardness.

3. The optimum quantity of lime for the production of jaggery of satisfactory quality depends upon the purity of the juice The best proportion for juices containing 2–2.5 per cent glucose as obtained by experiment, is that which would give the juice a reaction of 5.5 P. H. A less quantity is likely to give a soft jaggery and a greater a dark coloured jaggery. Purer juices containing less glucose than 2 per cent may be limed less, but they can stand a fair amount of over liming. Poor juices require considerable liming in order to yield a firm jaggery. As such juices stand liming ill the product is always dark coloured.

4. The defects in the prevailing methods of jaggery jaggery making by increasing the uncrystallizable sugars in the juice make it difficult to.lime. Better methods as the use of a smaller pan and improved furnace prevent this undue increase and enable less lime to be used without the risk of making the jaggery soft.

5. Jaggery boiling without the addition of lime as practised at K ruvatti and at the Manjri Station is a method particularly adapted for juices having a high glucose content and its general introduction would serve to solve the jaggery problem in Hospet. Inversion losses are however apt to be high in this method.

The superiority of the jaggeries produced in the smaller pan and with reduced quantities of lime in point of colour was readily admttted by the ryots at Kampli, but they were inclined to doubt their keeping qualities. In order to test the latter point the samples were examined for their moisture absorbing power in the laboratory, The results which are set down in Table IX do not been out this contention.

TABLE I

Analysis of Cane Juices, Kampli Bottoms and Tops.

Date of analysis.	Description of particulars of canes.	Brix.	Brix Top / Brix Bottom.
8-1-1927	Canes from plot near V. Rao's mill Tops.	12·75	
"	do. bottoms.	18·65	·68
14-1-1927	do. Tops.	13·04	
"	do. bottoms.	19·56	·67

TABLE II.

Analysis of Cane Juices, Kampli.

Date of analysis.	Description and particulars of canes.	Brix corrected.	Sucrose %	Glucose %	Purity Co-efficient.	Glucose Sucrose. Ratio.
10th January 27.	Juice taken direct from mill from one head load of fresh cut canes from plot near V. Rao's mill ...	17·18	13·79	2·08	81·03	15·09
do.	Juice taken from fulltank canes from same plot ...	17·27	14·01	2·00	81·07	14·28
12th do.	Juice taken from full tank-canes from plot near V. Rao's mill ...	18·01	14·54	2 63	80·74	18·09
do.	Juice from full tank Talavar Lingappa's land ...	16·13	12·64	1·79	78·86	14·16
do.	...	16·37	12·46	2·08	76·11	16·01
do.	Tank juice, Fort mill ...	16·67	13·70	1·67	82·18	12·19
14th do.	Tank juice, Canes from V. Rao's mill near Demonstration plots ...	17·41	13·89	2·18	79·78	15·69
do.	Tank juice used for expermental boiling...					

TABLE III.

Chlorine content of cane juices, Kampli.

Date of analysis.	Description and particulars of juice.	Cl. in 100 cc.	Remarks.
13th January 27	Tank juice from Mukkanna's mill, Fort Kampli.	·098	Clarified with Kieselguhr and alum.
do.	do.	·091	Clarified with Kieselguhr and Formalin.
14th do.	Tank juice used for experimental boiling II.	·049	do.
do.	Tank juice from Bandiachar's mill.	·063	do.

TABLE IV.

Analysis of cane juices-Kampli-Bottoms and Tops.

Date of analysis.	Description and particulars of Canes.		Brix.	Brix Top / Brix bottom
14th Mar. 28.	Demonstration plot canes.	Tops.	17·47	·99
		Bottoms.	17·69	
16th do.	Canes from plot towards east of above.	Tops.	16·87	·99
		Bottoms.	17·07	
17th do.	Canes from plot further east reputed to produce best local jaggery.	Tops.	19·76	·96
		Bottoms.	20·66	
18th do.	Lingayet Guru's plot near Demonstration plot.	Tops.	18·77	·94
		Bottoms.	19·97	
8th April 28.	V. Rao's plot near Muddapuram.	Tops.	16·2	·95
		Bottoms.	17·1	

TABLE V.

Analysis of Lime Suspensions.	Sample No. 1	2	3	4		
No. of cc. of 2N (approximate) HNO_3 taken up by 1 cc. of milk of lime ...	2·5	3·5	3·0	3·2	3·05	cc.
CaO in 1 cc. ...	·140	·196	·168	1·80	·171	gms.
CaO used for one boiling (local pan) (16 cupfuls=3200cc)	448	627	538	576	547	grams
per cent CaO in juice ...	·0343	·0480	.0412	.0441	.0419	

TABLE VI

Small scale Boilings.

No.	Date of experiment.	Description and particulars of boiling.	Glucose content of juice.	pH. value of juice.	Jaggery obtained
1	21st Mar. 28.	1 pot of Demonstration plot juice boiled down with 15 cc. of milk of lime the proportion corresponding to a little less than 2 cupfuls for 18 potfuls.	...	...	Jaggery of very light colour and fairly hard.
2	22nd do.	2 potfuls boiled down with 30 cc. of milk of lime same proportion as above.	2·63	5·5	Jaggery of fair colour but not so light as above.
3	23rd do.	2 potfuls boiled down with 60 cc. of lime proportion of lime nearly same as local boiling.	1·92	6·3	Jaggery of good colour.
4	23rd do.	2 potfuls boiled down with 90 cc. of lime proportion of lime 1½ tins local boiling.	2·38	6.7	Jaggery of darker colour than above but lighter than local jaggery.

TABLE VII.

pH values of Limed juices.

	Description and particulars of canes.	Glucose content of juice. %	pH value.
A.	Demonstration plot juice limed by Samalkot man for his boiling. 2 cupfuls of milk of lime added to 18 pots of juice. 20—3—28	2·5	5·5
B.	Demonstration plot juice limed by local boiler 4 cupfuls added to 1 tankful. (18 pots.) 20—3—28 ...	2·5	7·0
C.	Juice from Lingayet Guru's plot limed by local boiler. 5 cupfuls of rather dilute milk of lime added to 1 tankful 20—3—28	2·0	6·0

TABLE VIII.

Analysis of cane juices—Kampli.

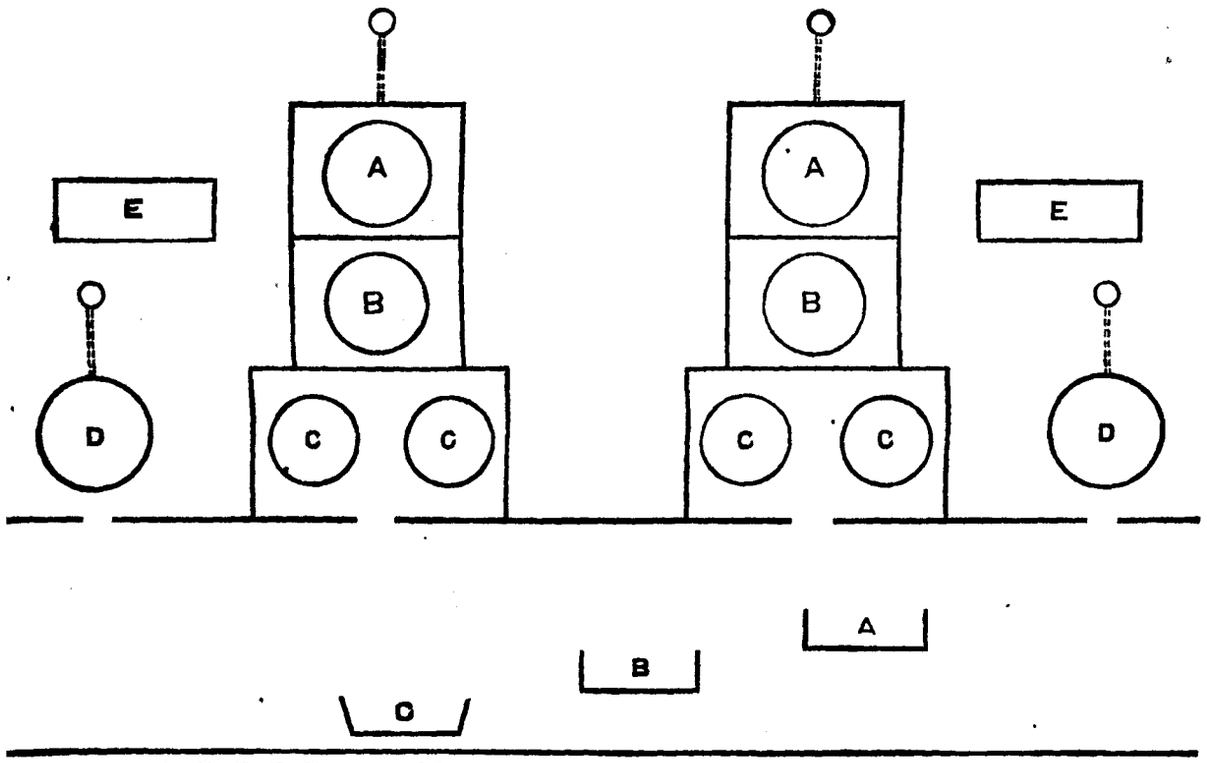
No.	Date of analysis.	Description and particulars of juice.	Brix corrected.	Glucose %	Remarks.
1	16th March 1928.	Demonstration plot canes Fresh juice used for boiling in Samalkot pan ...	17·2	2·08	Canes not quite healthy.
2	do.	Juice from field reputed to produce good jaggery. Mixed juice of tops and bottoms of six canes ...	16·57	1·85	Yields good quality of jaggery.
3	17th do.	Juice from Muslim cultivator's plot reputed to produce best local jaggery. Average of top and bottom values of juice of six canes.	20·21	1·24	Best jaggery produced at Kampli.
4	do.	Fresh juice from Lingayet Guru plot ...	16·79	1·85	
5	9th April 1928.	Bulk juice from V. Rao's plot near Muddapuram situated upland under Ramsagar channel ...	...	2·63	Yields poor jaggery.
6	15th do.	Do. do. taken towards end of harvest.	...	2·94	Jaggery obtained from this was soft as well as dark coloured.
7	17th do.	Fresh juice from aonther upland plot, Mudpuram ...	14·83	2·78	Poor jaggery.

TABLE IX.

Analysis of cane juices—Kuruvatti, Hospet, and Buksagar.

No.	Date of analysis.	Description and particulars of juice.	Brix corrected.	Glucose %	Remarks.
		Kuruvatti Juices.			
1.	31st March 28.	Juice from six average canes which had grown erect ...	21.6	·96	Soil loamy and well drained: canes planted first week of February 1927. Excellent jaggery produced by Poona method.
2.	do.	do. do. lodged canes ...	18·8	1·25	
3.	do.	do. do. arrowed canes ...	19·6	·81	
4.	do.	Pulp juice from tank ...	19·6	2·94	
		Hospet Juices.			
5.	3rd April 28	Juice from Lingappa's plot from six average canes. Mixed juice of top and bottoms ...	18·3	1·61	Black clay.
6.	do.	Juice from Rasul Sahib's plot at Chickwadgi from six average canes. Mixed juice of tops and bottoms. ...	17·2	2·5	Black clay. Jaggery produced, of poor quality
7.	5th do.	Juice from plot north of Railway line from six average canes. Mixed juice of tops and bottoms. ...	18·1	1·47	Black clay liable to be water-logged. Canes stunted in growth.
		Buksagar Juice.			
8.	17th do.	Juice from Prahlada Rao's plot from six whole canes. ...	19·3	1·39	Black clay yields very good jaggery.

Multiple furnaces at Kuruvatti



A, B, C, C, Battery of four pans, CC the lowest ones being placed at the same level.
D Single pan. E Cooling tank.

TABLE X

Moisture Absorbing Powers of different samples of jaggery.

No.	Description of Sample.	Moisture absorbed during 26 hours. per cent on dry matter.
1.	Hospet jaggery, prepared in Samalkot pan and over Sindwahi furnace ...	14·58
2.	and furnace Local pan ...	13·70
3.	Kampli jaggery prepare d in Samalkot pan and over Sindwahi furnace ...	18·21
4.	Do. Local pan and furnace ...	20·18
5.	Kurnvatti jaggery prepared according to Poona method.	15·25

Four Years' Experience of a Farm Tractor.

By Amanat Ali Habibullah, Dip: Agri.

I have about 800 acres of land under direct cultivation. A "McCormick Deering" or commonly called an International Tractor (15-30 H. P.) has been working on my farm for the last 4 years. It is being used for the following jobs:—

1. From the beginning of December till the end of March every year, for running a small ginning factory consisting of 8 gins. (The actual working days are about 75 days.)

2. From the first week of April till the break of the monsoon for ploughing.

3. In certain years, from the end of rainy season say from middle of September for a month or so, for Discing land prior to

Rabi sowing.

I would take each item separately.

Ginning Factory. (A)—The factory consists of 8 gins (Platt. Bros. single roller "Mc Carthy" cotton gins). Each gin if worked separately and the power if applied direct, requires about 2½ H. P. But as intermediate gearing or second motion shaft is used (in order to work more than one gin) some extra power is consumed, which in practice is found to be ⅓ H. P. per gin. Therefore 8 gins require 24 H. P. Mine is a 30 H. P. motor and therefore it pulls the load very easily. It is always safe and advisable to work an engine at a lighter load as it saves so much wear and tear.

(B) The factory is worked for ten hours daily (in two periods of five hours each with an interval of an hour). This gives time to factory labourers to take food and have some rest. In the meantime the driver looks to lubrication, cleaning etc.

(C) The running cost comes to about (i) Rs. 43-14-7 for the tractor and (ii) Rs. 33-7-2 for the factory (8 gins) as follows:

TABLE I.

Working cost of tractor per day :—		Rs.	A.	P.
1.	Driver at Rs. 60 per month ...	2	0	0
2.	Cleaner at Rs. 15 per month ...	0	8	0
3.	Kerosine 8 tins 4 gal. each ...	24	0	0
4.	Petrol ...	0	3	0
5.	Mobiloil 1 gallon ...	3	0	0
6.	Gear oil ½ gallon app. ...	0	8	0
7.	Grease and cotton waste ...	0	2	0
8.	Interest (Table 3 (b) 2), ...	3	9	7
9.	Depreciation (Table 3, (c) 2), ...	6	10	8
10.	Repairs and renewals (Table 3, (d) 2),...	3	5	4
	Total cost per day ...	43	14	7

TABLE II.

Working cost of Factory per day :—		Rs.	A.	P.
1. Fitter at Rs. 90 per month	...	3	0	0
2. Oilman at Rs. 20 per month	...	0	10	6
3. 9 feeder women (one per gin and one extra)	...	2	13	0
4. 3 Kapas carriers at 0-8-0	...	1	8	0
5. 2 men for filling and pressing bags	...	1	0	0
6. 2 women for removing cotton seed	...	0	10	0
7. Mochi at Rs. 20 per month	...	0	10	6
8. Ginning oil 2 gal	...	2	0	0
9. Breakage and repair (spare parts, roller washers, beltings etc.) as shown in Table 4-(d) 2,	...	6	0	0
10. Interst on the outlay table 4 (b) 2,	...	7	3	2
11. Depreciation table 4 (c) 2,	...	8	0	0
Total cost per day Rs.	...	33	7	2
Combined cost of (I and II)	...	77	5	9

TABLE III.

Interest, depreciation and spares for Tractor outfit :—

			Rs.	A.	P.
(a) 1.	Estimated to cost about	...	6000	0	0
2.	Maximum working period (on my estate).		5 months.		
3.	Average working period (ploughing on a farm or with a private owner	...	3½ months.		
(b) 1.	Interest on Rs. 6000 at the rate of Rs. 9 p. a. (The whole amount of interest is chargeable on 5 months or 150 days)	...	540	0	0
2.	Inrerest per day at the above rate	...	3	9	7
3.	Interest per acre of land ploughed (counting 5 acres a day)	...	0	11	6
(c)	Life of tractor is taken as 6 years.				
1.	The depreciation value comes to about 16·66 per cent per annum chargeable on 5 months actually worked	...	1000	0	0
2.	Depreciation per day	...	6	10	8
3.	Depreciation per acre (at 5 acres a day)	...	1	5	4
(d) 1.	Cost of repairs and spare parts as actually found (average of last 4 years)	...	500	0	0
2.	Do. per day	...	3	5	4
3.	Do. per acre	...	0	10	8

TABLE IV.

Interest, depreciation and spares for factory establishment :—

			Rs.	A.	P.
(a) 1.	Estimated to cost about Rs. 6000 (including building, construction, work erection etc.)	...	6000	0	0
(b) 2.	Interest on Rs. 6000 at Rs. 9 per cent p. a.	...	540	0	0
3.	As the working days are only 75, this amount int. i. e. Rs. 540 is to be charged on 75 days and therefore it comes to per day	...	7	3	2
(c) 1.	Depreciation 10 per cent (to be charged on 75 days only,	...	600	0	0
2.	Do. per day	...	8	0	0
(d) 1.	Cost of repairs and spare parts for the season (75 days)	...	450	0	0
2.	Do. per day	...	6	0	0

(D) The outturn of clean cotton per gin comes to about 5 maunds or 410 lbs. per day (of 10 hours). Ginning charges are Rs. 2½ per maund which gives an income of Rs. 12—8—0 per gin per day or Rs. 100 for the whole factory per day.

(E) The net income therefore comes to Rs. 22-10-3 per day.

Ploughing.

(A) Ploughing is done in summer only which in this tract (Melghat Taluq of the Amraoti district) cannot be commenced earlier than April as the cotton crop occupies a longer period, the last cotton picking is done in March and also the Wheat is harvested in that month. The working cost of ploughing by tractor per day is shown in table 5 below.

TABLE V.

			Rs.	A.	P.
1.	Driver's pay at Rs. 60 per month	...	2	0	0
2.	Cleaner at Rs. 15 per month	...	0	8	0
3.	Kerosin (5 tins for 5 acres in 10 hours or 2 gallons per hour)	...	15	0	0
4.	Petrol 1/6 gallon	...	0	6	0
5.	Mobiloil 1 gallon	...	3	0	0
6.	Gear oil ½ gallon	...	1	0	0
7.	Grease and cotton waste	...	0	4	0
8.	One pair of bullocks a cart and a driver or waterman for fetching water from well	...	2	0	0
9.	Interest (table 3, c, 2)	...	3	9	7
10.	Depreciation (table 3, c, 2)	...	6	10	8
11.	Repairs and renewals (table 3, d, 2)	...	3	5	4
	Total cost of ploughing per day	...	37	11	7

(B) From the above table we find that the total cost for loughing per day is Rs. 37-11-7 which comes to about Rs. 7-8-0 er acre (on the assumption of ploughing 5 acres a day). But his is only true for particular day or for a short period say a week r so. In actual practice we find that (i) continuous work for the whole week is never done as the driver must have atleast a day in week for rest, marketing and looking thoroughly over his machine that everything is in perfect order and for doing petty epairs etc. (ii) Similarly continuous work for the whole month s not done as (a) sometimes the driver may be required to go to own to get some repairs done there in a workshop at a blacksmith's and so on or (b) at times he might be compelled to wait or a spare part (having broken one by accident or any other ause) which has been ordered out from Bombay. If unfortunately the place where the tractor is working is at a long distance from railway or post office as in my case, considerable time s lost in transit, and therefore taking the whole month's average t is not possible to plough more than 100 acres a month.

(C) Thus counting as above 100 acres a month, the working cost of ploughing is increased per acre. The fuel and lubricating charges per acre remain constant while all other charges such as driver's pay, interest on the outlay etc., are proportionately enhanced. The ploughing charges therefore may go as high as Rs. 10 per acre.

V. DISCING.

The working cost per day is nearly the same as for ploughing but the days's work is greater. On an average 8 to 10 acres are disced. The discing charges therefore come to nearly half that of ploughing.

The soil in my tract being stiff black very big clods come up after ploughing in the hot weather. The disc harrow is therefore not a very good implement for working as a clod crusher after ploughing in the black cotton area. I use it only when the soil is moistened after a good shower of rain, or in the end of rains, for the preparation of the Rabi land.

Conclusion

1. International 15-30 H. P. tractor can be used for field and belt (for stationary) work as well.

2. It can pull 8 gins quite easily. The total cost per day (of 10 hours) for both tractor and factory (8 gins) comes to Rs. 77 —5—9.

3. The outturn of clean cotton per gin when worked with the tractor is 5 Maunds or 410 lbs. for ten hours.

4. Taking a day's average it can plough about 5 acres of land (Black cotton soil) in summer. Working cost per acre comes to Rs. 7—8—8.

5. In tract of black cotton area a power disc harrow cannot be used for breaking clouds after the land is ploughed.

6. The tractor can easily disc about 8 to 10 acres of land after a good shower of rain, the only idea being that there should be enough moisture in the soil. The working cost comes to about Rs. 4 per acre.

(From The Nagpur Agricultural College Magazine, July and October 1928).

NOTES.

British Association Meeting at Glasgow.—The presidential address in the agricultural section was delivered by Dr. J. S. Gordon and was devoted to the subject "The Live Stock Industry and its Development in the British Empire." Dr. Gordon said that "until quite recently all efforts to improve the live stock of the Empire were left to private individuals." In 1885 the first parliamentary grant for this purpose was voted and given to Ireland and since 1914 such grants have been made also to England and Wales and to Scotland. The result of all this has been considerable improvement in stock both in quality and prices. The latest figures however reveal that there is still room for much more work.

	No. of cows and calf heifers.	Bulls.	Sub-sidized bulls.	Sub-sidized to non-sub-dized.	No. of cows per sub sidized bull.
England and Wales ...	2,790,703	88,405	1287	1—69	2168
Scotland ...	460,317	17,578	937	1—19	491
Irish Free State ...	1,333,591	23,275	2205	1—11	604
Northern Ireland ...	270,283	4662	623	1—7	434

In Canada, Australia and South Africa the elimination of scrub bull has received attention.

Outside the Empire the Argentine has shown considerable progress. It was only as late as 1848 that the first Short-horn bull was imported into that country, yet in the course of the next 5 decades the improvement was so rapid that in 1895 native cattle constituted only 50 per cent of the total in the province of Buenos Aires and in 1924 this had declined to 3·5 per cent. During this latter period of 20 years the cross breds and half breds increased from 49 to 94 per cent and the pure breds from 0·6 to 2·5 per cent. In the English market Argentine chilled beef has risen in price and today sells at the same rate as English beef.

Dr. Gordon lays emphasis on the need there exists for extended reasearch along four distinct lines:—(a) animal nutrition, (b) animal diseases, (c) animal breeding and (d) marketing.

Of the four, researches in the first three seem to be of paramount importance to us in India at present. We have rapidly-expanding cattle departments in the provinces and our needs are no less than in Britisin, though the directions in which improvements are sought to be made will neeessarily vary.

Insects at Sea.—Now that so much interest is being taken in the migration of insects, it may be worth while to record that on the evening of November 2nd, 1927, when the S. S. "City of Karachy" was 18 miles off Cape Comorin, S. India, the following insects came on board; Cephonodes hylas (L), Precis orithya (L) (entered my porthole and settled at the foot of my bed, apparently looking for an Entomologist), Periplaneta americana (L) Diplacodes trivialis (Ramb) Pantala flavescens (Fb) Anax, guttatus Burm., Tramea basilaris burmeisteri Kirby, Two days latter off the south-east coast of Ceylon, Pantala flavescens (Fb), and Gryllotalpa africana Beauv. were found on board. The Odonata here recorded were: kindly determined by Lt. Col. Fraser, who says he has taken all of them except A. guttatus 40 miles off the Kathiawar Coast. The other species were determined at the Indian Museum, where a specimen of each species has been deposited. Coming down the Red sea, several specimens of Schistocera perigina (Oliv.) came on board.—T. D. A. Cockerell; University of Colorado, in the "Entomologist, October, 1928,

Y. R. R.

One way of acquiring Yellow Fever:—While working on experimental fever in rhesus monkeys at Lagos, Nigeria, West Africa, Professor Adrian Stokes was suddenly taken ill on September 15, 1927, and died four days later of yellow fever. The circumstances of his illness gave rise to the idea that the virus might pass through slightly injured, or even entirely unbroken skin. To determine this question, Dr. J. H. Bauer and N. P. Hudson made experiment at Lagos, which they described in the American Journal of Tropical Medicine for September 1928. On September 27, 1927, a single mosquito, Aedes aegypti, was allowed to bite a normal rhesus monkey No. 370. The latter's temperature rose to 105·9 F on October 1. Two drops of its blood were on that day rubbed on the unbroken skin of normal monkey 381, on a shaved

area of 382 and on a slightly scarified area of 383. Nos. 381, 382 and 383 died between October 7 and 16. Both gross and microscopical post-mortem examination of all the three monkeys gave a diagnosis of experimental yellow fever as the cause of death. Similar results in additional experiments led to the conclusion that the virus of yellow fever, when present in sufficient amount in the circulating blood of experimentally infected animals, can penetrate the intact skin and produce infection in rhesus monkeys.

—(From the Entomological News October 19, 1928) Y. R. R.

Artificial Silk:—Production of artificial silk on a commercial scale dates back to 1896 when a few hundred tons were produced in France from cellulose by the Nitro-cellulose process. Since then however other processes have been perfected and their products vary in regard to strength, fineness, lustre, intake of moisture.

Artificial silk has certain advantages over cotton, wool or natural silk and they are:—

(1) Its price is not affected by fluctuations in supply due to unfavourable weather or ravages of insect pests.

(2) Its raw material (timber) is abundant.

(3) The cost of its manufacture is more amenable to human control than are the direct products of Nature.

(4) Its production need not be limited to a particular type of climate or other natural resources.

It is not so elastic as wool nor so strong as cotton, yet possesses the advantages of softness and peculiar dyeing properties. It can be used alone or in combination with other textile materials.

Though the industry originated in France, Germany, Great Britain, Italy and the United States have forged ahead and in 1927 the three largest firms in Britain, Germany and Italy formed a combine which controls more than 70 per cent of the world's production of artificial silk.

Transport Prior to 1880 and Now:—Efficient and quick transport by sea and land is the greatest incentive to the ryot to invest in extensive areas of commercial crops. As Sir William Ellis in his address to the Engineers at the Glasgow meeting of

served, we are greatly indebted to the Engineer today for the assured safety and comfort of travel also for the prompt transport of products. Compare the movement of products prior to 1880 at the rate of a few miles an hour to freight trains running at 20 to 30 miles now and also those sailing vessels depending upon precarious weather conditions to the present day fast liners of 50 to 60 thousand tons ploughing the deep sea at 20 knots an hour even in a terrible gale. It is one of the glories of modern scientific advance that the produce of one part of the globe is transported and consumed in another part pretty quickly.

Fire Walking:—This is an old practice in this country and is always associated with certain religious activities. That the performers go unscathed seems to us to be no wonder but explainable on scientific grounds when we have the authority of Prof. Cheshire of Dulwhich who says that he thrust his hands into hot molten lead and took them out with no signs of injury.

Tractors in Western Canada.—This part of Canada seems to offer excellent facility for the use of tractors as is seen by the large scale purchase recently 6513 in 1926 and 10,026 in 1927. In 1926 there were in all 50,136 tractors working. 26,674 in Saskatchewan, 12.151 in Manitoba and 11,311 in Alberta.

A New Wonder in Science.—The human ear can perceive only sounds of comparatively low frequency. But sound of very high frequency is inaudible and when produced is, we are told, deadly in its effect. The production and study of such high frequency sound is called supersonics. Such sounds can be produced when electric currents of high frequency are passed into a crystal. Any living thing within range is killed instantaneously; for example, during an experiment a frog was tried and killed outright. This sound has remarkable effects on many other ordinary substances. It disintegrates mercury into extremely tiny pieces when kept in its range. It is said that this supersound is the nearest approach to the "death ray" yet to be discovered. Industrially no use has yet been found for this, but it can be used in preparing certain emulsions in medicine. We are told that in ancient days Rishis in India had the remarkable power of annihilating even armies by their mere look or by chanting some mantrums. Probably supersonics was known to them but was later forgotten.

S. V. D.

Mr. C. J. George M. A. One of the members of this department who left Coimbatore in September 1926 has just returned to us having obtained the Ph. D. Degree of the London University in Entomology.

Unseen Life in Drinking Water:—Besides the bacteria which can be seen only under high power microscopes, Prof. G. C. Whipple has according to "Nature" been able to calculate 187 genera— 108 plants and 79 animals in drinking water. These include organisms-like algae, fungi protozoa, rotifera, crustacea, bryozoa and sponges. All these organisms make the water unsavoury; nevertheless it must be noted that they do not thrive in polluted water i. e. water polluted by sewage. In the study of the life history of these organisms it is interesting to notice that many of them lead a symbiotic life, i. e., living one upon the other thus crustacea live upon rotifera and protozoa, these again upon algae and bacteria and so on. These organisms are found on the surface layers of tanks and lakes generally, obviously because of the sunlight that can be obtained.

The Greatest Geyser of the World:—In Yellow Stone Park in the U. S. A. a new geyser has been active since August last. Its crater is elliptical measuring 100 by 120 feet and is 8 feet deep. It suddenly bursts forth into furious activity hurling hot water in all directions up to a height of 100 ft. These outbursts occur at intervals of 15 to 20 seconds and continue for about three hours followed by a dead period of 9 hours. During this quiet period the crater is practically dry.

Bose' Travels:—Sir Jagadis Bose paid an official visit to Egypt on September 12-19, lectured and gave demonstrations on his investigations which have an important bearing on agriculture and medicine. In result a few Egyptian students will we learn be deputed to undergo training at the Bose Institute, Calcutta.

Departments Work Official Digest No 69.

MARCH—WEATHER.—The usual February—March showers failed this year in Waltair Circle. In Guntur a few showers were received and proved beneficial. Rain fell throughout the Madras circle in the last week of the month but this was ill distributed. Madura passed a practically rainless month. A heavy fall of 3·79 inches at Avanashi and of two inches at Dharapuram on one single day towards the end of the month was all the rain recorded in the Coimbatore circle. Elsewhere the month was dry.

EXHIBITIONS.—Small exhibitions were held in the following places;—Guruvayur (Malabar), Karamadai, Bhavani and Budabalu (Coimbatore); Sendamangalam (Salem); Tandonimalai (Trichinopoly); Mailam and Devanampatnam (South Arcot); Bitragunta (Nellore) and Gudivada (West Godavari). Officers of the department also attended meetings of ryots in several places.

WALTAIR CIRCLE.—J. 247 cane gave the highest yield of jaggery for some years and the demonstration of planting sets from young canes to improve germination and ensure vigor of plants proved successful on the Anakapalle station. At Samalkot the culture and harvest of plantains within a period of ten months was interesting.

From Samalkota 28,036 lb. of paddy seeds was distributed.

GUNTUR CIRCLE.—Trials of G. E. B. 24 and Co. 3 paddy strains on lands under tanks at Vinukonda were encouraging 3825 lb. and 3380 lb. of grain per acre respectively being obtained.

Manurial demonstrations with cattle manure and artificials given at Yerukalapudi were catching the combition of nitrate of soda giving the highest increase of profit i e. Rs. 211. The crop tried was sugarcane.

MADRAS CIRCLE.—140 villages were visited, 37 ploughing demonstrations were held and 114 ploughs were sold.

TRICHINOPOLY CIRCLE.—From the Aduthurai Paddy Breeding station 50,000 lb. of seed was distributed.

MADURA CICLE.—Pure Karunganni was making much headway in Tinnevelly,

COIMBATORE CIRCLE.—138 villages were visited, Six sets of new country model drills were prepared and a start made by sowing groundnuts in lines in Udamalpet.

WEST COAST CIRCLE.—The campaign against *Spodoptera* was continued. 26,432 selected cocoanut seednuts were planted in nurseries in Calicut, Nileshwar and Kasargod.

CATTLE FARMS.—96 cows and 21 buffaloes were covered by stud bulls during the month.

Students' Activities

The activities of the Students' Club recommenced with the return of third year students from a long tour in the Circars. Two papers were read by Messrs. David and Parthasarathy on the "Youth Movement". The latter quoting extensively from Sadhu Vaswani, dealt in good detail about the inauguration of the Bharat Yuvak Sangha, its aims and objects and the parallel youth leagues that were started in different countries of the world, thus emphasising the universal character of the movement. He gave a graphic account of the wonderful work that these associations could turn out, if organised as village centres, in improving the condition of the masses in rural sanitation and hygiene, in short, in rural reconstruction. He stressed the importance of physical training for youth in developing the manhood and phsique of the country. They were followed by Messrs. Sanjivi Chetty, Damodara Mudaliyar and others who spoke on the subject by way of supplementing the remarks, one of them pointing out that materialistic ideals of the West were not suited for the East. The Chairman, Mr. Muthusawmi Ayyar in winding up the proceedings made a speech bearing on the origin of the youth movement in the Western countries, which could be traced back to political origins while in India there was a wide contrast the motive power being raised into the realm of spiritualism and he concluded by saying it was up to the youth of the country to build up a strong cultured and contented nation.

On the 31st, Dr. C. J. George who recently returned from England gave a short conversation on the hostel and college life in the West, particularly in the London University on the high degree of specialisation afforded in British and continental universities and on the social and commercial life in the city of London. He observed that life in the city was very pleasant and enjoyable and that Indians were treated on a footing of equality with others everywhere except in Edinburgh Society. He contrasted the gay spirit of the Englishman with that of the hospitable and serene outlook of the Frenchman. Then a questionnaire ensued, which was patiently answered in the course of which a graphic idea of the routine of Indian students in London and the freedom they enjoy at the hands of their professors, who merely guide them, was given. The speaker also made mention of the numerous responsibilities of a post graduate student in the West where he is made to feel for himself he is worth something, which is not the case in an Indian University.

Departmental Notifications

GAZETTED.—Mr. G. R. Hilson, extension of leave for two months from 2nd November. Mr. K. S. Viswanatha Ayyar, Assistant Agricultural Chemist extension of leave for one month from 12th October. Mr. R. C. Woodford Temporary Superintendent, Central Cattle Farm, leave on average pay for 20 days from 5th November.

NON-GAZETTED :—APPOINTMENTS, PROMOTIONS, TRANSFERS ETC.

Mr. P. Abraham is appointed as Upper subordinate, V grade on probation in the Cotton section. Mr. P. S. Krishnan to officiate as assistant V grade in the Chemistry section.

The following Lower Subordinates in the IV grade are promoted as Upper subordinates agricultural section V grade from 9th October :—Messrs. S. Muthuswami Ayyar, V. M. Ramunnikidavu, D. S. Subramanya Ayyar and V. Butchi Raju and the following lower subordinates in the V grade to IV grade from the above date :—Messrs. R. Venkatarama Ayyar, A. G. Ramaswami Ayya, R. Narasimha Ayyar and P. M. Appaswami Pillai. D. Sitharamaswami, Plant collector, Paddy section to be sub assistant V grade. Mr. P. Sudarsanam Nayadu, assistant Cotton section transferred to agricultural section and posted to Guntur circle. Mr. S. Ramachandran Manager, Guntur is transferred to IV circle.

LEAVE FIRST CIRCLE.—Mr. K. Suryanarayana assistant demonstrator leave on average pay for one month from 5th October. Mr. D. Panakala Rao demonstrator leave on average pay on medical certificate for 3 months from date of relief 1—10—28.

SECOND CIRCLE.—Mr. S. Muthuswami demonstrator leave on average pay for 8 days from 12th October.

FIFTH CIRCLE.—Mr. M. Subramanya Pillai, leave on average pay for 13 days from 20th October.

SEVENTH CIRCLE.—Mr. V. K. Kunhunni Nambiyar, manager leave on average pay for 6 days from 29th October. Mr. Govindan Nambiyar, demonstrator, leave on average pay for one month and 22 days from 1st November. Mr. K. S. Ramanna Rai demonstrator, leave on average pay on medical certificate from 13th October.

EIGHTH CIRCLE.—Mr. B. Dasappa Malli, assistant demonstator, leave on average pay for one month from 5th October. Mr. P. V. Ragavendra Rao assistant demonstrator, leave on average pay for 4 months from date of relief.

LIVE STOCK.—Mr. V. Karunakaran Nayar manager, leave on average pay for one month from 4th October.

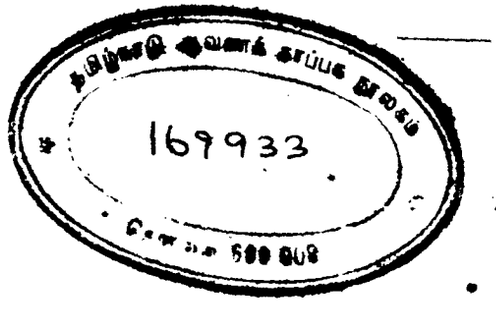
PRINCIPAL'S SECTION.—Mr. V.T. Subbayya Mudaliyar, manager, leave on average pay for 2 months and one day from 22nd October.

COTTON SECTION.—Mr. P. Gopalaratnam, assistant, leave on average pay for two months from 1st October.

PADDY SECTION.—Mr. A. Chidambaram Pillai manager, leave on average pay for three weeks from 13th October. Mr. R. Subbayya Goundan, sub assistant leave on average pay for 10 days from 22nd October.

G. E. SECTION.—Mr. R. Narasimhachari sub assistant leave on average pay for one month from 15th October.

CHEMISTRY SECEION.—Mr. B. S. Narasimha Ayyar assistant leave on average pay for 20 days from 22nd October.



(v)

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The Ramasastrulu-Munagala Prize 1929.

1. The Prize will be awarded in July 1929.

2. The Prize will be in the form of a Medal and will be awarded to the member of the Union who submits the best account, of original research or enquiry, carried out by him on any agricultural subject.

3. The subject matter shall not exceed in length twelve foolscap pages type-written on one side.

4. Intending competitors should notify the Secretary of the Madras Agricultural Students' Union not later than the 15th May the subject of the paper which they propose to submit and the paper should be sent in so as to reach the Secretary, Madras Agricultural Students' Union not later than the 1st June 1929, with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper which should be entered under a *nom-de-plume*.

5. Four type written copies of the essays should be sent in.

6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference.

7. The Union reserves to itself the right of publishing all or any of thepapers.

8. All references in the paper to published books, reports or papers by other workers must be acknowledged.

9. Papers submitted will become the property of the Union.

Any further particulars may be obtained from the Secretary, Madras Agricultural Students' Union, Lawley Rd. P. O. Coimbatore.

The Cardamom Planter

A TAMIL MONTHLY

Organ of the Travancore Cardamom Planters' Association.

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