Madras Agricultural Journal

Vol. 26 No 2

Feb. 1938

Regd. No. 1155.

THE MADRAS AGRICULTURAL JOURNAL

Vol. XXVI. February, 1938. No. 2.

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Published by

THE MADRAS AGRICULTURAL STUDENTS' UNION,
Agricultural College and Research Institute,
Coimbatore, S. India.

Annual Subscription Inland Rs. 4-0. Single Copy.
" " Foreign Rs. 4-8. As. 6.

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The Madras Agricultural Journal

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K. T. BHANDARI.

It is with deep regret we announce the death of Mr. K. T. Bhandari, Assistant Director of Agriculture, Salem, on the evening of the 12th February, at Krishnagiri, from heart failure. Mr. Bhandari was spending the evening at the local club and after a game of tennis while still chatting with his friends, suddenly collapsed and breathed his last.

Mr. Bhandari was 51 years old at the time of his death. He belonged to the second batch of "Licentiates in Agriculture" to pass out of this college. Joining service soon after graduating he served as an assistant farm manager in the Central Farm and subsequently served in the districts till 1919. The next four years he spent as an assistant lecturer in the college. He left the college in 1924 and served as a propaganda officer in the subordinate cadre till 1931 when he was promoted to the gazetted rank. At the time of his death he was, as noted above, the Assistant Director of Agriculture, at Salem.

As a student, Mr. Bhandari was good in his studies as well as in the sports ground. As an officer he was sincere and painstaking. He still has about five years more before he is due for pension and in his untimely death the department has lost an officer of ripe experience and sincere devotion to duty, which qualities, unostentatious as he was, were unfortunately not appreciated at the right quarter sufficiently early.

The late Mr. Bhandari was an active member of the 'UNION' ever since its inception and had acted as its general secretary for a period.

We offer our sincere condolences to his relatives and his many friends and colleagues in their bereavement.

The Madras Agricultural Journal.

(ORGAN OF THE M. A. S. UNION)

Vol. XXVI.] FEBRUARY 1938. [No. 2.

SUGARCANE GROWING IN THE TANJORE DELTA

By M. ANANDAN,

Superintendent, Agricultural Research Station, Adutural.

Introduction. When the price of paddy, the only staple crop of the Tanjore delta, began to fall steeply in 1930, the Agricultural Research Station, Adutural took up the trial of other crops than paddy in the wetlands from 1931 onwards so that the experience gained in growing them and the results obtained may be passed on in time to the *mirasdars* of the delta. Among the crops tried, sugarcane was one of the most important and it is proposed to give in this paper an idea of the methods adopted in growing this crop successfully on this station during the past six seasons. Neither the station staff nor the vast majority of the *mirasdars* of the delta had any previous experience of growing sugarcane in the paddy lands of this delta.

Choice of land. The question of choice of fields for growing sugarcane is of very vital importance in a delta tract with very poor natural facilities for surface as well as sub-soil drainage, as the absence of such facilities really precludes the possibility of growing canes successfully in a vast majority of the area in this delta. Out of a million acres of paddy land in the old delta, not more than 50,000 acres would be suitable for canes. But considering the few hundred acres that are under canes at the moment, 50,000 acres is a very large area, indeed, for future expansion of cane cultivation in the tract. If a careful search is made it should be possible for every *mirasdar* to select a few fields that are higher in level and better drained than the other fields in the holding. Such fields should invariably be selected for growing canes as canes refuse to grow normally in badly drained or water-logged soils.

Preliminary Cultivation. (1) *Ploughing:*—Soon after the harvest of the paddy crop in February the fields should be ploughed twice before the soil loses moisture and dries up too hard for working the plough. It is of course not an easy matter to plough the fields after harvest and get good tilth because of the waxy nature of the soil. But this procedure is far better than digging trenches for planting in an unploughed field as it has been found from experience that such fields are badly infested with weeds and are costly to maintain. In case it is not possible for any reason to plough the fields immediately after harvest, ploughing should be done soon after

a soaking rain if one is received before trenches are dug for planting. Ploughing in dry fields after a rain invariably produces excellent tilth in the heavy soils of the delta.

(2) *Trenching*:—Trenches for planting should be 15 inches broad and 1 foot deep when finished and 3 feet apart from centre to centre as it has been found that canes planted 3 feet apart in lines allow of the usual operations, e. g. weeding, manuring, earthing up, trashing and propping being done conveniently. In the first five years trenches were dug by hand labour and if the soil is fairly good tilth it takes from 25 to 30 men to do an acre. During 1936 and 1937 seasons, a double mould board plough was used to make the trenches and with a pair of animals this plough is capable of finishing 25 cents in a day of 8 hours. To get the trenches straight, ropes are laid 3 feet apart and the straight line marked at intervals of say, 10 feet, with twigs and the ropes removed before the plough is worked. With this device it is possible to get very straight trenches. By using a double mould-board plough it is possible to bring down the cost of trenching by 50 per-cent but this implement can be used only in previously ploughed fields. After the trenches are prepared, the bottom of each trench should be dug loose to a depth of 6 inches and left exposed for a few days before cattle manure is applied.

(3) *Manuring*:—A dose of 20 cartloads of well-rotted cattle manure or Indore compost per acre is applied to the trenches and the manure is well dug in a few days before planting. Care should be taken that undecomposed straw or other vegetable remains are not applied to a cane field, as such materials would attract white ants which later on would attack the cane setts and young canes in turn and kill them out in numbers.

As it is generally believed that phosphatic manuring has influence on the setting qualities of jaggery, bonemeal at the rate of 200 lbs. per acre is dug in along with the cattle manure. No other manure is applied before planting. It is a good plan to sow a crop of sunhemp on the crest of the ridges separating the rows of young canes. It was found from experience that this crop is best sown immediately after the first weeding, say a month after planting the cane setts. Both the cane and the green manure crop get ideal conditions for growth after this first hoeing. Within 40 to 45 days the sunnhemp would have attained its maximum growth when it is pulled out and applied to the cane crop by laying the plants along and close to the cane rows. 3,000 lbs. of this green manure has been found to be a fairly good dose per acre. Before earthing up and covering the green manure a dose of 500 lbs. of groundnut cake and 100 lbs. of ammonium sulphate is applied on this as a top dressing. After this, the young cane is earthed up on either side covering the manures in the operation. No further dose of manure is given thereafter, though a second weeding and earthing up are given to the crop generally in its fourth month.

Planting. Before actually planting the setts it is found better to flood and soak the trenches 5 to 6 hours in advance to break down the hard

clods and produce a soft puddle to allow of the setts being gently pressed down. When the water in the trenches has fully soaked down, cane setts with 3 buds or eyes are laid in a line along the centre of each trench with buds pointing sideways and ends of setts touching each other. The setts are then gently pressed down to a depth of 1 to 2 inches so as to have a thin layer of soil on the top of the setts. As planting is usually done in the height of summer, it is essential that the setts should be protected by a layer of soil as otherwise the exposed setts would be affected by the direct rays of the sun and killed. This precaution is not very essential when planting is done during the rainy season. It is a good plan always to dip the setts for 5 minutes in Bordeaux mixture to kill out fungus spores and mealy bugs. The number of setts required for planting an acre varies from 11,000 to 15,000 setts, depending upon the internodal lengths of the variety used.

Besides cane setts, tops of canes also can be used for planting and, in planting tops it is better to thrust the cut ends into the soil in such a way that the planted top makes an angle of 30° with the soil surface. It may be stated as a general rule that the younger a cane or part of a cane the better it would be for use as planting material. When setts are taken from a fully mature cane, the top half of the cane yields the best setts. If whole canes are to be used for setts, it should be from a crop that is 6 or 7 months old. From the trials carried out on the station, it has been found that the best sett for use is the sett immediately below the top. Cane tops though they give good germination have certain drawbacks which setts have not. They easily carry over insect pests without a chance of detection, particularly borers from the old crop to the new. Besides, as they are planted in a slanting position, canes developing from the buds at different levels have not the same anchorage as those developing from a sett laid flat and pressed into soil. There is also a general belief that canes arising from tops are the first to flower though this point has not been experimentally tested. Another defect noticed is that some of the developing buds find it difficult to come out through the leaf sheaths and require to be released by removing the leaves. Such buds get etiolated by remaining long inside the sheath and lack vigour.

Planting season From the results obtained by planting canes during every month of the year continuously for two years, the favourable season for planting canes in this delta has been found to be from January to May, the best months being March and April. January and February are early for planting because of the difficulty of preparing the fields satisfactorily immediately after harvest, though early planting gives the crop a longer period of active growth before the North East monsoon rains begin. The general experience is that a cane should have finished at least six months of vigorous growth before fields get water-logged from the heavy rains of the North East monsoon from the middle of October and before the mild spell of cold weather begins in November, as canes slow down considerably their rate of growth from the middle of October to the middle of January,

Thereafter with the advent of the bright weather, some growth takes place though not very appreciable before the canes begin to mature fast. That it is water-logging more than the cold weather that is responsible for the slowing down of growth is evident from the fairly good growth canes planted in dry lands make even during the rainy or the cold season. So to get the best results, planting should be begun from the middle of March and finished before the middle of May at the latest.

Irrigation. The irrigation season for the Cauvery delta begins from the middle of June when water is let down from the Stanley lake at Mettur for starting the cultivation of paddy. This water is available till the end of January of the following year. So from February to the middle of June water is not available from this irrigation source for the cane crop, though unfortunately it is during this period that cane crop requires the help of artificial irrigation most as it happens to be the season of severe hot weather and of very scanty and undependable rainfall. So lift irrigation of some kind is absolutely essential both for planting a new crop or for ripening an old one from February to June. Though the water table in the delta is very high, underground or sub-artesian springs are very weak, so much so that the recuperative power of wells after pumping out a supply is very poor. To give an example a 15 feet diameter well with 15 feet of water and 2 bore holes giving 40 gallons per minute on the station is pumped dry by a 7-horse power engine and 3" pump within 1 to 1½ hours and it takes more than 12 hours for this well to recoup the supply. But with the help of even such a poor well it should be possible to cultivate 5 acres of cane by careful adjustment of planting. Wherever conditions are more favourable with better sources of supply either from wells or tanks or rivers, it should be possible to command a much larger area. In the absense of good artesian springs, it is not known whether it would be possible to instal electrically operated bore well pumps as has been done quite successfully in the United Provinces. It is a subject worth investigation by the Industries and the Electrical Departments of the Government, as Tanjore District is already getting power from Pykara.

The number of irrigations that a cane crop should receive depends upon the quantity and distribution of rainfall. It has been found from experience that on an average 4 irrigations are essential for sprouting the crop after planting as the germination of a cane crop is not finished before the end of the third week after planting. As the stiff clay soil overlying the cane sett bakes too hard and hinders the young sprout freely emerging it is necessary and better to give more light irrigations at short intervals than heavy irrigations at longer intervals during the sprouting period as they help to keep the top soil moist for the sprout to emerge freely. Moreover there is no necessity for heavy irrigations for a crop that is just planted as the root zone is at this stage very narrow and shallow. The intervals between the sprout irrigations may roughly be as given below. The first irrigation on the 4th day after planting, second on the 10th, third on the 16th and the fourth on the 22nd day. Thereafter the irrigation may be once in 12 to 15 days in the absence of rain. Assuming that a crop is planted in the middle of March, at least half a dozen lift irrigations would be necessary before the receipt of channel water in the middle of June and allowing for summer rainfall. From the middle of June to the end of September water is plentiful in the channel and there may be necessity for 4 heavy irrigations during this period. Thereafter the crop gets the N. E. monsoon and there will be no necessity for irrigation. On the other hand the problem will be to drain the excess rain water from the fields in order to keep the crop healthy. In the case of canes like Co. 281, Co. 285, sorghum hybrids and similar ones that mature within 8½ to 10½ months, no further irrigations may be found necessary before the crop is harvested for milling. But canes of longer duration would require at least 3 or 4 irrigations to mature the crop from February to April the number depending upon the ripening period of the variety concerned.

Drainage. The question of drainage in a cane field should receive special attention, particularly during the continuous wet weather during the north-east monsoon rains. Cane fields should be free of stagnant water as far as possible, as otherwise the crop does not grow and becomes pale and sickly in appearance. Under such conditions fungoid diseases, particularly "red-rot" will have very favourable opportunities for development. It is better to provide drainage channels all round a cane field and connect them with the big drainage or storm water channel running through a holding so that there is no scope for rain water to remain in the cane field unduly long. These drains should be cleared of obstructions frequently to keep them always trim and serviceable.

After Cultivation. (1) *Hoeing and weeding.* When the swamp paddy fields are converted into temporary garden lands to grow other crops than paddy, weeds take advantage of the conditions to grow along with the crop and smother any young crop whether cane, soy bean, cotton or groundnut, if early precautions are not taken to hoe out the weeds. Nut-grass is the most pernicious of these troublesome weeds and difies total extinction despite all efforts at its removal. So one ought not to neglect weeding a young cane crop early enough. During the fourth week after planting a cane crop, the first weeding should be given as by that time most of the active buds should have sent out sprouts and the period of danger of injury to the hidden buds would have almost passed. The first weeding is better done by women with the small hand hoes as mammatty hoeing by men may cover up a large number of young sprouts with earth, though it is claimed that cane borers are kept under check by earthing up a cane crop as early as possible. When the crop is 2 months old a second weeding combined with a mammatty-hoeing may be given, provided no green manure crop of sunnhemp had been intersown just after the first weeding. If a green manure crop is grown, this hoeing and weeding and first earthing up can be combined into one operation when the green manure is applied to the

crop in the third month. It is possible to intercultivate the crop with a plough like Cooper No. 11 instead of hand hoeing.

(2) *Earthing up.* In the beginning of the third month young canes can be given the first earthing up. In this operation the rings dividing the cane rows is broken up and the earth so obtained is used for filling the cane trenches and forming a sloping ridge on either side of the canerow so that the canes now occupy a ridge and the interspace between rows of canes becomes a trench to serve both as drains for storm water and furrows for irrigation. A second and final earthing up is given to the crop at the end of the fourth month or in the beginning of the fifth month. The earthing-up can be performed by a double mould-board plough after breaking up the ridges with an iron plough, the finishing touches alone being given by men with mammatties. Hardly any injury is done to the crop if the operation is done before cane formation has not progressed far.

(3) *Trashing.* The removal of old or dried up leaves from a cane crop is known as trashing. When the cane crop is in its seventh month that is just before the heavy North-east monsoon starts, a trashing can be given as it will avoid rain water stagnating inside the axils of leaves and thus prevent the sprouting of dormant buds or eyes. Insects like scales, nymphs of cane flies and mealy bugs are also removed in trashing. After trashing, a cane crop looks very neat and one is able to judge more accurately the development of millable cane and to estimate the tonnage. The whole crop gets better aerated also. Another advantage in removing the cane trash just at the start of the monsoon is that it can be immediately made into Indore compost heaps for quick decomposition into manure with the help of unfailing rains at this time of the year.

(4) *Propping.* As the Tanjore delta with the rest of the East coast of the Peninsula is subject to cyclonic weather of greater or less intensity every year, particularly during the North-east monsoon months from October to January, cane crops are liable to lodge badly. Another factor which helps the canes to lodge easily is the extremely wet nature of the soil during this period which makes soil round the cane roots loose. Lodged canes have been noted to be higher in glucose content and poorer in sucrose. Jaggery from such canes does not set well because of the high glucose content. Propping of canes is done on the station by a double strand of wire made to pass along each row of cane in a series of figures of eight enclosing a clump of cane in each half of a figure of eight and securely tying the ends of the wire to horizontal bamboo props running along the margins of the cane field and at right angles to the cane rows. If the cane rows are long, one or more rows of horizontal bamboo props will have to be erected inside the cane field to prevent the wire from sagging and giving way. Spacing the horizontal bamboo props 25 feet apart has been found to secure the canes well and prevent their lodging.

Maturity of canes. Each variety of cane has its own duration of growth and maturity. The local Nanal canes mature in 8 to 8½ months, the sorghum

hybrid canes are the next to mature, Co. 351, 352, and 357 maturing within 8½ to 9½ months, Co. 353 in 9 to 10 months and Co. 355 within 9½ to 10½ months, Co. 285 within 10 to 11 months, Co. 218, 214 and 290 within 11 to 12 months. Among the thick canes Fiji B is the earliest to mature within 10 to 11 months, while all the other canes like Co. 365, 364, 400, 402, 404, 408, 417, 419, 421 and P. O. J. 2878 take between 11 to 12 months to mature while J. 247 takes between 12 to 13 months to do so. These durations are with regard to the conditions obtaining in this delta and are only approximate. Heavy manuring, particularly nitrogenous manuring is known to delay the ripening of a cane crop. The exact time for the harvest of a cane crop to get the maximum quantity of sugar or well-set jaggery has to be found out by taking Brixometer readings of cane juice of whole canes as well as juice extracted separately from the bottom halves and top halves of canes as the bottom half of a cane matures earlier than the top half. When the ratio of readings taken of top and bottom juice is 1 : 1 or in its neighbourhood, the cane can be considered as mature for harvest. A practical method which any *mirasdar* can easily carry out is actual trial boilings of juices at weekly intervals and thus time the harvest when jaggery begins to set well. When this stage is reached the aim should be to harvest and crush the canes within the shortest possible period as delay in harvesting may again spoil the chances of getting good jaggery, by over-aging of the canes.

Flowering or 'arrowing' in canes. There are certain varieties of canes that flower freely while there are others which fail to do so. 'Arrowing' is the term more frequently used for flowering in cane. People generally believe that immediately a cane sends forth its flower it is mature and ready for harvest. It is not so. From the observations made on this station during the past six seasons, it has been found that canes planted from January to the end of April or even till the middle of May invariably come into flower during the second half of October, irrespective of the date of planting. So the flowering of canes in this tract is governed more by the season than by the age of the crop. The same varieties when planted after May fail to flower in October and may make a feeble attempt at flowering in December-January. From a series of periodical chemical analysis of flowered canes carried out by the Government Agricultural Chemist at Coimbatore during more than one season it has been found that it takes at least 2 months more for such canes to mature or to begin to deteriorate in sugar content. This period should be longer in this delta and widely varying because of the season-fixed nature of flowering in October of every year, of canes planted any day after January and before June. The canes that regularly arrow on this station are Co. 218, Co. 281, Co. 213, Co. 285, Co. 351, Co. 352, Co. 353, and Co. 355.

Harvesting. The harvesting of cane can be done either with the help of an ordinary mammatty or special cane knives. In harvesting, care should be taken to cut the cane as close to the ground as possible so that very little of the millable canes are left behind. It may be worth while even to include

2 or 3 inch lengths of cane below the ground level, if such portions can easily be cleared of adhering roots and earth. The cane is stripped of all the old leaves till the whorls of leaves at the top are reached. These leaves are not easy to strip and so the top of the cane is cut off and the cane sent to the mill for crushing. Canes should be milled and converted into jaggery or sugar immediately after harvest, as otherwise harvested canes particularly in the hot months, begin to deteriorate. So the quantity of cane to be harvested should depend upon the capacity of the mill and the boiling equiments. Four to five boilings can be conveniently taken in a day of 8 to 10 hours and would consume about 1 to 1½ tons of cane. Thus a 30 ton cane crop in an acre would take about 20 days to harvest and mill, with a bullock driven mill. If canes are sent to a factory, any area can be cut and despatched, depending upon the labour and transport facilities available each day.

Yield. The yield of cane crop depends on the variety, the soil conditions and treatment given to it. Under the treatment given and the conditions prevailing at the Aduturai Station, the following may be given as the average yields of the various canes so far grown. The maximum yield given by some of the canes are also given, so that one may be aware of the potentialities of each variety when grown under favourable weather and other conditions.

Statement showing yields of cane crops.

Variety.	Planted crop		Ratoon crop
	Average yield per acre in tons.	Maximum yield per acre in tons.	Yield per acre in tons.
Thin Canes			
Reed cane.	15·0	18·0	18·0
Co. 213	28 0	33·3	21·8
,, 214	,,	26·3	—
,, 281	30·0	37·3	23·6
,, 285	30·0	39 9	27 1
,, 290	28·0	41·7	25·3
Sorghum Hybrids.			
Co. 351	25 0	—	34·4
,, 352	28·0	—	40·9
,, 353	30·0	—	40 0
,, 355	30·0	—	36·8
,, 357	25·0	—	29 1
Thick Canes.			
Co. 363	35·0	43·8	—
,, 364	35 0	—	—
,, 400	32 0	35 1	—
,, 402	35 0	44·6	—
,, 404	30 0	40·3	—
,, 407	32·0	42·5	—
,, 408	30 0	33·1	—
,, 413	*	45 8	—
,, 416	*	45 3	—
,, 417	*	29·2	—
,, 419	*	61·6	—
,, 421	*	57·1	—
J. 247	32 0	38 3	—
POJ. 2878	35 0	40 0	—
Fiji B	30·0	—	—

* Grown for the first time in bulk.

Ratooning. Canes were ratooned on the station every year and from the results obtained, it may be stated that generally speaking, thin canes particularly Co. 281, 285, 290 and 213 and sorghum hybrids ratoon well. The yield of a ratoon crop has averaged between 20 to 25 tons while in 1936-37, ratoons of some sorghum hybrids touched 40 tons. It is not advisable to ratoon canes more than once for various reasons, particularly for fear of diseases and insects getting a firmer hold of such crops.

Canes suitable for the delta. Co. 281 has been found to be the best all round cane for the conditions of this delta. It matures fairly early, gives fair tonnage, is highly priced for both jaggery and sugar making, and withstands water stagnation remarkably well. For these reasons, this cane is the one that has been keenly taken up by the cultivators in this delta. Co. 285 also grows equally well, resists water stagnation and equals or even excels Co. 281 in tonnage but it is not in favour with the *mirasdar* or the factory as it is very hard to trash, and very difficult to crush because of the extreme hardness of the rind and consequently never gives more than 60% extraction. Fiji B (Badila) is a cane that does well under local conditions but such conditions are rather difficult to obtain. Among the sorghum canes, Co. 353 is fairly early, grows better and gives fair tonnage. Co. 351, 352 and 357 are early but the tonnage is not high. Among the thick canes Co. 419 seems to be the most promising cane, closely followed by Co. 421. Other thick canes that are of promise are Co. 363, 364, 402, 417 and POJ 2878.

Fungoid and virus diseases of Canes. Red rot *(Colletotrichum falcatum)* and Smut *(Ustilago Sacchari)* are the two fungoid diseases noted on the cane crop here. These diseases have occurred only in very mild forms so far. Smut is confined to only one variety Co. 213 while other varieties have been so far free from this disease. Rigid selection of setts from healthy clumps of canes is one method of keeping down and even freeing the cane crop of these diseases ultimately. In the case of smut it is better to uproot the affected clumps after covering the smutted tops with a gunny and burn them. Another method to avoid the spread of this disease to other varieties is the total exclusion of Co. 213 in the cropping. Of the virus diseases 'mosaic' disease of sugarcane is one. Fortunately this disease has not so far been noted on the cane crop on this station and it is believed that cane crops in this delta are also so far free from it.

Insect pests of cane. The list of insects noted on the cane crop in this delta is fairly long and in some cases the ravages of these pests have been severe particularly of the cane borers and cane flies. The more important of the pests and the methods for their control are given below :—

The Cane borers (*Diatraea sticticraspis*, H; *D. venosata*, W; and *Scirpophaga auriflua*, M.): The first two bore into the young canes and cause dead hearts. Dead hearts may be pulled out and destroyed. A Chalcid parasite—*Trichogramma minutum*—has been found in large numbers parasitising the egg-masses. The last one commonly known as the

cane white borer—is a pest of young and grown up canes. It bores into the stem from the top shoots unlike the other borers. Eggs are laid in masses and covered with brown hairs. Eggmasses may be collected and destroyed. In cases where dead hearts are prominent these may be pulled out and destroyed. Various parasites have been collected from the larvae.

The cane flies (*Pyrilla perpusilla*, Gr.) : The nymphs and adults suck the juice from the tender leaves. Light traps are effective against adults. Leaves containing eggmasses and nymphs can be clipped and burnt. A Drynid parasite - *Dryinus purilla*—has been noted on the nymphs and eggs are found attacked by Chalcid parasites.

The cane mealy bug (*Repersin Sacchari*, Gr.). The bugs suck the juice from the leaves and stem. Healthy setts may be used for planting.

Termites (*Odontotermes obesus*, R.): These bore into planted setts and kill the tender shoots. Fields showing attack of the pest have to be irrigated with water containing crude oil emulsion. The pest is often serious in virgin fields.

The cane Hespid (*Telicota augias*, L), the hairy caterpillar (*Euproctis scintillans*) and the scale insect (*Aclerda japonica*, N) have been noted on the cane occasionally.

Cost of cultivation. The cost of cane cultivation is a fairly heavy item of investment and depends on the level of wages paid to men and women and also the cost of manures applied. Cost of cultivation including cost of setts and harvesting charges per acre may vary from Rs. 150 to 175. The level of wages adopted on the station is 5 annas a man and 2 annas a woman per day. The average cost of cultivation for various items involved in growing a cane crop is given below. If the cost of setts and of propping is not taken into account, the charges would be approximately Rs. 100 to 125 per acre, as propping is hardly done by any mirasdar though it is essential while setts are taken from non-millable portions of one's own cane crop, mostly tops. This item may also be safely omitted. The net profit from a cane crop again depends upon the yield of cane, the market price of jaggery or the price paid by the sugar factory when canes are sold to a neighbouring factory. From a 30 ton yield from an acre, the net profit that may be expected is anything from Rs. 75 to Rs. 150.

Average cost of cultivation of a cane crop in Tanjore delta.

(Area: 1 acre).	Rs. a. p.
4 courses of ploughing.	10—0—0
Trenching	6—0—0
Manures and manuring.	
20 cartloads of cattle manure at 8 annas per cartload	10—0 0
200 lbs. bonemeal	6—8—0
100 lbs. ammonium sulphate	5—0—0
500 lbs. groundnut cake	15—0—0
Carting and applying the above manures	5—0—0
Sunnhemp leaves—Cost of seed, sowing, collecting and applying	3—0—0
12,000 setts at 2—8—0 per 1,000	30—0—0
Planting setts.	6—0—0
Weeding	3—8—0
Earthing up	12—0—0
Trashing (twice)	7—0—0
Propping	18—0—0
Irrigation and drainage	8—0—0
Harvesting	30—0—0
Total	175—0—0

The cost of converting one ton of cane into jaggery comes to Rs. 3.

STUDIES IN SUGARCANE JAGGERY

IV. Some Properties of Jaggery in Relation to Moisture.*

By T. VARAHALU, B.A., M. Sc.,
Agricultural Research Institute, Coimbatore.

In an earlier communication (1) the long felt need for a systematic investigation into the several probable factors which govern the differential properties exhibited by jaggeries, as they are available in the market, was indicated. In it, a preliminary review of the results of such an investigation was also given briefly. In what follows are embodied the results of the study made to understand the properties of jaggeries, in respect especially of their relations to various degrees of relative humidity.

For purposes of the present study, only two types of jaggeries, the distinctly good and the distinctly bad ones, were selected, based on the following empirical tests. It may be mentioned here that a number of samples of medium quality were also studied, but as their properties stood between those of the good and the bad ones, they are not included in this paper.

Test.	Good Jaggery.	Bad Jaggery.
1. Appearance & Consistency.	Generally dry, hard crystalline rigid solids.	Generally damp & some times sticky solids; (occasionally pastes & liquids also).
2. Grinding or crushing.	Reduced to a powder. The powder sometimes lumps up.	Soft pastes, which sometimes spread.
3. Sound produced when struck againt a hard object.	A metallic sound is produced.	Only a thud is caused.
4. A scratch made on its surface.	It is white and persists as such for a long time.	No white streak is formed at all.
5. Pin point penetration.	It does not penetrate; it sometimes bends.	Penetrates easily and quickly.

* Paper presented before the twenty-fifth session of the Indian Science Congress held at Calcutta, 1938.

Experiment 1. A few good and bad jaggeries were exposed in duplicate to identical conditions of relative humidity and temperature, which ordinarily favour loss of moisture. At the end of eight days they were all weighed tentatively. It was found that they all lost moisture as expected.

The figures point out that under the same conditions of humidity and temperature, the good type of jaggeries part with a far greater proportion of their moisture than the bad jaggeries. Further, the bad jaggeries retained considerably more water than the good ones. These observations hold good independently of the magnitude of their initial moisture contents.

Table I.

Moisture Contents of Jaggeries after Eight Days of Exposure to Dry Conditions.

Sample No.	Initial Moisture.	Moisture content at the end of eight days (dry basis).			Moisture loss (%) of initial moisture.
		'A'	'B'	Average	
	%	%	%	%	%
		Good Jaggeries.			
(9)	7·00	1·07	1·11	1·09	84·33
(10)	5·56	1·02	1·03	1·03	81·66
(15)	6·22	1·46	1·97	1·72	72·51
(18)	5·84	1·10	1·01	1·06	81·85
		Bad Jaggeries.			
(13)	7·57	4·25	3·88	4·07	46·24
(36)	7·10	3·98	4·04	4·01	43·52
(40)	5·36	3·17	3·08	3·13	41·78
(41)	6·24	3·54	3·68	3·61	42·15

Experiment 2. In order to ascertain how jaggery responds to different degrees of relative humidity, some typically good and some typically bad jaggeries were placed in enclosed atmospheres of the following relative humidities:

(i) 0·00%, (ii) 50%, (iii) 60%, (iv) 75% and (v) 100%. The temperature was maintained throughout the period of the experiment at 27°C by placing all the desiccators, containing the sulphuric acids of the requisite strengths, in an incubator kept at that temperature. The samples were weighed from time to time until equilibrium was attained, as evidenced by the constancy in weight. The original moistures in the samples were determined separately. In the cases of the samples R and T placed in 100% humidity chamber, it was observed that towards the final stages, there were signs of fungus growth, and consequently their final weights were taken at that stage.

The results are presented in Table 2.

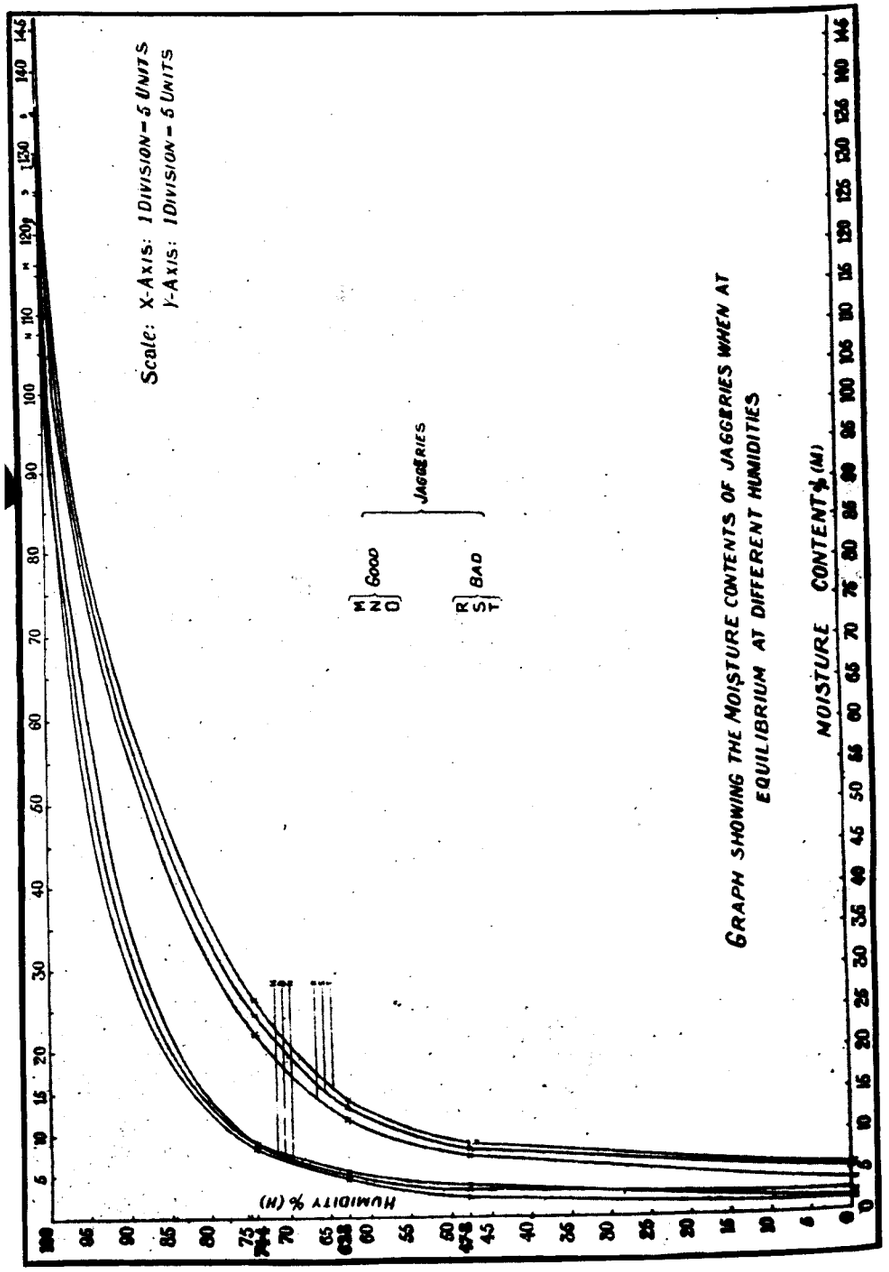


Table 2.

Responses of Jaggeries to Different Relative Humidities at 27°C.

Sample No.	Initial moisture %	*Relative Humidities (27°C).* 0·00% Moisture at equilibrium.	0·00% Moisture loss.	50% Moisture at equilibrium.	50% Moisture loss.	60% Moisture at equilibrium.	60% Moisture loss.	75% Moisture at equilibrium.	75% Moisture loss.	100% Moisture at equilibrium.	100% Moisture loss.
					Good Jaggeries.						
(M)	4·93	1·30	73·65	2·25	54·37	4·75	36·52	8·40	Gain	116·30	
(N)	7·78	1·83	76·08	3·58	53·98	5·55	28·61	8·92	Gain	107·40	
(O)	5·14	2·73	46·88	3·43	33·27	5·37	Practically no change.	8·92	Gain	134·80	
					Bad Jaggeries.						
(R)	10·63	3·95	62·85	7·34	30·95	11·96	Gain	22·41	Gain	124·40	
(S)	11·98	5·10	57·42	8·00	33·22	13·50	Gain	24·70	Gain	125·05	
(T)	12·83	5·56	56·75	8·74	32·03	14·12	Gain	26·23	Gain	130·00	

Note: (i) **The moisture loss represents the percentage of the initial moisture.**

(ii) **The moisture at equilibrium represents the moisture content calculated on dry basis.**

The moisture contents at equilibrium in the several humidities are also represented graphically. (Plate I).

From an examination of the data and of the graphs the following points become apparent:

1. (i) At equilibrium in any given humidity below 100%, the bad jaggeries always retain more water than the good ones. This confirms the observation made in the preliminary Experiment 1.

(ii) While the actual moisture contents vary with the degree of humidity, the relative differences between the two types of jaggeries are however always maintained.

These observations connote that with considerably unequal amounts of water in them, both the good and the bad jaggeries have the same vapour pressure when at equilibrium in any given humidity. From this it follows, that the conditions in the two types of jaggeries may be so fundamentally different, that at any given humidity and temperature, more water is bound up with far greater tenacity in bad jaggeries than in the good ones, thereby rendering it unavailable for further evaporation under those conditions.

It may be mentioned here that in subsequent communications it will be shown that the two kinds of jaggeries differ conspicuously in their gross structure and in their microtexture, and also in the qualities of the impurities contained in them.

The observations in this experiment also seem to argue for the probable existence in jaggery of water in two forms, as the "free" and the "bound" water and that under any given set of conditions, this bound water is greater in the bad jaggeries.

Jaggery. $nH_2O + x$ Free Water—> Jaggery. mH_2O

where the value of x is indefinite and depends mainly on external factors of humidity, temperature and wind velocity etc., while n is conditioned mainly by factors internal to jaggery. This may be considered as a quality factor.

It therefore looks to be possible that the amount of water bound up in jaggery at equilibrium at any given humidity below the saturation may go to serve as a measure of the quality of the jaggery.

2. The curves showing the moisture contents (Fig. 1) of the two types of jaggeries are conspicuously separated, and their slopes are characteristic. Their continuity and smoothness are also significant in that they indicate no sudden changes in the nature of the forces holding the water and they are further suggestive of the probability that the water in the jaggery is held by forces of absorption.

3. At 50% relative humidity both the good and the bad jaggeries parted with their moisture. At 60% relative humidity the bad ones actually absorbed more moisture, while the good ones were still loosing it. At 75% humidity both types were taking up water. It would thus appear that between 50% and 60% relative humidity, there may lie an optimum humidity wherein the hygroscopic tendencies of both the types of jaggeries would not be manifested. This property may be useful in the study of the conditions for the storage of jaggery in bulk for commercial purposes.

Experiment 3. Both the good and the bad jaggeries were found to take up moisture at and above 75% relative humidity. Hence, to follow their rates of absorption of moisture 75% and 100% humidities were chosen. The samples of the 'A' and 'B' series used in Experiment 1 with their moisture contents after eight days of exposure to the dry atmosphere, were placed respectively in the 75 and the 100 per cent. humidity chambers. The progressive absorption of moisture was followed at intervals of two hours for a period of 32 hours. The concomittant changes in the consistencies of the jaggeries during the period were also noted.

At the end of this period the samples in the 'B' series which were placed in the 100% humidity chamber were rejected, and those of the 'A' series were allowed to continue to remain in the 75% humidity until equilibrium was attained, which took 28 days. (Tables 3 & 4).

Table 8.

Progressive Moisture Contents of Jaggery in 75% Relative Humidity.

Time in hours	Moisture content %	Consistency	Moisture content %	Consistency	Moisture content %	Consistency	Moisture content %	Consistency
				Good Jaggeries				
	(18)		(9)		(10)		(15)	
0	1·11		1·01		1·02		1·46	
2	2·05		2·04	dry	1·30		2·24	
4	2·78		2·91		1·22		2·95	
6	3·34		3·55		1·85		3·46	
8	3·91		3·76		2·36		4·14	
10	4·26		4·35	Moist but	2·69		4·59	
12	4·55		4·78	crystalline	3·07		4·96	
14	4·87	dry	5·17		3·18		5·42	
16	5·15		5·61		3·38		5·74	
18	5·29	moist but	5·91		3·38		5·93	
20	5·50	crystalline	6·11		3·53		6·17	
22	5·65		6·38	Moist appear-	3·63		6·38	
24	5·79		6·40	ance, but	3·65		6·54	
26	5·79		6·46	crystalline	3·63		6·56	
28	5·79		6·46		3·63		6·59	
30	5·88	" " "	6·46		3·60	The driest of	6·66	
32	5·88	" " "	6·34	Very moist appearance, but cryst.	3·60	all	6·70	Very moist but cryst.
28 days	10·53		11·72		7·57		12·13	
				Bad Jaggeries.				
	(13)		(36		(40)		(41)	
0	4·25		3·98		3·17		3·54	Moist
2	4·55	Moist	4·33		3·48		3·89	
4	4·81		4·66		3·70		4·19	
6	4·98	Extremely	4·83	Very moist	3·88	Extremely	4·43	
8	5·25	moist	5·14		4·22	moist	4·83	
10	5·44		5·75		4·37		5·00	
12	5·62		5·65		4·54		5·19	
14	5·80		5·96	Extremely	4·76	Tending to	5·48	
16	6·02		6·19	moist	4·91	collapse &	5·65	Extremely
18	6·19	Collapsing	6·26	Tending to	5·03	dissolve	5·77	moist
20	6·27		6·44	dissolve	5·19		5·93	
22	6·37		6·62		5·21		5·93	
24	6·52		6·82		5·35		6·07	
26	6·53		6·84		5·41		6·17	
28	6·58		6·95		5·42		6·23	
30	6·69		7·16		5·53		6·32	
32	6·77	" "	7·26	" "	5·63	" "	6·42	Collapsing
28 days	15·31		15.95		13.74		15.55	

Table 4.

Progressive Moisture Contents of Jaggery in 100% (Saturated) Relative Humidity.

Time in hours.	(18) Moisture content %	(18) Consistency.	(9) Moisture content %.	(9) Consistency.	(10) Moisture content %.	(10) Consistency.	(15) Moisture content %.	(15) Consistency.
			Good Jaggaries.					
0	1·01		1·11		1·03		1·97	
2	5·05		5·76		5·83		5·52	
4	7·94		8·50		10·10		8·00	
6	9 74	Extremely	10·78	Extremely	12·67	Very moist.	9·54	Very moist.
8	11·25	moist.	12·86	moist.	14·74		10·16	Collapsing.
10	12·53	Collapsing.	14·33	Dissolving.	16·48	Collapsing.	12·37	
12	13·59		15·49		18 80	Running.	13·41	Running.
14	14·79		17·04		20·17		14·70	Running.
16	16·06	Running.	18·46	Running.	21·91		15·89	
18	17·12		19·61		23·17		16 90	
20	18·01		20·46		23·93		17 78	
22	18·78		21·32		25·26		18·84	
24	19·87		22·20		26 63		19 83	
26	20·64		22·98		27·32		20·58	
28	21·26		23·55		27·76		21 23	
30	22·24		25·26		29 97		22·86	
32	23·46	¾ soild.	26·32	¼ soild.	31·49	¼ solid.	23·95	¼ solid.
			Bad Jaggaries.					
0	3 88		4·04		3 08		3 68	
2	6·91	Extremely moist.	7·12	Extremely moist.	5·36	Very moist.	6·23	
4	9·15	Collapsing.	9·46	Collapsing	6·26	„ „	7 74	Extremely moist.
6	11·15	Running.	11·83	Running.	8·37	„ „	9·23	Collapsing.
8	12 94		13·96		9·60	Collapsing.	10·64	Running.
10	14·62		16·03		10·69	Running.	11 99	
12	16·07		17·77		11 68		13·16	
14	17 09		20·61		13·12		14·80	
16	19·80		22 58		14·46		16·22	
18	21·24		24·74		15·59		17 46	
20	22 30		26·38		16·37		18·24	
22	23 41		28·09		17·10		19·13	
24	24·67		30·52		18·19		20·20	
26	25·58		31·03		19·14		21·38	
28	26·35		32·02		19 93		22·12	
30	27·88	A thin	34·80		21·56		23·78	A thin fluid.
32	29 12	fluid.	36·14	A complete liquid.	22·69	The whole except a ¼th is liquid.	24·80	A speck of solid.

The data reveal some very interesting properties of jaggeries.

1. The good and bad jaggeries differ markedly in their rates of absorbing moisture as brought out by the following figures taken from Table 3.

		Good Jaggeries. 18	9	10	15	Av.	*Bad Jaggeries.* 13	38	40	41	Av.
(1)	Initial moisture %	1·11	1·07	1·02	1·46	...	4·25	3 98	3·17	3 54	...
(2)	Moisture after 32 hours %.	5·88	6·43	3·60	6·70	...	6·77	7·26	5·63	6 42	...
(3)	Moisture absorbed in the interval %	4·77	5·36	2·58	5·23	...	4·84	2 52	3·28	2 49	2·79
(4)	Moisture at equilibrium after 28 days %	10·53	12·72	7·57	12·13	10·48	15·31	15 95	13·74	15·55	15 14
(5)	Moisture absorbed after stage (2) %.	4·65	5·29	3 97	5 43	4·49	8·54	8·69	8·11	9 13	8·62
(6)	Moisture absorbed in the entire period %	9 42	10·65	6·55	10·67	9 32	10·06	11 97	10·57	12·01	11·40

During the first 32 hours, the good jaggeries absorbed considerably more moisture (av. 4·85) than the bad ones (av. 2·79). In the second period extending up to 28 days, the moisture taken up by the bad jaggeries, is this time, far in excess (av. 8·62) of what is absorbed by the good ones, (av. 4·49).

Thus it becomes evident that good jaggeries take up less total moisture at greater rates, while the bad ones, under the same conditions, take up more water, but at considerably slower rates. This property argues for the probability that a good jaggery possesses a more open texture.

2. An examination of the moisture contents of jaggeries at certain phases in their consistencies which are presented below, as taken from Tables 3 & 4, reveals another important property by which the good jaggeries distinguish themselves from the bad ones, in that the former characteristically possess a greater strength of surface.

Moisture Contents of Jaggeries at certain Phases in their Consistencies.

Sample No.	100 % Relative Humidity Phase I	Phase II	Phase III	75 % Relative Humidity Phase I	Phase II	Phase III
			Good Jaggeries.			
(18)	9 74 to 11·25	12·55	14 79	5·88 Very dry	Not Reached	Not Reached
(9)	11·78 to 12 86	14 37	17·04 to 18·46	6·43 Just damp	„	„
(10)	12 67	14·74	18·80	3·60 Very dry	„	„
(15)	9 57	10·15	13 41	6·70	„	„
			Bad Jaggeries			
(13)	6 91	9 15	11·15	4·81 to 5·25	6 02 to 7 66	Not reached
(36)	7·12	9 46	11·83	4 82 to 6·18	6·26 to 7 26	„ „
(40)	6·26	9 60	10 69	3 88	4·54 to 5 63	„ „
(41)	7·74	9 23	10 64	5·64	6·61	„ „

Note: Phase I: When they are extremely moist
Phase II: When they just indicate a tendency to collapse
Phase III: When they begin to dissolve and run into liquid

It will be seen that in 75% relative humidity, the good jaggeries, with about the same moisture contents, ranging from 3% to 7%, as the bad ones, were still looking drier, and were within Phase I, while the bad ones already entered on Phase II.

Again, in 100% relative humidity all the three phases were attained by both the types of jaggeries, and at every phase, the good ones are conspicuous by their containing larger amounts of water than the bad jaggeries.

Thus, the good jaggeries are indicated to possess a greater strength of surface and are as such capable of holding considerably large amounts of water in surface solution, without collapsing or yielding their structures. In this respect the bad ones are too poor. With comparatively lower moisture contents these yield and change their shapes permanently.

The significance of these properties of jaggeries of the two types, and their responses to the changing seasonal and humidity conditions were discussed in the previous communication (loc. cit. 1).

II

A reference to literature showed that not much work was done on the relation of jaggeries to moisture. Only two references were to be had in this regard. Krishnamurti Rao and Ganapathy Aiyer (2) studied the moisture absorption of jaggeries prepared by them from a number of varieties of cane under known and controlled conditions. They prepared jaggeries (i) with and without addition of lime and (ii) with addition of substances like glucose, sodium chloride and potassium sulphate etc., to juice. They reported moisture contents of these jaggeries in saturated humidity after exposure for 9 days and for 26 days.

Lakshmana Rao (3) reported the moistures absorbed by jaggeries, prepared by him using different types of pans and furnaces, in 26 hours in saturated humidity.

The writer's data indicate that in about 26 days of exposure to any given humidity the equilibrium was almost attained, and that in the saturated humidity series the total amounts of water contained in the samples at equilibrium was in every case much above 100 per cent. calculated on dry matter. Thus these figures are nowhere within comparable limits of those given by Krishnamurti Rao and Ganapathy Aiyer. Their highest figure for total moisture was 38·9 after 26 days in saturated humidity, and the lowest was 5·6.

Taking the figures given by Lakshmana Rao who kept the jaggeries for 26 hours in saturated humidity, they appear to agree well with those of the writer. The writer's figures for moistures absorbed in 100% humidity after 26 hours range from 20% to 30%, while those of Lakshmana Rao vary from about 15—20%. The figures of Krishnamurti Rao and Ganapathy Aiyer given as moisture contents after 26 days compare with what the writer got in about 32 hours.

It must however be mentioned here that the details as regards the exact experimental conditions which obtained in the experiments are not mentioned by these workers.

Summary and Conclusions. 1. Responses of jaggeries, classified into good and bad ones based on some empirical tests, to different degrees of humidity, viz., 0 ', 50%, 60%, 75% and 100%, were studied.

2. The good and the bad jaggeries are sharply contrasted in their properties:

(i) The good jaggeries have a more open texture.

(ii) They contain comparatively smaller amounts of water when at equilibrium in any humidity below 100%.

(iii) They possess a far greater strength of surface, and are as such capable of holding large amounts of water in surface solution without collapsing or yielding their structure.

The bad jaggeries stand in striking contrast in all these respects.

3. It is probable that the water in jaggery is held by forces of absorption. There is evidence to suggest that the total water in jaggery might be existing in two forms as the "free" and the "bound" water, and that the "bound water" is held by forces of absorption.

4. It was suggested that the moisture content of jaggery at equilibrium in any given humidity below the saturation might serve as a reliable measure or single value to qualify and evaluate the quality of a given jaggery.

5. An optimum humidity might be lying between 50% and 60% relative humidity, in which both types of jaggeries would not manifest their hygroscopic tendencies. This observation, it was suggested, might prove useful in any study of the conditions for the preservation of jaggeries on a large scale.

The author takes this opportunity to express his grateful thanks to Rao Bahadur B. Viswa Nath, Director, Imperial Agricultural Research Institute, New Delhi, and to Mr. P. V. Ramiah, The Government Agricultural Chemist, Coimbatore, for the facilities and encouragement, they afforded throughout the course of the investigation.

References.

1. Varahalu, T., Physico-chemical Studies on Sugarcane Jaggery: *The Madras Agri. Jour.* XXIII: 389—393 (1935).
2. Krishnamurti Rao, K. and Ganapathy Aiyer, G., Jaggery—Raw Sugar—or Gul: *Jour. Madras Agri. Students' Union*, XI: 266—278 (1923).
3. Lakshmana Rao, T., Jaggery Making in Hospet and Suggestions for Its Improvement. *Madras Agri. Jour.* XVI: 414—434 (1928).

THE ECONOMIC ROLE OF HORN WORMS (*Sphingidae*) WITH SPECIAL REFERENCE TO S. INDIA*

By Dr. T. V. RAMAKRISHNA AYYAR, B.A., Ph. D.,
Retired Government Entomologist, Madras.

As all entomologists are aware, horn worms are the larvae of moths belonging to the family *Sphingidae* known popularly as hawk moths. Though these insects are not so very important from an economic stand-point compared with the caterpillars of such groups of moths as the Noctuidae (cut worms etc.), Pyralidae, (leaf caterpillars) Arctiidae (Hairy caterpillars), etc.; some horn worms occasionally come to some prominence not only as pests of cultivated crops, but also in some other respects. This paper is an attempt to bring together our knowledge of the general bionomics of Indian Sphingids which possess some economic importance with special reference to S. India. We have so far records only of three sphingids of economic importance from South India *vide* Fletcher's book published* in 1914 though Hampson, Lefroy and latterly Fletcher refer to about a dozen forms from all over India. In view of the fact that our knowledge of these insects has considerably increased since then, and since we have no connected or upto-date account of these insects from S. India, this paper is an attempt in that direction; as far as the writer is aware - the only recorded publication on any sphingid from S. India since 1914 is the one by the present writer on the bionomics of *Polyptychus dentatus*, Cr. In the present paper brief notes on all the Indian forms so far noted to have any economic importance are added with special reference to forms noted in S. India. In all fifteen species are included; a few remarks on the striking features of sphingids in general are also added to make the paper somewhat comprehensive of the whole family.

General Bionomics of Sphingids. Among moths (Heterocera) including numerous families the Sphingidae (hawk moths) include insects which are some of the biggest stout built and beautiful moths known. They are found chiefly in the tropical regions. Their stout body and quick dashing flights have gained them the name of "hawk moths". The life histories and habits of almost all the members of the family are similar—the larvae feeding and developing on plants only. The fairly large oval eggs are laid singly on the specific food plant and the caterpillars that emerge are generally stout and cylindrical and in some cases grow to a length of four or five inches by the time they pupate. The special characteristic of hawk moth caterpillars, not found in most other caterpillars, is the possession of a dorsal horn on the apical abdominal segment hence known as hornworms. It is median in position and may be curved or straight, smooth or tuberculated

* Paper read at the Indian Science Congress (Entomology Section), Calcutta, January 1938.

and long or reduced in different species. In one case however, *Polyptychus dentatus*, L. the writer noted a horn like process on the head also during the earlier larval stages—a character quite uncommon and unique in the family. Hawk moth caterpillars often assume frightening attitudes by raising their front part and assuming the form of the sphinx; hence they are known also as sphinx caterpillars. Some of them also possess in addition to the anal horn bright ocellar spots on the thorax which appear like eyes and these evidently act as protective adaptations. The full grown larvae generally pupate under the soil, often under a cocoon of soil. The pupa is generally of large size and two types of them are found among the members of the family; one similar in form to that of all moths—a compact chitinous object; the other type, which is peculiar to some hawk moths only, is known as the jug handle pupa—since in this type the proboscis sheath of the chrysalis is separated from the main body and attached to it, this modification appearing like the handle of a water jug. The adult moths, as already noted above, are stout built creatures, active fliers and generally crepescular and nocturnal in habits, though a few are sometimes found flying during day time. Similar to other caterpillars horn worms are also often subject to the attacks of parasites and other natural enemies. The writer has once reared from a single larva of the nerium hawk moth (*Deilephila nerii*) as many as sixty eight individuals of a parasitic wasp (*Megarhogas theretrae*, V). From the egg of the cardia sphingid (*Polyptychus dentatus*, C) he also got a minute chalcid parasite (*Anastatus coimbatorensis*, G). From another sphingid larva that of (*Macroglossum vialis*) a braconid wasp *Microplitis sp.* was also reared. Parasitic flies also have been found to attack these caterpillars. The tachinid fly *Sturmia atropivoria*, RD, has been reared in numbers on the gingelly sphinx—*Acherontia styx*. Outside India a bacterial disease of horn worms has been noted on the tomato and tobacco worms (*Protoparce* spp.—insects close to our sweet potato hawk moth *H. convolvuli*); this disease gradually turns the caterpillar watery and before dying it clings on to the plant by means of the proleg hooks. We have not noted such a thing on sphingids so far in S. India though such a case has been noted by the writer affecting the paddy arm worm (*Spodoptera*) more than once.

In South India the following species have been noted to possess some economic importance:—

1. *Acherontia styx*, W. Known as the death's head moth on account of the peculiar skull mark on its thorax. The moth is stoutbuilt and has a dark brown general color with marks of blue and yellow especially on the abdomen. The caterpillar of this moth is a pest of some importance attacking cultivated crops like Sesamum, Lab-lab and Brinjal all over India. It is green with golden stripes along the sides of the body. There are records of the insect on potato in N. India. The insect has wide distribution all over India.

2. *Acherontia lachesis*, FB. This insect is very similar to *A. styx* in general form and color but has a stronger build and darker color. The

larva is more or less similar to *A. styx* and is found in company with the latter but is not so common. Has been noted by the author feeding on Nyctanthus plant in Malabar. Sometimes this moth is noted hiding under roof of houses. The moths of these species make a screeching noise when disturbed.

3. *Ambulyx pagana*, F. A large moth with pinkish brown wings. The stout greenish larva has the abdominal spine short and reduced. It has been sometimes found feeding on the foliage of *Pongamia glabra* in Coimbatore.

4. *Acosmeryx anceа*, Cr. The larva of this insect has been found by the writer on Daincha (*Sesbania aegyptiaca*).

5. *Hippotion celerio*, L. A dark grey moth with a whitish streak along fore wings and pink and dark patches on hind wings. The caterpillar is not as stout as those of *Acherontia* or *Ambulyx* and the color varies; it may be a shade of green or sometimes with a mixture of violet and brownish red. There are conspicuous many colored eye spots (generally two pairs) on either side of the body behind the third thoracic segment. The abdominal horn is long and straight. In S. India this caterpillar feeds on the foliage of about half a dozen common plants including Grape vine, Elephant yam, *Colocasia* and garden Balsam. A common wild shrub it feeds on is *Boerhavia*. It has a wide distribution all over India. Is recorded on *Beta* and *Rumex* in N. India and on cotton in Egypt.

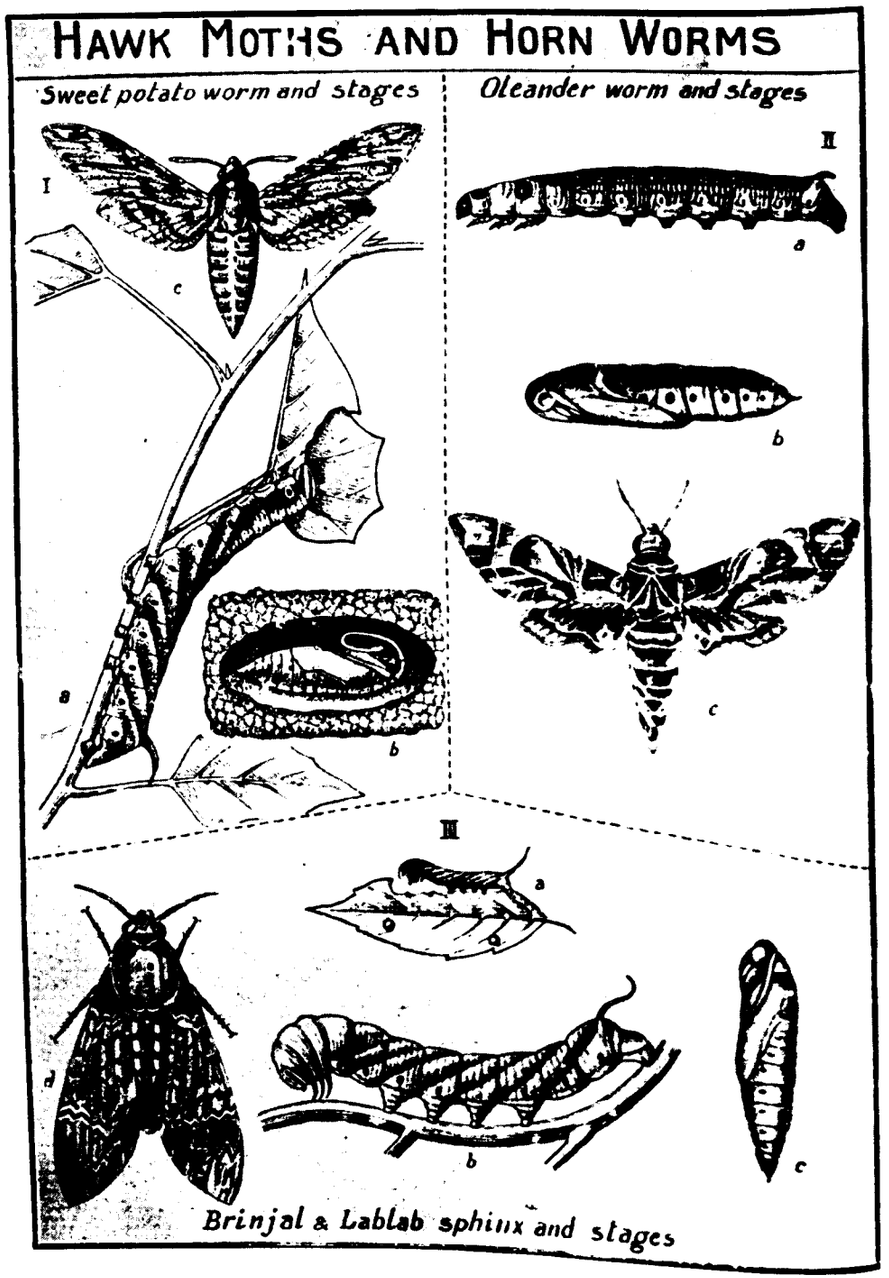
6. *Theretra Oldenlandiae*, Fabr. The moth is in general form and appearance similar to *H. celerio* with a dark and white streak along upper wing. The green caterpillar is commonly found on *Colocasia*, both wild and cultivated. Recorded on sweet potato and Balsam in N. India.

7. *T. latus (gnoma)*, Wlk. Is a closely allied species also found occasionally on grape vine with *H. celerio*, L.

8. *Rhyncholaba* actens, Cr. A grey medium sized moth with bright green patches on the wing. The larva which is beautifully adorned in colors is occasionally found on *Colocasia* with *Theretra* spp. It has several eye spots on the body; of these the thoracic ones are bigger and many colored. Life history notes on this insect (with figures) reared in Pusa on *Pathomesa wallichii* plants are given in Bulletin 89 (1919).

9. *Deilephila nerii*, L. A large stout olive green moth, one of the most beautiful insects known. This is known as the Oleander hawk moth after its common food plant the garden oleander (nerium). The large sized stout larva is green or yellowish green with conspicuous large eye spots behind the thorax and a long yellow rough abdominal horn. It is common all over India and confines its activities almost entirely to this plant. It is noted by Fletcher to have been bred to on *Jasminum* and *Tabernaemontana* in N. India.

10. *Herse (Protoparce) convolvuli*, L. Among sphingids of economic importance in S. India this insect occupies a very important position since this caterpillar often causes wholesale damage in fields of pulses and sweet



potato, and has been also noted on sunflower and ground nut in N. India. The writer once noted a whole field of green gram in the Godavari district completely defoliated by caterpillars of this moth. The moth is pale whitish grey with pale violet bands on the abdominal segments. The caterpillar is pale green with yellowish or reddish brown stripes along the side of the abdomen. The genus *Protparce* has a very wide distribution all over the tropics. In California, Australia, etc. the species of this genus attack Tabacco and Tomato badly and those species appear to be very much allied to our *H. convolvuli*, L.

11. *Thamnoecha uniformis*, B. A stout dark grey moth with the thorax bordered with black, especially around the posterior margin and sides. The caterpillar at a glance may be mistaken for that of *Acherontia styx* but slight differences in color and in the build of the thorax and the anal horn are clear. It has been recorded by the writer on the Parijath (*Nyctanthus arbortristis*), plant in Malabar where it occasionally defoliates this valuable and sacred flower plant.

12. *Nephle didyma*, F. A medium sized olive greenish moth often with 2 or 3 silvery spots on the fore wings. The caterpillar is green with a faint brownish band along the middorsal line and white lateral striae on the abdomen; the thoracic region is swollen. The caterpillar occasionally pupates inside leaf folds in the food plant itself which is generally *Carissa caranda* in Coimbatore (a local fruit which is pickled). It has also been noted on the same plant in Calcutta.

13. *Rhophalopsyche bifasciata*, B. A small dark grey moth with a yellow patch on hind wing with dentate margins. The caterpillar is greenish or greenish brown in color with the abdominal horn, long and stout. The caterpillar is in many respects similar to that of *Macroglossum spp.* noted below and breeds on *Morinda tin toria* leaves.

14. *Macroglossum spp.* These are what are known as humming bird hawk months due to their close general resemblance to humming birds. Some of them even mimic those birds (see fig.). Two or three species are common in South India and these are generally found to breed chiefly on *Morinda tinctoria* leaves; these include *M. gyrans*, W. and *M. vialis*, B. small moths with abdominal tufts. These are occasionally found flying during daytime also. The larvae are green with the horn edged with black; variations are frequently found in the form and coloration of these larvae. *M. vialis* has also been recorded as having been reared on *nux vomica* leaves on the Nilgiris by Fellowes Mason in 1921.

15. *Cephanodes picus* Cr. This is a beautiful small stout built moth with hyaline wings, yellow and red colored abdomen and with a conspicuous hair tuft at the anal end. It is also a humming bird hawk moth and is often found flying during day time visiting flowers of sorts. . This has not been noted as a pest but is found to act as an efficient pollinator of many flowers.

The above are the species so far known from S. India having an economic importance. Most of them in their larval stages are plant feeders

and some of them such as *Acherontia*, *Herse*, *Hipotion*, *Theretra* and *Deilephila* are plant pests of some importance. As adult moths most of the sphingids are either harmless or helpful. The harm done has been noted chiefly with the death's head moth *Acherontia styx*, which has been often reported to rob honey from bee hives. The writer doubts whether this moth causes any appreciable loss in honey in the case of artificial hives where it is impossible for it with its stout body to enter a hive through the small bee hole. As regards beneficial work done it may be added that several species of hawk moths, especially the crepescular and diurnal species like *Macroglossa*, *Cephanodes* etc. carry on good work as pollinators; their long tongue helps them in reaching some of the deep flowers like those of the Convolvulaceae.

It is quite possible that further studies might add a good deal to our present knowledge of Indian hawk moths and their economic importance.

References to Literature.

Lefroy, M. — Indian Insect Life, 1909

Fletcher, T. B. — Some South Indian Insects 1914.

Ayyar, T. V. R. — Life history description of *Cardia sphinx* (*Polyptychus*)—Rpt. of 3rd Ent. Meeting Pusa, 1919, (with plate).

— — Notes on insect parasites from S. India, *Journal of Bombay. N. H. Socy.*, Jan. 1925, (with figures).

— — Bulletin on Insect pests of crops in S. India. *Bull. No. 27, Madras Dept.*, 1932.

— & Margabandhu, V. — Hymenopterous parasites of economic importance in S. India. *Madras Agri. Journal*, Dec. 1934.

THE CHEMICAL COMPOSITION AND ENZYME CONTENT OF INDIAN HONEY

By K. VENKATA GIRI, M. Sc., A. I. I. Sc.,

(Department of Biochemistry, Indian Institute of Science, Bangalore).

Figures for the composition of honey commonly used in other countries are known, but there is no information available regarding the composition of Indian honeys. The present investigation was, therefore, undertaken as a preliminary step towards the analysis of Indian honey samples, for the purpose of purity determinations in order to set standards by which the purity of honey could readily be ascertained.

The study of the analysis of the honey samples has now been made by the most reliable methods which can be obtained. Sucrose, levulose and glucose have each been determined separately. Since these are the only carbohydrates which are absorbed as sugars from the gut, their sum constitutes the available carbohydrates of honey.

Materials and Methods. All the honey samples were obtained through the courtesy of Messrs. The Coorg Honey and Wax Producers' Co-operative Society, Ltd. They were collected from three different places and were known therefore to have been collected by bees under different floral conditions.

The methods used for the preparation of the sample for analysis and for the determination of water and ash were those described in A. O. A. C. Reducing sugars were determined by Lane and Eynon's (1923) copper titration method. Total sugar was estimated after inversion with hydrochloric acid. The difference between the percentage of total sugar and of reducing sugar, calculated from Lane and Eynon's invert sugar table, gave the percentage of sucrose in the honey.

The iodometric procedure described by Lothrop and Holmes (1931) was adopted for the determination of fructose/glucose ratio. The values for fructose and glucose were calculated by solving the simultaneous equation obtained from the iodometric determination and from the estimation of the reducing power by Lane and Eynons copper method.

Diastatic number. The diastatic number of honey was determined according to the method of Gothe (1914).

Phosphatase activity. The presence of the enzyme phosphatase in honey was shown for the first time. The activity of the enzyme was determined as follows :—

10 c. c. of honey was diluted to 20 c. c. with water. 5 c. c. of the honey solution was added to a reaction mixture containing 10 c. c. of N/5 acetic acid-acetate buffer of pH 5 2, and 5 c. c. of 2 per cent. sodium-β-glycerophosphate, with or without magnesium chloride, the total volume of the mixture being adjusted to 25 c. c. The reaction mixture was incubated at 35° ±0·1 for 24 hours. At the end of the period 10 c. c. of the mixture were removed and added to 10 c. c. of 10 per cent. trichloracetic acid, filtered and the inorganic phosphorus was determined by the method of Fiske and Subbarow (1925). The activity of the phosphatase is expressed in terms of mg. P liberated in the total volume (25 c. c.) of the reaction mixture after 24 hours hydrolysis by 5 c. c. of diluted honey (1 : 1).

The results of the analysis are presented in Table I.

Discussion. It will be noticed that all the honey samples examined contain approximately the same amounts of free levulose and glucose. The sucrose content, however, varies from 0·380 to 1·04 per cent. The results show that the ratios of dextrose to levulose are practically the same for all honey samples investigated (1·1 to 1·18).

It has been suggested that the colour of honey is usually associated with the mineral ash content. There is very little data available on this point in literature. Schuette and Remy (1932) examined a number of samples of honey and have shown that the darker the colour, the higher the proportion of mineral constituents. Further, the dark honeys were found to contain more copper and manganese than the lighter coloured products. The results of the analysis of Indian honeys also support the hypothesis that there exists in honey a relationship between the degree of pigmentation and the mineral content. Thus, honey No 2 (Table 1) which is dark in colour has a higher

Table I.

Number.	Details of samples.	Water %	Ash %	Glucose %	Laevulose %	Ratio Laevulose/Glucose	Sucrose %	Free acid (c. c. of 0·1 N NaOH required to neutralise 100 g. of the sample.	Diastatic No.	Phosphatase activity in mg. P in the total volume of R-M after 24 hrs. hydrolysis: without M mg.	with 0·01 M M. mg.
1.	North Coorg honey. Crystallised yellow colour. ...	17·5	0·031	39·2	39·5	1·01	0·380	18	7·1	0·208	0·293
2.	South Coorg honey. Bitter honey Dark colour. (Slightly fermented). ...	22·14	0·46	36·7	36·8	1·00	0·570	64	10·0	0·680	0·780
3.	West Coorg honey. Yellow colour. ...	20·7	0·062	35·8	40·1	1·12	1·04	25	8·3	0·233	0·260
4.	West Coorg honey. Yellow colour. ...	19·5	0·074	36·1	40·5	1·12	1·00	22	10·0	0·300	0·335
5.	West Coorg honey. Crystallised Small crystals distributed throughout. ...	16·0	0·103	34·2	38·5	1·12	0·380	17	6·3	0·375	0·450
6.	North Coorg honey. Yellow colour. Slightly fermented. ...	19·2	0·120	35·1	37·7	1·07	0·760	30	6·3	0·381	0·540
7.	West Coorg honey. Yellow colour. Crystallised. Crystals settled at the bottom. ...	19·0	0·075	35·1	39·1	1·11	0·380	19	5·0	0·312	0·312
8.	North Coorg honey. Yellow colour Crystallised. The crystals were distributed throughout. ...	16·2	0·048	36·7	41·4	1·12	0·475	18	5·0	0·153	0·175
9.	West Coorg honey. Crystallised Crystals settled at the bottom. ...	19·7	0·043	35·1	38·7	1·10	0·285	21	5·0	0·258	0·258
10.	South Coorg honey. (Processed: heated upto 158°F.)	20·4	0·072	34·2	40·4	1·18	0·760	14	2·0	0·233	0·260
11.	South Coorg honey. (Processed: heated upto 158°F). Yellow colour. ...	20·9	0·116	34·2	38·7	1·13	0·570	13	2·5	0·189	0·280
12.	Blended and processed and heated upto 158°F. ...	18·7	0·055	35·8	40·1	1·12	0·570	13	2·5	0·190	0·210

proportion of ash. In view of the importance of manganese and copper in the diet, it would be useful to determine the mineral content of various samples of Indian honey.

Titratable acidity recorded in the table for honey samples ranges from 13—25 for normal honey samples, and 30 and above for fermented samples of honey. The results, therefore, indicate that there appears to be some relation between the acidity and fermentation. The high figure for titratable acidity obtained in the case of fermented samples are probably due to the formation of organic acids as a result of fermentation.

The subject of enzymes in honey has been studied rather extensively for a number of years ; much of the work having been undertaken in an effort to find means for detecting adulteration (Auzinger, 1910; Axenfeld, 1903; Feelenberg, 1911; Gothe, 1914 ; Langer, 1903; Lenz, 1910 and Utz, 1908). Much work is being done on the evaluation of honey on the basis of diastase content. Braunsodorf (1931) has suggested the value 23·8 as a lower limit for first class diastatic honeys while 17·9 as the lowest permissible limit for unheated honeys. The present results have shown that the temperature which is generally employed for pasteurisation has noticeably affected the diastase content. All the honey samples examined are found to possess very low diastatic activities. It may be due to the high temperature occurring in the places where the honey has been collected. Many North American, particularly Californian honeys have been found to have low diastatic values (Bartels and Fauth, 1931) and it has been suggested that the high temperature occurring in many districts of California accounts for the low enzymic content of the honey. Fiehe (1930) also observed that Californian honeys have a very low diastatic value, and suggested that 8·3 be considered as a suitable lower limit of diastatic power and he states that it is becoming recognised as such in the trade.

It has been shown for the first time that an enzyme which hydrolyses sodium glycerophosphate into inorganic phosphorus occurs in honey. The activity of the honey phosphatase is affected by variations in hydrogen-ion concentration and the enzyme was found to be active at a pH range of about 4·5 to 6·5. The enyzme was found to be activated by magnesium. The results show that fermented honey samples show characteristically high phosphatase activity, while the values for unfermented samples are decidedly low. The effect of pasteurising honey is to lower the phosphatase activity somewhat. It is suggested that honey phosphatase is derived chiefly from fermentation yeast and bees and partly from the plants.

Spoilage of honey held in storage over long periods of time is a serious problem in honey industry. The spoilage of honey is due to two main factors : (1) contamination by sugar tolerant yeasts, and (2) decomposition of sugar when the honey is kept at 80°F or above for a long time. The freshly extracted honey is always infected with sugar tolerant yeasts, which are capable of setting up fermentation under favourable conditions.

The favourable factors for the growth of yeast are coarse crystals, a high water content and the abundance of pollen grains. Excess of moisture has some relation to the spoilage of honey by fermentation. In table I it can be seen that the fermented honey samples contain decidedly high water content. Further, it has been noted that the size of the crystals and the water content are related to each another. The water content increases when the crystals are coarse and large and settle down at the bottom. On the other hand if the water content is low, the crystals are small and form throughout the liquid phase. The top portion of the crystallised honey contains more moisture than the bottom layer. Fermentation begins at the top and slowly spreads down through the honey. For preventing spoilage it is necessary to control the crystal formation. The crystals should be as small as possible. Their formation as small crystals can be controlled by the addition at temperature of about 75°F of 5 to 10 per cent. of a previously processed finely crystallised honey, followed by thorough agitation and mixing. The product can be filled into the final containers and stored for two days at about 57°F. after which the honey can be stored at any temperature without danger of fermentation.

The fermentation is also prevented by pasteurising honey at 130°F. for 30 minutes. At high temperatures of about 160°F. the flavour and colour are spoiled, particularly when followed by slow cooling. It is recommended to pasteurise all honeys before storage or marketing.

Summary. The sucrose, glucose, laevulose, water, ash, acid, diastatic number and phosphatase activity of genuine samples of honey have been determined. The diastatic numbers of all the samples of honey were found to be too low. For the first time, it is shown that phosphatase occurs in honey.

The author's thanks are due to Prof. V. Subrahmanyan for his keen interest in the present investigation and to the Coorg Honey & Wax Producers' Co-operative Society Ltd., for kindly supplying the honey samples.

References.

1. Auzinger, A. (1910) *Z. Unter. Nahr. Genuss.*, 19, 65, 353
2. Axenfeld, D. (1903) *Zentrabl. physiol*, 17, 268.
3. Hartels and Fauth. (1931) *Z. Unters. Lebensm.*, 68, 396.
4. Braunsdorf. (1931) *Ibid*, 61, 411.
5. Fellenberg, T. von. (1911) *Mitt Lebensmittu Hyg Bidg. Gendhtsamt. (Switz.)*, 2, 369
6. Fiehe. (1930) *Z. Unters. Lebensm*, 61, 420.
7. Fiske, C. H., and Subbarow, Y. (1925) *J. Biol. Chem*, 66, 375.
8. Gothe. (1914) *Zeit. f. Unters. d. nahrgs. u. genussm.*, 28, 273, 286.
9. Lane and Eynon, (1923) J. *Soc. Chem. Ind*, 42, 132T.
10. Langer, J. (1903) *Schweiz. Wohnscher, chem u pharm.*, 41, 17.
11. Lenz, W (1910) *Apoth Ztg*, 257, 678.
12. Lothrop, R. E. and Holems, R. L. (1931) *Ind Eng. Chem. Anal. Edn* 3, 334
13. Schuette and Remy. (1932) J. *Amer. Chem. Soc*, 54, 2909.
14. Utz (1908) *Ztsc'r. Offentlal. Chem.*, 14, 21.

Soil Erosion: The Growth of the Desert in Africa and Elsewhere*

By SIR DANIEL HALL, K. C. B., F. R. S.

It is a commonplace of geology that the surface of the earth is constantly in motion; that our mountain ranges have taken shape and our river courses and valleys have been excavated by rain, frost and wind. In many parts of the world this movement of the soil surface is taking place rapidly, with serious consequences to the agriculture of those countries, owing to soil erosion.

The soil is dependent for its stability on its normal covering of vegetation, but as a rule the soil proper is not more than 6 inches to a foot deep, and it is in the surface layer that the fertility resides. There is thus always a danger that if the cover of vegetation is removed, the soil itself may shift under the action of either wind or rain. The earliest cases of erosion caused by such movement of the soil are those which follow deforestation in regions where the mountains in which the rivers take their rise are below the permanent snow line—*e.g.*, in the eastern Mediterranean. There is no evidence in support of the belief that forests increase the rainfall of a country; indeed, by the transpiration from their leaves, they must reduce the total amount of the rainfall retained by the soil, but they serve as its regulator; as the rain falls, it is absorbed by the spongy soil below the trees, rich in humus, and reappears later in the springs and rivers when the rainy season is over. Too commonly, however, the forests have been cut down without regard to their regeneration, both for the value of their timber and for a desire to extend the grazing land.

The grazing animals themselves do further damage, especially if they are goats: not only do they destroy every seedling tree, but they tread hard paths down which the rain runs with gathering volume and increasing velocity, gradually forming gullies, until in a generation or two the hillside gets bared down to the hard, infertile subsoil. Nor does the damage end there. The rainfall, running off without a check, develops into a torrent and eats into the meadows bordering on its course. The earth that has been torn away is carried down to the plains, where it is deposited, and turns the river into a chain of malarious swamps. Similar phenomena can be seen in the new countries opened up in the nineteenth century: forests were destroyed, and rivers have become subject to violent flooding.

Another form of soil erosin which is perhaps even more spectacular is that exhibited by the vast duststorms, such as those which in 1934 swept over the United States east of the Mississippi. In Canada also wind erosion has occurred on a disastrous scale. The causes are easy to discern. This form of erosion occurs only in comparatively arid districts with an annual rainfall below 20 inches, and usually where the fundamental subsoil is of a sandy type. In America before white settlement, these regions were covered with grass: some of the land was good grazing, with a fair depth of rich soil, but in the drier parts the sod was thin and there were only a few inches of soil. At first this poorer land was kept for grazing, but when the price of cereals rose rapidly from 1917 onwards farmers began to extend to them the area under plough. The system of farming was of a wasteful type; the straw was burnt, no stock was kept, and very few years with no recuperative crop were enough to exhaust the limited stock of humus. When years of drought came the light soil, no longer bound

* A summary of an evening discourse delivered at the Royal Institution on November 12, 1937.

together by either vegetation or humus, began to drift in the fierce winds that sweep over those great plains. The plough had destroyed the binding power of the soil, and the whole of the fertile top layer was swept away.

The methods practised by the pioneers in the development of a new country are rarely those of sound agriculture, but merely a form of shifting cultivation. Many European soils have been cultivated for a thousand years or more without showing any decrease in production, by the application of sound agricultural practice, while in China intensive cultivation has been maintained perhaps for four thousand years without soil erosion or loss of fertility.

In recent years where the danger of soil drifting is acute, means of cultivation have been introduced to minimize the risk In some places the land has been divided into strips, bare land alternating with land under crop, in place of the former large areas under the same treatment. Incipient soil erosion through wind is in this way checked b fore it can proceed far. Another practice is to establish shelter belts to break the winds, though in some of the districts where wind erosion is worse—such as Saskatchewan and Alberta--it is no easy matter to find species that will stand up to the extremes of climate.

Erosion through wind, as described above, is worst on the flat plains, but erosion by rain is more common where the cultivated land is on a slope. In such parts the danger does not lie in a large annual rainfall, for that will as a rule generate a forest vegetation which protects the soil; it is the sudden heavy rainfall which causes most damage. Cultivated land on a slope may suffer from erosion by water of two kinds: (*a*) a continuous slow removal of the good soil (sheet erosion) and (*b*) a catastrophic wash-out (gullying). As preventive measures the slopes can be terraced and cultivated along the contours. The object of this is to enable the soil to absorb the rain as it falls without allowing it to set up a flow over the surface, but it may be necessary to break the terraces at intervals with spillways to lead accumulated water into drains or watercourses. Alternatively, belts of unploughed vegetation may be left to break a run-off By such means, coupled with the growth of a leguminous plant which can be dug in to add nitrogen and humus to the soil, planters in tropical countries have been uble to check erosion even where the rainfall is excessive. Such a system of contour terracing has been practised in China from time immemorial.

But wherever torrential rains occur there is always a danger of gullies being started in the bare soil. Gullying can be initiated either by careless methods of soil management or, on grassland, by over-grazing which bares the surface. In the early stages such gullying can be checked by throwing dams across the gash made of anything that will hold up the rush of water and cause the sediment to accumulate. Even more effective has been the introduction of rapidly growing vegetation—*e. g.*, Kudzu (*Pueraria thumbergiana hirsuta*), a creeping leguminous plant which not only checks the flow of water and filters out the silt, but binds the earth and at the same time gathers nitrogen.

The examples of erosion hitherto described are those that are due to unthinking exploitations of the soil by civilized man. Consideration should also be given, however, to what is taking place in Africa under native systems of farming. In the first place, it must be realized that whereas European farming is essentially founded upon a rotation of crops, in which a recuperative leguminous crop finds a place and in which livestock play their part in converting into manure-those parts of the crops, such as straw, which are not valuable for human food, together with grass and other rough fodder, the African tribes, on the other hand, are for the most part still in the more primitive stage of "shifting cultivation." Under this practice the cultivator clears a plot of land, perhaps burning off the timber, before putting in his food crops After two or three

years of continuous cultivation the soil begins to become exhausted, and when that takes place and weeds become intractable, the plot is abandoned and a new piece of land is taken up. The abandoned plot in course of time recovers sufficiently to be taken into cultivation again, but under this system a tribe requires several times as much land as is actually under cultivation at any one time.

Another point of great importance is that the Bantu tribes, which predominate in east Africa, attach the greatest value to cattle, which represent wealth and position, but serve little or no economic purpose. They are not eaten, except ceremonially; by many tribes they are not milked; they are not beasts of burden, and their dung is not used as manure. At the same time every native is anxious to increase the number he owns, for on that depends his position in the tribe.

Within the past century, since British rule has maintained peace, the human population has increased very markedly, and this increase has been accompanied by an even greater increase in the numbers of livestock. The animal population has far outstripped the means of sustenance and is destroying vegetation in uncultivated areas which ought to be recuperating in readiness to be brought into cultivation again. The Kenya Land Commission, reporting in 1923, stated that "Probably about the year 1920 the main stock areas of the native reserves had attained their optimum carrying capacity, and although fully stocked were not overstocked." Since that time the cattle population has roughly doubled itself. Through presistent over-grazing, the ground has been beaten hard into little paths, even where it has not been eaten bare, and thus large areas have been laid open to erosion from rain, especially on the hillsides. Under cultivation, the humus of the soil rapidly becomes exhausted; the climate produces recurrent periods of drought followed by rainfall of fierce intensity, with a result that soil erosion, widespread and disastrous, occurs. Furthermore, the native population not only practises a destructive and wasteful form of agriculture but, as already mentioned, keeps a vast uneconomic herd of cattle including the devastating goat in large numbers. It is small wonder that famine is never far away from some of the tribes, and if this is to be avoided the native must either change his methods or limit his numbers. African soil was never rich, and soil erosion has been developing for years without attracting much notice, but has now reached the stage where the growth of the desert may speed up catastrophically.

It is only recently that the dangers of erosion in Africa have been realized. The problem and the means of attacking it have, however, occupied increasingly prominent places in various Government reports since 1929, and it is now evident from Sir Frank Stockdale's report on his tour through Africa this year that all the African colonies have become erosion conscious.

Much yet remains to be done before the arrears of years of misuse of the soil can be repaired, and before the native population can be educated to systems of farming which will maintain the fertility of the land. Drastic changes in native custom will need to be brought about, and in many cases expenditure will be called for which can hardly be found within the limited resources of a particular colony.

The regeneration of wasted lands must begin with closing them for a time to grazing, so as to allow the return of natural vegetation. A certain amount of minor engineering is needed to check run-offs and dongas by da[illegible] tations. At the same time, cultivators must be taught the vi[illegible] ploughing and planting and of vegetation strips in cultivated l[illegible]

Such measures, however, do not touch the major cause [illegible] erosion—*i. e.*, overstocking. To combat this, legislation is necessary with a view to compelling

a reduction in the number of cattle. This must be done by way of purchase, and since the animals discarded would at first be practically valueless for food, factories would be required to turn the carcasses into fertilizer, and, later, into successively better products as the quality of the cattle dealt with improved. A reduction in the number of cattle or sheep to one-half would not only relieve the pressure on the land, but would give the native owners some chance of improving the quality of their livestock, both by selection and better feeding; whereas at present numbers only are valued. Education should also be the means of inducing the natives to use cattle economically for milk or meat and for traction, or at least to sell them for food. One cannot escape from the fact however, that forcible limitation of the number of cattle a man may hold will be a grave interference not only with tribal custom, but also with the dignity of individuals. One idea which has its attractions is that a special token currency should be introduced for the purchase of native livestock that would constitute a visible display of wealth and status.

Even more fundamental must be the education of the natives in the adoption of a conservative system of farming—a rotation that would include the leguminous crops, and thus help the native dietary as well as restore nitrogen to the soil. Already compost making is another means of maintaining fertility that is being taught to the natives. The African cannot increase or even maintain his present numbers unless he learns how to use his plot of land so that it will continuously produce food. Demonstrations have shown how it can be done but it will need both a strengthening of the agricultural staff and years of effort before the improved practices are taken up. Effort in all these directions on a large scale is an urgent necessity. Many of the tribes are on the verge of starvation, the desert is growing apace, and as the cropping or grazing area shrinks the pressure upon it becomes greater and destruction proceeds at a compound interest rate. Responsibility for action must lie not only on the colonial Governments, but on the British Government itself, which has declared itself trustee for the native populations and must save them from themselves.

(*The Empire Cotton Growing Review*—January 1938)

Research Notes.

Jassids on Cotton.

Two species of Jassids are found on Cambodia, Uppam and Karunganni cottons; one is *Empoasca devastens*, Dist. and the other *E. formosana* Paoli. The former is the commoner and more abundant, and is recognisable by a pair of black dots, one on each of the apical end of the tegmen; the latter occurs in sparse numbers and can be distinguished by the faint brown patches on the wings and the absence of black dots.

Both the nymphs and adults feed on the leaves from underside by sucking the plant sap with the aid of their stylet like proboscis. Severe infestation by the jassids adversely affects the growth of plants. Young seedlings may succumb and older plants become stunted in growth. The curling down of the margins of the leaves, development of red lesions along the upper margins and the chlorotic and cream coloured patches on the underside are the chief symptoms of jassid infestation.

Jassids are found in the field from October onwards and seem to reach the peak in December and January; thereafter they show a tendency to go down; in April and May their population is very light and sparse The warm weather appears to have something to do with the decrease in their numbers.

Besides cotton, several plants like Brinjal (*Solanum melongena*), Bhendai (*Hibiscus esculntus*) and sunflower are known to be infested in varying degree by these jassids. But Bhendai and Brinjal suffer most and exhibit the characteristic symptoms.

Eggs are laid inside the plant tissues such as tender petioles, twigs and succulent leaves; they are translucent and slightly awl shaped. Egg period varies from 5 to 15 days. Nymphal period occupies about 10 to 12 days. There are five instars, and all the instar stages are passed on the underside of the leaves. Older nymphs develop a tendency to become gregarious and crowd on the underside of the semi-dry basal leaves. Both the sexes are present in the field in almost equal proportions; they are known to live up to 23 days.

Contact sprays with Nicotine have given very good results against adults and nymphs, especially the latter. Lime sulphur and Bordeaux mixture sprays and sulphur dust had practically no effect on the pest.

Agri. Research Institute
Lawley Road P. O.
Coimbatore. 11-2-'38.

M. C. Cherian

M. S. Kylasam

Agricultural Jottings.

BY THE DEPARTMENT OF AGRICULTURE

The Protection of Orange Trees Against Disease. Food and industrial crops are essential to the life of man, but ever since the dawn of history vegetation in all forms has been subject to the ravages of pests and disease. It is only in recent times that the magnitude of this waste has been realised. In the United States it is estimated that loss to-day due to plant pests and diseases amounts to Rs. 3,233,000,000 annually.

In India millions of people are dependent on crops for food and other necessities of life and for this reason it is of paramount importance to find means to protect plants against disease.

Oranges are among the most valuable of crops grown in South India and one of the main centres of cultivation is in the taluk of Razampeta, Cuddapah district. In recent years in this area growers have been incurring increasing loss due to a disease called MOTTLE LEAF or 'FRENCHING'. This is known to exist in many parts of the world. Towards the end of 1935 the disease assumed a more serious form in many gardens. The problem of how to eradicate it was immediately taken up by the agricultural department.

Although the nature of the disease is still obscure the symptoms are quite definite. In its early stages yellowish patches appear between the veins of the leaf and on both sides of midrib which is in contrast to the colour of the leaf as a whole. In a more advanced stage the whole leaf with the exception of the midrib turns yellow. In cases where the trees have been allowed to remain in this condition for some time the leaves assume a peculiar congested appearance which is characteristic of stunted growth.

Methods of control are simple and inexpensive. It is necessary to spray the trees with a wash composed of zinc sulphate and lime, the recipe for which is given below :

Zinc sulphate	...	...	2 lbs.
Slaked lime	...	...	1 lb
Water	...	...	20 gallons.

In the rainy season a pound of casein may be used as an adhesive.

This treatment was quite successful in the garden of M. R. Ry. Badri Jayaramaiah Garu who has kindly furnished the following information for publication.

"At the outset about 25 per cent of the trees standing in the garden were treated, sprayings being repeated four times at intervals of from 15 to 20 days from the month of September. In view of the entirely satisfactory results obtained the remainder of the trees, about 210 in all, were sprayed from January onwards. The cost worked out as shown below.

Zinc Sulphate 128 lbs. at 4 as. per lb.	Rs.	32	0 0
Lime 64 lbs. at 4 as per lb.		4	0 0
Cost of labour: Hire on 20 gallon sprayer for 8 days.		8	0 0
16 coolies at 4 as. each.		4	0 0
Wages & extra wages of messenger at 10 as. a day.		5	0 0
Total Rs.		53	0 0

The following statement shows the amount for which the garden has been leased during each of the past four years.

Year.	*Amount realised by lease*	*Remarks.*
1934.	Rs. 3,400	No. disease.
1935.	5,200	do.
1936.	1,800	Very badly affected.
1937.	5,025	Completely free from the disease after four sprayings.

The owner estimates that during the past year the increased return which may be attributed to the effects of disease eradication is Rs. 2,720/-

In view of the success thus obtained large numbers of trees are now being sprayed and already 2,511 have been treated. There are twenty garden owners who have applied for help and during the next four months it is anticipated that the local demonstrator will supervise the spraying of about 2,000 additional trees.

Improvement in Palm Jaggery. The making of jaggery in Palm juice is an ancient cottage industry and is practised mainly by the tapping communities in several parts of the Madras Presidency, notably in Tinnevelly and East Godavari districts. Owing to the primitive methods used in its manufacture, the jaggery is of dark colour and of poor quality, and is, therefore, not consumed as such but used in sugar factories for refining into white sugar.

Palmyrah jaggery is said to have certain medicinal properties, and is valued for that reason. Recent work done at the Bose Institute at Calcutta, as reported on in Scientific literature, has shown that the juices of the Palm contain a large quantity of Ascorbic Acid (Vitamin C) in a stable form, and it may be due to this, that Palmyrah jaggery is favoured, but no data exist as to whether the Vitamin C, which is not thermostable, is present in the jaggery made from the juice. It is proposed to investigate the problem in the near future in the chemical laboratories at Coimbatore.

With the passing of the Prohibition Act in this Presidency, the putting to use of the trees, till now being tapped in the districts, is a serious problem. Its solution lies in making of a superior quality of jaggery from Coconut and Palmyrah palms, for direct consumption as well as for refining purposes. The product now available is dark in colour, of poor quality and with a characteristic flavour; all the three factors militate against its use for direct consumption. If a better quality product can be placed in the market, it might be possible to induce people to consume it in the same way, as cane jaggery is being consumed direct.

The production of a better type of jaggery from palm juices has been the subject of investigation in the laboratory of the Government Agricultural Chemist for sometime past and experiments conducted in connection therewith have been attended with a considerable measure of success.

At the outset, it may be mentioned that palm juices are in no way inferior to the sugarcane juice in point of sugar content or purity. They are found to be even purer than the latter and contain in general much less reducing sugars than the sugarcane juice The palm juices are, therefore, as suitable as cane juice for the production of good quality jaggery and sugar and the failure to obtain such a result from the former is apparently due to the defects in the traditional method of manufacture.

It may be pointed out that in the tapping of sweet toddy for jaggery making, it is the local practice to add excess of lime to the receiving pot with the object of preventing the juice from undergoing alcoholic fermentation. To produce good coloured jaggery from these juices, the first and most important step is to delime the juice to the correct reaction. In the local method, this is not done and hence the dark coloured product. It has been found as a result of numerous trials carried out in the laboratory that addition of a suspension of superphosphate to the juice till it reacts neutral to litmus gives satisfactory results. The operation of deliming may with advantage be avoided, if other means are found to prevent the juice from fermenting during collection.

The delimed juice is boiled, allowed to settle for a few minutes and then decanted. The decanted juice on concentration in the usual way yields a jaggery better in colour and having less of the flavour than the one prepared in the ordinary manner.

A produce almost white in colour and almost free from the characteristic palmyrah flavour may be obtained by filtering the delimed and boiled juice through paddy husk activated carbon and concentrating the filtered juice in the usual way.

For the preparation of high quality, white sugar, by the open pan process the treated and filtered juice should be concentrated to a temperature of 110°—111°C and the rab so obtained may be allowed to ripen for about a week and then centrifuged.

Cheap way of Polishing Turmeric. Like most of other farm produce turmeric requires preparation before it is put on the market Turmeric is an important every day commodity well known in the Indian household.

After harvest the rhizomes (raw turmeric fingers) are cured by boiling in pans with cow-dung water and drying in the sun. They are then cleaned free of adhering rootlets, scale leaves and particles of earth. The rough coated dirty brown rhizomes are transformed into a smooth attractive bright yellow, in which form it is ready for the market. This process of cleaning is termed polishing.

An improved method of polishing evolved by the Agricultural Department employs a horizontally mounted barrel of expanded metal 2' long by 3 feet diameter provided with a handle at either end for rotation by two men. The barrel takes a charge of about 70 lb. of cured (boiled and dried) turmeric which is polished in about 7 minutes at the normal working speed of 30 R. P. M. of the barrel. The steady rolling action cleans and polishes the turmeric as it rolls on the expanded metal. The expanded metal is covered on the outside with a tight wrapping of woven wire which serves to retain the smallest finger turmeric within the barrel and at the same time allows the dust and rootlets to escape during polishing.

When the polishing is complete i. e., when the required colour is obtained after continuous rotation of the drum, a door which runs the full length of the

barrel is swung open and the entire charge of turmeric is emptied in a few seconds into a gunny or basket which is placed under the drum.

The normal output of such a polisher is over one ton of polished turmeric per day of 8 hours at a cost of about Rs. 0—10—0 per ton (in Coimbatore district). By the local method in which the turmeric is polished by the use of bamboo baskets, the average cost of polishing is Rs. 3/- per ton. The new polisher drum effects a saving of Rs. 2—6—0 per ton or taking the average yield per acre as 2 tons of polished turmeric, a saving of Rs 4—12—0 per acre is effected. This saving is based on a rate of wages of annas four per day for man and annas two per day for woman cooly.

The polishing machines have been built at a moderate cost—about Rs. 30/- are easily portable and are available with the Agricultural Department for demonstration and hire at cheap rates in all turmeric growing areas of the Presidency.

An Account of the Tour of the Second Year B. Sc. Ag. Students of the Agricultural College, Coimbatore.

By K. S. SANKARAN & R. VISWANATH

In accordance with the usual practice in our College, we started on an agricultural tour in the southern districts of the presidency in the early part of January.

We all met at the Agricultural Research Station at Adutural on the morning of the 3rd. This station was started nearly two decades ago with a view to evolve improved strains of paddy from the varieties commonly grown in the locality and also bring about other improvements in the cultivation of paddy and other crops in Tanjore and the neighbouring districts. From what we saw and heard during our short stay there we were convinced that within the short period of its existence it has achieved an amount of success and popularity which those responsible for its inception could have hardly dreamt of. A visit to the farm will easily convince anybody about the useful work done there in the main crops as well as in demonstrating the immense possibilities of cottage industries like poultry rearing, bee-keeping etc., in augmenting the resources of the villager.

Our next place of halt was Tanjore. While there we paid visits to the Borstal school, and the newly opened Agricultural and "Malaria" Research Stations at Pattukottai. On the 8th we reached Trichinopoly. The next morning we visited a tanning factory run on most up-to-date lines and learnt in detail tha process of ordinary and chrome tanning of raw hides and skins. We spent the afternoon at Lalgudi. The working of the Lalgudi Sivagnanam Co-operative Society is amply demonstrative of the place of Co-operation in Rural Development and fully substantiates the truth of the observation

"If co-operation persists Rural India exists
If co-operation fails the last hope of Rural India fails".

Before leaving Lalgudi we paid a hurried visit to the grand anicut and saw the new Canal of the Cauvery Mettur project—a project rendered possible by the now famous Mettur dam, admitted on all hands as one of the recent Engineering Wonders of the world.

Leaving Trichinopoly on the 10th we reached Pudukottah the same afternoon. Thanks to the facilities which we enjoyed at the hands of the State authorities our stay there was a very pleasant and instructive one. Though agriculturally the state is not blessed with the bounties of Nature the capital town has a fascinating charm of its own, with its well laid-out streets, broad roads, a protected water supply, electricity and several other amenities, which many more important towns in the south of India can hardly boast of.

The 12th noon saw us at Madura. The buzz and stirring murmur of the streets of the Temple City, the Eternal Bells of the temple of "Madurai Meenakshi", the historic Tirumalainaick's palace and the ever open shops of the city afforded us an unique opportunity for recreation and temporary relaxation. The next morning we visited the municipal sewage farm where the cultivation of various forage plants and fruit trees is undertaken on extremely profitable lines. This showed us very clearly the high manurial value of town sewage and how a judicious handling of the same really results in the winning of "Wealth from waste".

The next three days were spent at the Agricultural Research Station at Koilpatti. The visit to this farm added considerably to our knowledge of the dryland cultivation in the south of the presidency and we were glad to be told that the farm, the oldest in the presidency, has really been able to do a large amount of good to the ryots of the black soil area of Madura, Ramnad and the Tinnevelly Districts. Dindigul was our last place of halt. The cultivation of the betelvine, grapes and tobacco attracted our attention here, as also the manufacture of cigars and scented chewing tobacco. We returned to Coimbatore on the 17th night. Though all-too-short, as it now appears, the tour was very enjoyable and instructive and we express our sincere gratitude to all those, official snd nonofficial, who spared no pains to make our visits to their respective spheres of activity as instructive and pleasant as possible.

Crop and Trade Reports.

Paddy—Final Forecast Report. The average of the areas under paddy in the Madras Presidency during the five years ending 1935—36 has represented 15·3 per cent. of the total area under paddy in India.

The area sown with paddy in 1937—38 is estimated at 10,043,000 acres as against 9,796,000 acres for the corresponding period of the previous year and the finally recorded area of 9,889,532 acres in 1936—37. The present estimate exceeds the final area of the previous year by 1·6 per cent. but falls short of the area of 10,200,160 acres in an average year by 1·5 per cent.

One million four hundred and forty-eight thousand acres have been reported as sown since the last December forecast was issued. The extent so sown was large in the Carnatic (359,000 acres) North Arcot (175,000 acres) Ramnad (200,000 acres) and Tinnevelly (145,000 acres). The area sown in December and January

was greater than that sown in the corresponding period of the previous year by 156,000 acres or by 12·1 per cent.

The area under second crop paddy is expected to be slightly above normal.

The harvest of the main crop of paddy is in progress.

The yield is expected to be normal in Kistna, Guntur, Kurnool, Cuddapah, Salem, Tanjore, Madura, South Kanara and the Nilgiris and below normal elsewhere especially in Anantapur and Tinnevelly where it is estimated to be 80 and 60 per cent. of the normal respectively. The seasonal factor for the Presidency works out to 94 per cent. of the average as against 97 per cent. in the Season and Crop Report of the previous year. On this basis, the yield works out to 94,756,000 cwt. of cleaned rice. This represents a decrease of 1,133,000 cwt. of cleaned rice or 1·2 per cent. when compared with the estimate of 95,889,000 cwt. of cleaned rice in the Season and Crop Report of the previous year. The yield in an average year is estimated at 102,007,000 cwt. of cleaned rice.

The wholesale price of paddy, second sort, per imperial maund of 82⅔ lbs. as reported from important markets on 7th February 1938 was Rs. 2—12—0 in Chittoor, Rs. 2—11—0 in Virudhunagar, Rs. 2—10—0 in Guntur, Madura and Tinnevelly, Rs. 2—8—0 in Vizianagaram, Anantapur and Hindupur, Rs 2—6—0 in Ellore and Masulipatam, Rs. 2—2—0 in Vellore, Rs. 2—0—0 in Cocanada, Rajahmundry, Cuddalore and Mangalore, Rs. 1—13—0 in Kumbakonam, Rs. 1—12—0 in Negapatam and Rs. 1—10—0 in Conjeevaram. When compared with the prices published in the last report, i. e. those which prevailed on 3rd January 1938, the prices reveal a rise of 11 per cent. in Anantapur, 8 per cent. in Guntur, 6 per cent. in Masulipatam, 5 per cent. in Hindupur and Virudhunagar and 3 per cent. in Cocanada, Rajahmundry and Ellore and a fall of 24 per cent. in Kumbakonam, 15 per cent. in Negapatam, 11 per cent. in Madura, 10 per cent. in Conjeevaram and 2 per cent. in Tinnevelly, the prices remaining stationary in Vizianagaram, Cuddalore, Vellore, Chittoor and Mangalore.

Gingelly—Third Report. The average of the areas under gingelly in the Madras Presidency during the five years ending 1935—36 has represented 15·2 per cent. of the total area under gingelly in India.

The area sown with gingelly up to 25th December 1937 is estimated at 546,400 acres. When compared with the area of 511,900 acres estimated for the corresponding period of last year, it reveals an increase of about 6·7 per cent.

There is an increase in area in Vizagapatam, Nellore, the Central districts, Madura and South Kanara partly counter-balanced by a decrease in area in the other districts. The variations are marked in West Godavari (— 17,000 acres), Bellary (—11,000 acres), North Arcot (plus 13,500 acres), Salem (plus 27,500 acres) and Coimbatore (plus 31,300 acres).

The main crop has been harvested except in the south. The yield is reported to be below normal except in Guntur, Cuddapah, Nellore, Salem, Tanjore, Ramnad and South Kanara.

The seasonal factor for the Province works out to 90 per cent. of the average as against 91 per cent. for the corresponding period of last year. On this basis, the yield is estimated at 66,300 tons as against 62,800 tons for the corresponding period of last year, an increase of about 5·6 per cent.

The wholesale price of gingelly per imperial maund of 82⅔ lbs. (equivalent to 3,201 tolas) as reported from important markets on 7th February 1938 was Rs. 6—9—0 in Trichinopoly, Rs. 6—6—0 in Salem and Tinnevelly, Rs. 6—4—0 in Cocanada, Rs. 6—2—0 in Ellore, Rs. 6—0—0 in Vizianagaram, Rs. 5—15—0 in Cuddalore, and Rs. 5—5—0 in Rajahmundry. When compared with the prices published in the last report i. e., those which prevailed on 3rd January 1938, these prices reveal a rise of approximately 10 per cent. in Rajahmundry and 6 per cent. in Tinnevelly and a fall of approximately 8 per cent. in Cuddalore, 4 per cent. in Cocanada and 1 per cent. in Ellore, the prices in Vizianagaram, Salem and Trichinopoly remaining stationary.

Ginger Crop—Final Report. The area under ginger in 1937 is estimated at 11,000 acres in Malabar as against the actual area of 9,634 acres in the previous year.

The yield is estimated to be normal as in the previous year. On this basis, the total yield is expected to be 3,930 tons of dry ginger as against 3,580 tons in the previous year. (*Director of Industries, Madras*).

Cotton Raw in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1938 to 11th February 1938 amounted to 6,379 bales of 400 lb. lint as against an estimate of 439,700 bales of the total crop of 1937—38. The receipts in the corresponding period of the previous year were 6,314 bales. 6,285 bales mainly of unpressed cotton were received at spinning mills and 692 bales were exported by sea while 2,848 bales were imported by sea mainly from Karachi, Bombay and Egypt.

(*Director of Agriculture, Madras*).

College News and Notes.

Students' Corner :- Students' Club. Under the auspices of the Officers', Students' and Ladies' Clubs, Mr. B. Chenga Reddy, B.A., recited and enacted some passages from Shakespeare's plays, Tagore's works and Ramayana, on 9—2—'38. In spite of his indifferent health, Mr. Reddy acquitted himself most creditably, engaging the audience for more than 2 hours.

"Agricultural students—their place in Modern Indian Society" was the subject of a lecture delivered by Rao Sahib V. Muthuswami Iyer with Rao Sahib T. V. Rajagopalachariar in the chair. The speaker said that Agricultural students should become more ruralised. He suggested that Agriculture can be introduced in schools and that Agricultural graduates are eminently fitted to be teachers. The President stressed on the importance of the study of Agricultural economics and concluded by saying that Agricultural graduates should be given state-aid and lands belonging to Temples and Mutts to be cultivated by them.

Obituary. A meeting of the Officers and Students of the Agricultural College and Research Institute convened by the Principal, Mr. R. C. Broadfoot, was held on 15—2—38 in the Freeman Hall and passed the following resolution of condolence on the demise of Mr. K. T. Bhandary.

"This meeting places on record its expression of deep regret and sorrow on the sudden and untimely death of Mr. K. T. Bhandary, Assistant Director of Agriculture, Salem, on 12 February 1938, and conveys to his widow and family its condolences and sympathy in their irreparable loss."

The Secretary, The Madras Agricultural Students' Union, under authorisation, communicated this resolution to Mr. K. G. S. Bhandary, Agricultural Demonstrator, Tiruppur.

Mr. K. V. Chelapathi Rao,	A. D. Kovvur	A. D. Tanuku.
,, P. Somayajulu,	F. M. A. R. S. Maruteru	A. D. Salur.
,, P. C. Sahadevan,	Asst., A. R. S. Pattambi	F. M. A. R. S. Adutorai.
,, M. Narasimham,	F. M. A. R. S. Siruguppa	A. D. Guntur.
,, M. Rami Reddi,	A. D. Guntur	A. R. S. Siruguppa.

4. Leave.

Name of Officers.	Period of leave.
Mr. K. Govindan Nambiar, F. M. Taliparamba.	Extension of L. a. p. for 2 months and 7 days from 24—12—1937.
,, L. Narasimha Acharya, A. D. Ponneri.	L. a. p. for 9 weeks and 2 days from 6—2—'38.
,, P. Abdulla Haji Sahib, A. D. Manjeri.	L. a. p. for 1 month from 24—1—'38.
,, R. G. Mal, A. D. Nanguneri.	L. a. p. for 4 months from 15—2—'38.
,, C. S. Gopalaswami Rao, Mycology Asst., Samalkota.	L. a. p. for 5 weeks from 10—2—'38.
,, V. S. Narayanaswami Ayyar, A. D. Nannilam.	L. a. p. for 4 months from 1—3—'38.
,, S. Dharmalinga Mudaliar, Asst., Paddy Section.	preparatory to retirement. Extension of L. a. p. from 19—2—'38 to 26—3—'38.

Agricultural College and Research Institute, Coimbatore.

ADDITIONS TO THE LIBRARY DURING JANUARY 1938

A. Books.

1. *Cotton Progress in Brazil.* Pearse, N. S. (1937). 2. *The Potato: Its Culture, Uses, History and Classification.* Stuart, W. (1937). 3. *Green and Gold: The Story of the Banana.* Berta Hadar. (1936). 4. *The Garden of Gourds.* Bailey, L. H. (1937). 5. *The Physical Distribution of Fresh Fruits and Vegetables.* Duddy, E. A. and Revzan, D. A. (1937). 6. *Canadian Animal Husbandry.* MacEwan, J. W. G. and Ewen, A. H. (1936). 7. *Principles of Feeding Farm Animals.* Bull, S. & Carroll. W. E. (1937). 8. *Diseases and Parasites of Poultry.* Barger, E. H. & Card, L. E. (1935). 9. *Marketing Poultry Products.* Benjamin, E. W. & Pierce, H. C. (1937). 10. *Market Research and Analysis.* Brown, L. O. (1937). 11. *American Agricultural Conditions and Remedies.* National Indus. Conf. Bd. Studies. (1936). 12. *The Tenure of Agricultural Land.* Sachin Sen. (1937). 13. *Vitamins, 2nd Edn., Revd.* Harris, L. J. (1937). 14. *Smith's Inorganic Chemistry, Revd., Edn.* Kendall, J. (1937). 15. *Recent Advances in Cytology, 2nd Ed.* Darlington, C. D. (1937). 16. *Statistical Tables: Their Structure and Use.* Walker, H. M. & Durost, W. N. (1936).

B. Reports.

1. Report on the Operations of the Madras Agrl. Department for 1936-'37. 2. (Bangalore) Indian Coffee Cess Committee, 2nd Annual Report, 1936-'37. 3. Imperial Agricultural Research Institute (New Delhi), Scientific Reports for 1937. 4 & 5. Bengal Agricultural Department Annual Report for 1936-'37 (Parts I & II). 6. Central Provinces and Berar Agricultural Department Report on Demonstration Work carried out in the Northern Circle, 1936. 7. Report on the Operations of the Burma Agricultural Department, 1937. 8. Hannah Dairy Research Institute (Ayr.), Annual Report, 1937. 9. Report of the Minister of Agriculture for the Dominion of Canada for 1937. 10. Report of the Minister of Agriculture (South Australia) for 1937. 11. Fiji Agricultural Department Annual Bulletin of Divisional Reports, 1936. 12. Minnesota Agricultural Experiment Station 43rd Annual Report, 1936. 13. Missouri Agricultural Experiment Station Work during the year 1936. 14. Montana Agricultural Experiment Station 43rd Annual Report, 1936. 15. Nevada Agricultural Experiment Station Annual Report of the Board of Control for the Fiscal Year 1936. 16. Annual Report of the Director of New Hampshire Agricultural Experiment Station for the Year, 1935.

C. Special Publications.

17. A Review of the Past History and Appreciation of the Present Position with regard to the Improvement of Bullock-Drawn Implements, with Suggestions for the future by N. G. Charley. 18. Reports of the Imperial Economic Committee—31st Report on Tobacco. 19. A Report on the Rehabilitation of the Dry Areas of Alberta and Crop Insurance, 1935—1936. 20. Contributions to the Knowledge of Chemical Weathering and Soil Formation in Siam by Blanck, et. 21. The Response of Government to Agriculture by A. P. Chew. 22. Rainfall Penetration and Consumptive Use of Water in Santa and River Valley and Coastal Plain, 1930. 23. Water Losses under Natural Conditions from Wet Areas in Southern California, Parts I & II, 1933. 17(a). Review of the Literature on

Stock-Scion Incompatibility in Fruit Trees, with Particular Reference to Pome and Stone Fruits. *Eng Imp. Bur. Fruit Pro. Tech. Comm. No. 9.* 18(a). The Preservation of Fruits and Vegetables by Freezing. *Canada Agr. Dep. Pubn. No. 551.* 19(a). A Study of the Uniformity of Soil Types and of the Fundamental Differences between the Different Soil Series *Alabama Poly-Tech. Inst. Bull. 244.* 20(a). Sheet Erosion Studies on Cecil Clay *Ibid. Bull. 245.* 21(a). Field Experiments on Sugarcane in Jamaica, 1933—1936 *Jamaica Agr. Dep. Bull. 9.* 22(a). The Gumming Disease of the Sugarcane. *Mauritius Agr. Dep. Sci. Ser. Bull. 25.* 23(a). The Mineral Content of Mauritius Pastures *Ibid. Sci. Ser. Bull. 26.*

D. Bulletins, Etc.

24. Reworking Fruit Trees. *S. Austr. Agr. Dep. Bull. 322.* 25. Two Common Diseases of Sheep—Infectious Entero-Toxaemia and Internal Parasites: *Ibid. Bull. 325.* 26 The Re-working of Orchard Trees. *Ibid. No 326.* 27. Deciduous Fruit Investigations: i. Environment and its Influence Upon Fruit Production. ii. Some Physiological Effects of Oil Sprays upon Deciduous Fruit Trees. *U. S. Agr. Sci. Bull. 151.* 28. The Cyanide Fumigation of Citrus Trees in the Eastern Cape Province, South Africa. 29 The Onion and Its Allies. *Ibid. Bull. 171 and 174.* 30. Farm Tenure in Iowa: 1. Tenancy Problems and their Relation to Agrl. Conservation. *Iowa Agr. Exp. Stn. Bull. 351.* 31. Crops and Soils information. *Louisiana A. E. S. Bull. 283.* 32. Planting and Care of Shelter-Belts on the Northern Great Plains *U. S. Farm Bull. 1603.* 33. Conserving Corn Belt Soils. *Ibid. 1795.* 34. Vitamin Content of Foods. *U. S. Agr. Dep. Mis. Pub. 275.* 35 Sources of Moisture for Precipitation in the United States. *Ibid. Tech. Bull. 589.* 36. Water Application Efficiences in Irrigation and Their Relation to Irrigation Methods. *Utah Agr. Exp. Stn. Bull. 348.* 37. Stack Silage. *Wash. Agr. Exp. Stn. Bull. 348.*

E. Circulars, Leaflets, Etc

38. The Mango Hopper. *Madras Agr. Dep. Leaf. 77.* 39. Composts *Eng. Min. Agr. Fish. Adv. Leaf. 289* 40. Baffles for Terrace Outlet Control. *Oklahoma Agr. Exp. Stn. Cir. 328.* 41. A Soil Resources Program for Oklahoma. *Ibid. Cir. 335.* 42. 4-H Club Agricultural Engineering Manual 43. How to build a Septic Tank. 44. How to make and Use the McPhet Terracer. 45. Drouth Rations for Oklahoma Livestock. 46. Farm Stead Improvement for 4-H Agrl Engineering Club Members. 47. Poultry Management for 4-H Club Members and Farm Flock Owners. *Ibid. No 338, 43 340, 341, 346 and 350.* 48. American Grape Varieties. *U. S Agr. Dep. Cir. 437.* 49. Production of Peppers. 50. Cockroaches and Their Control. 51. Bed Bugs. 52. House Ants. *Ibid Leaf. 140, 144, 146 and 147.*

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Printed at The Scholar Press, Palghat.