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EDITORIAL

Increasing Rubber Production With the Japanese occupation of Malaya and the Dutch East Indies, which were the peacetime suppliers of about 97 per cent of the world's natural rubber, the United Nations were confronted with a serious rubber shortage as never before. To make up for this staggering deficit and meet the mounting demand for rubber for military and civil needs, the United Nations are straining every nerve to stimulate and augment production of both artificial and natural rubber to the maximum possible extent. The United States of America, Canada and Russia have on hand an all-out programme of production of synthetic rubber. In India a compaign for increasing the production of natural rubber was inaugurated by the Government of India with the constitution of the Indian Rubber Production Board, in November 1942. This body is, as it should be, represented by the Governments of Travancore, Cochin and Madras, the Commerce and Supply Departments of the Government of India and the various rubber producers' organisations. The Board has its headquarters at Kottayam in the Travancore State and Sir C. P. Ramaswami Iyer, the Dewan of Travancore, is the Chairman. The location of the Board in Travancore is much to be commended, as the State claims about 70 per cent of the total Indian production of rubber with 104,465 acres out of an all-India area of 136,606 acres. The Board, according to the Government Memorandum, will "encourage and ensure the increased production of rubber by all possible means through intensification of tapping, new planting, improved methods of manuring and spraying, distribution and maintenance of machinery or estate requisites, propaganda, scientific research, and any other matters that may be necessary." It is gratifying to note that the Board has set itself to the task with notable promptitude and has achieved substantial progress during the short period it has been in existence. Its efforts to popularise the intensive method of tapping by the "double cut half spiral" system which has been found to give substantially higher yields of rubber than the "single half spiral" system and organising the supply of essential estate requisites and rice for the labour working on the estates are sure to whip up immediate production of plantation rubber. The Board is also encouraging new plantations by notifying the availability of suitable lands for planting Hevea and arranging for the supply of budded plants and clonal seeds from reputed estates in India and Ceylon. Permits for new plantations have already been given for about 17,000 acres and it is estimated that the planting of about 50,000 acres will be completed by the end of 1943. While opinion seems to be divided regarding the advisability of extending the area, as the synthetic rubber industry which is being now developed with feverish haste to meet the essential war needs is likely to compete with natural rubber in post war period, yet the report of the Good Year Tyre Company that synthetic rubbers like 'Buna', 'Ameripol' or 'Neoprene' though possessing elasticity and resilience cannot be universally substituted for the natural product which has a markedly different molecular make-up surpassing all known artificial rubbers in "rebound in severe-service tyre treads", must be assurance enough to the waverers. We hope that the services of the Rubber Production Board will be fully availed of by all planters including small growers who are at present in difficulties in the matter of obtaining proper coagulants and hands trained in the new method of tapping so that the maximum outturn from existing trees is obtained.

Side by side with the drive for enhancing the production of Para *(Hevea braziliensis)* and Ceara *(Manihot Glaziovii)* rubber, the Forest Research Institute at Dehra Dun, the Imperial Agricultural Research Institute at New Delhi and the Agricultural Research Institute at Coimbatore are engaged in the investigation of extracting rubber from other laticiferous plants like the Mexican guayule and the Russian dandelion. In India we have a variety of latex yielding plants growing under different climatic and soil conditions and there is no doubt that a systematic survey and investigation on the possibility of extracting rubber from them will furnish results of considerable value. The investigations conducted by the Botanical and Chemical Sections of the Coimbatore Agricultural Research Institute have shown that we have in *Cryptostegia grandiflora*, of which we published an account in the January issue, a good source of rubber almost equivalent in quality to Para rubber. It is hoped that this study will enable us soon to have complete information on the best method of extracting the latex, quick methods of propagation and other connected matters, so that the present shortage may be immediately met and we may not be in difficulties for the 'tyres' we sorely need.

The Bruhl Medal This medal awarded by the Royal Asiatic Society of Bengal for outstanding work in any branch of Botany has been awarded to Sri Rao Bahadur G. N. Rangaswami Ayyangar, B. A., F. N. I., I. A. S., who recently retired as Geneticist, Millets Specialist and Principal of the Agricultural College and Research Institute, Coimbatore. The previous awards were to the Rev. E. Blatter, I H. Burkill and Sir David Prain. We congratulate Mr. Ayyangar on this signal honour.

The Director of Agriculture, Madras We are glad to learn that the period of service of Mr. P. H. Rama Reddy, I. A. S., Director of Agriculture, Madras has been extended by one year from 16th February 1943. This is to be welcomed as the Department can ill-afford to lose his services at a time when much is expected of it in the matter of increasing the food production in the Province as an integral part of our War effort.

Soil Erosion and Conservation of Moisture in Un-irrigated Black Soils

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Lecture No. 2*

The results of run-off experiments conducted at Hagari have shown that a large proportion of the rainfall is lost by surface flow. The greatest opportunity for conserving moisture in dry soils, therefore, lies in the reduction of losses due to surface run-off. It is naturally impossible to prevent run-off completely. If but a portion of it is saved, a substantial increase in the moisture supply is effected.

As mentioned already, in the black soils the main *hingari* crops, cotton and sorghum have to depend on the moisture that is stored in the soil by their sowing time. Rainfall during their growth period is poor and precarious. The effective rainfall for crop growth is that received in the period August to October, normal for August, September and October is 12·3 in. against an annual normal of 20·6 in. (for the last ten years). Conservation methods like bunding, scooping or listing, therefore, help in better utilisation of the rain water. They arrest run-off and allow the water to stand on the field for a longer time, giving greater chance for it to be absorbed by the soil. Ploughing, by throwing the land into better physical condition, helps in better absorption of the rain water by the soil, provided the furrows do not run along the slope. Any implement which cuts a furrow can be used for forming basins, if the furrower can be lifted at intervals. In the case of the basin-lister this is arranged by means of an eccentric cam. The local interculturing implements, *dhantulu* or blade harrows, can also be used for forming the basins by lifting the harrow at intervals.

As moisture is the limiting factor for crop growth in dry areas, a study of its movements under field conditions is essential.

Theoretical Before considering the movements of moisture in soils under field conditions, I shall briefly outline the theoretical aspect of the problem. The earliest hypothesis on the movements of moisture is familiarly known as the capillary tube hypothesis. It is based on the fact that if a capillary tube is dipped in water, the water level inside will be higher than that outside; the rise in the height is given by the equation:

$h=\frac{2T}{gdr}$; where h is the height of meniscus above the water level,

T is the surface tension between water and air,

g is the acceleration due to gravity,

d is the density of the liquid, which may be taken as unity for water, and

r is the radius of the tube.

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The height of rise is therefore proportional to the inverse of the radius of the tube. If r is very small, then h should be high. If we visualise the soil as consisting of a bundle of capillary tubes of varying cross-sections, r may be taken as the average effective cross-section. If r is very small then water should rise to great heights by capillarity. It follows that the soil between the water table and the water front should be saturated. Varying estimates to which water can rise by capillarity were made by different workers. Their range varies from 10 ft in a year to about 200 ft. in a favourable term of years. Under laboratory conditions, the rise from a water table never reached these phenomenal heights; it rarely exceeded four feet. This was explained away by the fact that it is impossible to imitate the field structure under laboratory conditions. Dr. B. A. Keen in his classical lysimeter experiments showed that the upward rise of water by capillarity occurs over only limited distances. Large cylinders with water-tight bottoms, 2ft. × 6ft, were used for the experiment; their tops were kept a little above the ground level. After the soil was refilled in the natural order, it was allowed to settle for a period of eight years. The level of free water surface was noted in a side tube. From these readings the depth of the free water level was plotted aginst time, during a period of severe drought. The curves obtained by him for the movement of the free water level from an initially saturated soil were very interesting. From these it is concluded that once the water recedes about 80 cm. in clayey soils, it is not drawn back to the surface by capillarity. For all practical purposes upward capillary movment is ineffective even over these limited distances. Dr. B. A. Keen, in a later work came to the conclusion that when water recedes 180 cm. or 6 ft. it is not drawn back by evaporation. Dr. V. I. Vaidyanathan, working at the Irrigation Research Institute, Lahore, found that sub-soil water, in the month of June was drawn to the surface by evaporation from a depth of about 22 ft. But the amount thus reaching the surface is a negligible quantity, being 7 mm. for the whole month. This is a very minute fraction of the evaporation losses at the soil surface, much less is it of any use for cultivation. Thus the simple theory of capillarity could not explain the observed phenomena quite satisfactorily. The theory was also applied to the study of the rate at which water moves through soils. In explaining this the fundamental equation for the flow of liquid through a tube under a known pressure head is used:

V, the volume of liquid flowing out in time t, through a tube of length l, under a pressure head h, is given by :

$$V = \frac{\pi g h d t r^4}{8nl}$$

where r is the radius of the tube, d, the density and n, the viscocity of the liquid.

In the case of downward movement of water, as happens under irrigation or when a rain is received, suppose water is maintained to a constant depth 'a' above a soil column. If we assume that the capillary attraction also assists the forward motion of the liquid through the soil, the total pressure head at a point distant 'h' from the source is a+h+k, where k is the capillary attraction. The rate at which the water front moves can be shown to be:

$$\frac{dh}{dt} = \frac{P}{S}\,\frac{(a+h+k)}{h}$$

$$= \frac{P}{S}\left(1 + \frac{a+k}{h}\right),$$ for the downward motion, P, being the permeability, and S, the pore space.

When h is zero, $\frac{dh}{dt}$ is infinity and when h is infinity, $\frac{dh}{dt} = \frac{P}{S} =$ a constant. Thus in the case of downward movement of water, the rate is infinite in the beginning and tends to become a constant at great heights from the source of water.

In the case of vertically upward motion as happens in the case of the capillary rise from a water table, 'a' disappears and 'k' and 'h act in opposition. Hence we have:

$$\frac{dh}{dt} = \frac{P}{S}\,\frac{(k-h)}{h} = \frac{P}{S}\left(\frac{k}{h} - 1\right)$$

When 'h' is zero, $\frac{dh}{dt}$ is infinity; and when h = k, $\frac{dh}{dt}$ is zero. The velocity of water decreases hyperbolically from infinity to zero at a certain height 'k' from the water table. This shows that $\frac{dh}{dt}$ should vary linearly with $\frac{1}{h}$. From experiments on the vertical rise of water through soils it was found that the expected linear relationship held good only for the first 15 to 20 minutes and there was a progressive decrease in the value of $\frac{dh}{dt}$ over the greater part of the experiment. This demonstrated the insufficiency of the capillary tube hypothesis.

In the case of the horizontal motion of liquid through a soil, 'k' alone acts; 'a' and 'h' disappear; we have $\frac{dh}{dt} = \frac{P}{S} \cdot \frac{k}{h}$ or the velocity is inversely proportional to the height, h.

In a qualitative manner all the above conclusions hold; but they fail to explain quantitatively the movement of water through soils.

When the capillary tube theory failed to explain the phenomena of moisture movements, the analogy of heat conduction and conduction of electricity through solids was applied to the case of movements of water through a porous substance like the soil. This also was not quite successful as the analogy implies that the capillary conductivity or the facility with which water moves through soils should be a constant of the substance, like electrical conductivity or heat conductivity.

It was next realised that a complete picture of the nature of the pore space in a soil was necessary before any correct hypothesis could be postulated. The geometry of the pore space existing in an ideal soil composed of spheres of uniform radius was investigated. The properties of liquid films were applied to moisture films existing round points of contact of the spheres. The pressure below a curved surface of the liquid is less than that above, the deficiency in pressure being given by the product of the surface tension, T and the curvature of the surface $\frac{1}{r}$, r being the radius of curvature of the particle P. D. is proportional to $\frac{T}{r}$. Different pressure deficiencies are associated with different values of $\frac{T}{r}$. The development of the subject is largely due to the work of Versluys, Haines and Fisher. Three stages in the distribution of moisture through the pore spaces of the soil are worked out.

Starting from dryness to saturation, the first one is the 'pendular stage' or the stage of discrete ring formation. As the moisture content is increased, the rings in adjoining cells meet and continuity is established in the moisture within the pore space. The pressure deficiency, which is very high at low moisture contents falls from infinity to 4·1 $\frac{T}{r}$, when the upper limit of the pendular stage is reached. This has been determined as 24% of the pore space or 3·55% moisture content by weight of soil. This is the stage when the films within neighbouring cells meet and continuity in the film is established. It is the beginning of the 'funicular stage' of distribution, when the film thickens at the waist. Between 6% and 24% saturation, side by side with the pendular stage, the funicular stage also is possible. The funicular stage extends beyond 24% saturation; its upper limit is not yet determined. As the soil moisture is increased, saturation of the air cells commences, this being the commencement of the 'capillary stage'. In the capillary stage the soil suddenly passes from saturation to flooding. The capillary stage is complete only when all the pore space is filled with water.

At complete saturation the pressure deficiency is zero. But saturation can exist in certain portions of the cells down to a P. D. of 12·9$\frac{T}{r}$. Between 30% saturation and complete saturation regions of local saturation can exist side by side with regions of low moisture content.

These are some of the salient features of the theoretical studies on the movements of moisture in soils. The subject is still developing.

Experimental Coming to the practical aspect of moisture movements in soils, during the last five years, studies on the seasonal distribution of moisture in soils under field conditions were carried out at Hagari. The relative efficiency of cultural methods intended to conserve rainwater can best be seen only by a study of the moisture condition of the soil at the different depths before and after rainy periods. Soil samples were taken once a fortnight during the crop period in fields which differ in respect of the preparatory cultivation which they received, like bunding, bunding combined with ploughing once in two years and ploughing once in four years etc. Soil sampling was done by means of King's sampler of the tube type, consisting of a cylindrical brass tube about 6 ft long, having a steel end piece, with a sharp edge and marked every three inches.

Screw augers were not found of much use in these black soils as the soil is lifted in big clods and it is difficult to sample without loss of moisture. Every six inch layer of soil down to 3 feet was sampled and the moisture content for any layer is obtained as the average of about six individual determinations. After the first year, samples were taken for layers 0 to 6 in., 6 to 12 in., 12 to 24 in. and 24 to 36 in. The moisture content of the soil when plotted against the date of sampling gives the curve of seasonal fluctutations of soil moisture for the different layers. Thus the field distribution of moisture is obtained under different experimental conditions—rainfall being the only source of moisture. Figures 1, and 2 contain typical curves for the seasonal variation of soil moisture in a plot cropped with cotton and in one which was fallow. The curves for a plot containing sorghum were almost similar to those of the cotton plot except that they lie a little higher than the corresponding curves for the cotton plot.

The soil reaches its peak of moisture after the September–October rains. All layers reach their field capacity by the end of October. Cotton and sorghum during their growth period depend almost entirely on the moisture stored in the soil at the time of their sowing. During the dry period the amount of moisture lost by the different layers of the soil decreases with increasing depth. The curves for the fallow plot show that evaporation losses are confined practically to the top six inch layer of soil. The effect of the diurnal variations of temperature and circulation of air are a maximum in this layer. The absorption of soil moisture by the crops was effective only to a depth of 2 to 2½ feet, as seen from the differences in the moisture content of the different layers, between the moisture at the end of the rainy period and at the end of the growth period of the crops. The following table contains the differences in moisture content of the soil between 31st October 1935 and 6th March 1936, and shows the amount of moisture lost by the different layers of the soil during the period.

Loss of moisture from the soil during the dry period: (31–10–35 to 6–3–36)

Layer of soil	Cotton plot	Sorghum plot	Fallow
0 to 6 in.	17·5	16·9	14·3
6 to 12 ,,	15·5	15·1	5·9
12 to 18 ,,	13·0	11·2	3·9
18 to 24 ,,	10·6	10·0	2·9
24 to 30 ,,	6·4	6·9	2·8
30 to 36 ,,	1·5	0·5	0·2
0 to 36 in.	10·7	10·1	5·0
0 to 36 in.—in inches	5·1	4·8	2·4

The rate of evaporation being high at high moisture contents, the moisture in the top six inch layer of soil rapidly comes down to the hygroscopic moisture in the course of a few weeks after the rainy period. In the cropped fields the variations of moisture with season in the different layers become almost parallel to each other, losses in moisture gradually diminishing with depth. A clear indication that by fallowing the land moisture is carried over to the succeeding season is provided by the curves in fig. 2, where the moisture below the 12 in. depth was almost constant during the dry period. Curves of soil moisture variations obtained in succeeding years are in general conformity with those given in figures 1 and 2. The moisture in a fallow plot is steady below the 12 in. layer, during the dry period, when the distribution of moisture with depth becomes more and more regular as the dry season advances. It follows an exponential relationship of the type :

$$Y = F - (A.\ b.\ 10^{-ax});$$

where Y is the moisture content at any depth x;

F, the Field capacity (equivalent to the moisture equivalent of the soil);

A, the maximum observed moisture at lower depths,

a and b are constants which can be evaluated from the observed moistures at a few depths.

Calculated and observed values of soil moisture, using the above relationship are given below:

Depth in inches	Observed moisture per cent	Calculated moisture per cent
3	8·1	11·4
9	19·1	19·3
15	25·0	23·9
21	26·8	26·5
27	27·5	28·0
33	27·0	28·8

Considering the variations in moisture which normally exist under field conditions, the agreement between the calculated and the observed values is fairly good.

The moisture content of fields which differ in respect of preparatory cultivation was next studied. The effect of bunding, and bunding combined with deep ploughing was investigated. Scooping by various implements like basin lister, *dhontulu* etc. was also studied in regard to its effect on the conservation of moisture. The curves of moisture distribution similar to those given in figures 1 and 2 have been obtained, extending over different seasons, in an experiment where the treatments are as follows:

(a) Control : preparatory tillage consists of working the *guntaka* or the blade harrow three times before the rainy season ;

(b) Bunded ;

(c) Bunding combined with deep ploughing by Cooper No. 21 plough, once in two years ; and

(d) Bunding combined with deep ploughing once in four years. Ploughing, in these soils is done after the harvest of a cereal. As the rotation is sorghum—cotton, the earliest interval of ploughing is once in two years.

These studies have definitely shown that under the *ryots'* method of cultivation, large quantities of rain water are lost by surface flow without being absorbed by the soil, during the short but heavy period of rainfall, usually September—October It has been shown that ploughing and erection of bunds about 7 in. high help considerably in the absorption of rain water by the soil. From the seasonal curves of moisture it was found that the summer showers are just sufficient to compensate for losses due to evaporation. Although ploughing involves some loss of moisture, all such losses occur in the fallow period when no crop is on the land. With the commencement of the monsoon the ploughed plots are quick to absorb the rain water. Similarly scooping the land by the basin lister or by the local interculturing implements like *danthulu* (blade harrows) has checked erosion and increased the powers of absorption of rain water by the soil. The following are a few typical instances to illustrate the beneficial effects of these cultural treatments on the conservation of rain water, when it is received in heavy instalments.

Trial of Improved Dry Farming Methods

Treatment	Moisture per cent in the layer 0 to 3 ft. on 16-8-38	Moisture per cent in the layer 0 to 3 ft. on 31-8-38	Difference	Rainfall absorbed in inches
(Rainfall between the dates - 6·2 in.)				
Control	18·1	22·1	4·0	1·9
Bunded	19·0	24·1	5·1	2·5
Ploughed once in 2 years and bunded ...	17·2	25·1	7·9	3·8
Ploughed once in 4 years and bunded ...	17·3	26·4	9·1	4·4

Scooping Trials

Treatment	Moisture per cent in the layer 0 to 3 ft. on 16-8-38	Moisture per cent in the layer 0 to 3 ft. on 1-9-38	Difference	Rainfall absorbed in inches
(Rainfall between the dates—6·2 in.)				
Control	15·3	21·2	5·9	2·8
Bunded	15·4	24·8	9·4	4·5
Scooped with basin lister and bunded ...	16·6	26·8	10·2	4·9
Scooped with *danthis* and bunded ...	15·7	26·4	10·7	5·1

The effect of any particular treatment on the absorption of rain water depends also to a large extent on the initial moisture condition of the soil; the drier the soil the greater is its capacity to absorb moisture. The treatments are found to be most effective in checking erosion during the first spell of heavy rains and particularly in years of low rainfall. In years of very good rainfall, however, the effect of the treatments is not so conspicuous in the conservation of rain water, as there is a tendency for the different plots to attain the maximum field capacity; yet there is the lasting benefit of saving the soil, which is otherwise washed off in large quantities as shown by studies on surface run-off.

Figures 3 and 4 contain curves of the seasonal variations of soil moisture, for the first and second foot layers of a control plot, during four years, including a famine year In a famine year like 1937-38, when only 15 in. of rainfall was received the moisture condition of the soil below the first foot was very low; the maximum moisture attained by the second foot layer was 22 per cent during 1937-38, while the corresponding figures for 1936-37, 1938-39 and 1939-40 were 28·3, 28·5 and 28·2 per cent respectively. The available range of moisture which is the difference between the maximum moisture and the wilting point (about 18 per cent) was very low during the famine year. It was found during the course of these studies that the moisture content in the second foot layer has a decisive effect on the yield of crops, which are also influenced by the moisture content of the soil at the sowing time to a large extent.

Percolation of rain water to the lower layers of the soil was found to be very slow due to the heavy nature of the soil and there is consequently a lag in the attainment of moisture by the lower layers. Once the moisture content of any layer reaches about 25 per cent, the percolation to lower layers is improved, due to the continuity of moisture films established within the pore spaces of the soil.

The gradual percolation of rain water to lower layers is illustrated by the figures in the following tables, giving moistures before and after periods of rainfall.

Soil Moisture in a fallow plot, 1935-36

Moisture % on the dates	0 to 1 ft.	1 to 2 ft.	2 to 3 ft.	Rainfall between the dates of sampling	
				Rainfall in inches	No. of rainy days
23-9-35	22·6	22·9	21·4		
4-10-35	29·6	23·5	21·6	2·41	3
14-10-35	24·9	26·3	22·4	0·19	1
31-10-35	27·5	30·6	28·6	3·62	6

Trial of Improved Dry Farming Method, Soil moisture in control plot, 1938-39

Moisture % on the dates	0 to 6 in.	6 to 12 in.	12 to 24 in.	24 to 36 in.	Rainfall between the dates of sampling	
					Rainfall in inches	No. of rainy days
12-7-38	9·4	13·5	15·5	20·7	3·89	6
16-8-38	20·4	15·1	16·5	20 0	6·15	8
31-8-38	21·9	29·2	21·5	19·1		

It is seen that a rainfall of 2·41 in. increased the moisture content of the first foot layer alone by 4th October 1935 and thereafter slowly percolated to the second foot layer and increased the moisture content of that layer only after a lapse of about 10 days. The second instalment of 3 62 inches of rain immediately soaked even to the third foot layer owing to the better conductivity for water at high moisture contents. In the second table it is seen that a rainfall of 3·98 in. received on six rainy days increased the moisture content of mostly the top six inch layer only. The moisture content of this layer was initially very low, being the end of the hot weather period. The next instalment of 6·15 in. of rain enhanced the moisture content of the top two feet of soil.

Towards the end of the crop period, *i. e.*, at the time of harvest of the crops, the moisture in the differently treated plots tends to come to the same level, though the maximum moisture at the end of the rainy period may be different.

Fallowing the land naturally leaves a large reserve of moisture for the succeeding crop, in the lower layers (Vide figure 2). It is seen from the following table how a crop after an year of fallow absorbs the moisture from the third foot layer also, while in plots which are continuously cropped, absorption of moisture is negligible in the third foot layer.

Moisture absorption in plots having a crop after a fallow and having a crop after a crop

Losses in moisture per cent between 15—10—40 and 16—1—41, difference in the moisture content between the dates

	0—6 in.	6--12 in.	12—24 in.	24--36 in.	0--36 in. in inches.
Sorghum (40-41) after cotton	19·4	13·1	12 2	2 1	4·90
Sorghum (40-41) after fallow	21·1	14·2	11·5	10·1	6·29
Fallow (40-41) after sorghum	18 3	2·6	1 7	1·0	1 92

The extra moisture is utilised in the production of additional dry matter in the plots after fallow. In view of the uncertainty of the seasons, however, fallowing of a large area cannot be recommended to the cultivators,

Fallowing a small proportion of the holding as an insurance against famine is feasible.

Indirect influence of conservation of water (a) Conservation of moisture reduces the shrinkage and consequently the amount of cracking during the period of crop growth. It has already been mentioned that clayey soils swell when wet and shrink very much on drying. The changes in the volume of the soil due to wetting and drying are large and with the advance of the dry season numerous cracks are formed. It was found that the black soil of Hagari has a shrinkage coefficient of about 65% by volume, when passed through a sieve of 100 mesh to the inch ; *i. e.* when 165 c. ft of soil are dried from sticky point (about 40 per cent moisture) to dryness, the volume will be reduced to about 100 c. ft. In the field the shrinkage will naturally be less than this owing to the presence of coarse particles and as the range of moisture the soil has to pass through in one season is limited. If, however, we can succeed in reducing the desiccation of the soil during crop growth, the shrinkage will be less and there is less possibility of wide cracks developing during the crop period.

(b) A second and more interesting effect of conservation of moisture in heavy soils is that on soil hardness. Losses of soil moisture by evaporation have been shown to be most effective in the top 12 in. layer of soil. This layer, after reaching the maximum field capacity for moisture during the rainy period, is subjected to sudden drying thereafter. The layer of soil between 3 to 12 in. thus becomes very hard, if the desiccation is rapid—the top 3 in. of soil remaining in a loose and friable condition, being disturbed by interculturing and exposed to alternate heating and cooling, on account of the diurnal fluctuations of temperature. If the hardness sets in later in the life of the plant, when it has established itself well, it may not affect the crop growth ; but, if by adverse conditions, the hardness sets in early, the crop suffers on this account badly. By conserving moisture, the setting in of the hard layer may be postponed to a stage when it is of no consequence to the growth of the plant.

In this lecture, I have placed before you certain facts in regard to the movements and conservation of moisture in black soils, which have emerged as a result of the studies conducted during the last six years at Hagari.

Before concluding I wish to record my grateful thanks to the University of Madras for inviting me to deliver "The Maharajah of Travancore Curzon (Endowment) Lecture" in agriculture this year. My thanks are due to the Imperial Council of Agricultural Research, which is financing the Dry Farming Scheme at Hagari, jointly with the Local Government. I must record my grateful thanks to Mr P. H Rama Reddy, I. A. S. the Director of Agriculture and to Mr. P. V. Ramiah, M. A, B Sc. (Edin.), Government Agricultural Chemist, for their continued interest in the work. My thanks are also due to the Superintendent, Dry Farming Station, Hagari, for the

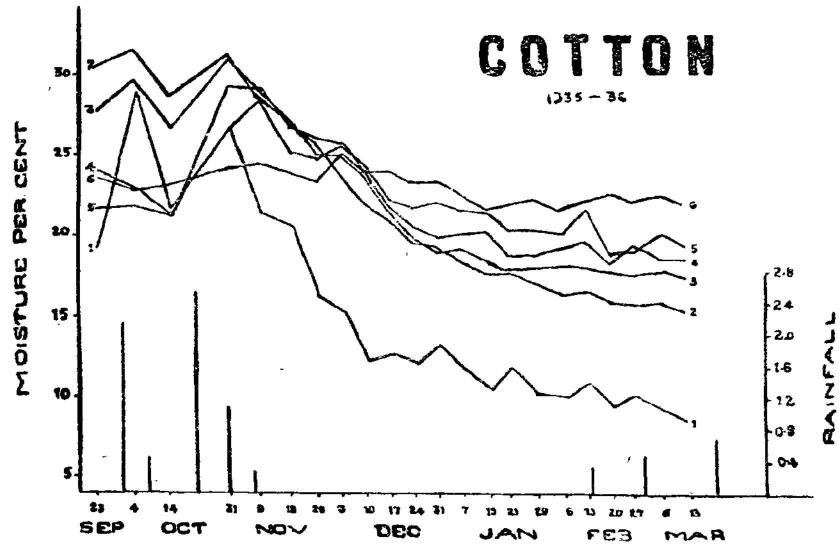

Fig. 1. Soil Moisture curves in a Cotton plot.

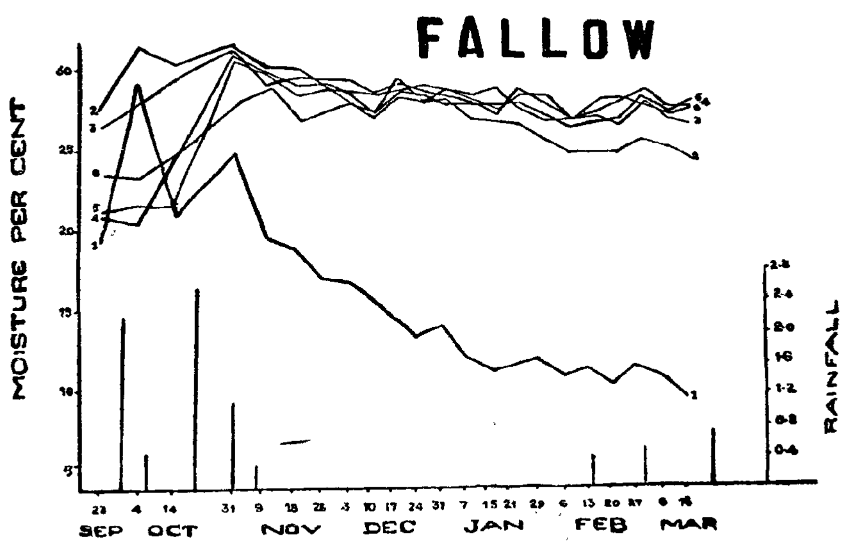

Fig. 2. Soil Moisture curves in a Fallow plot.

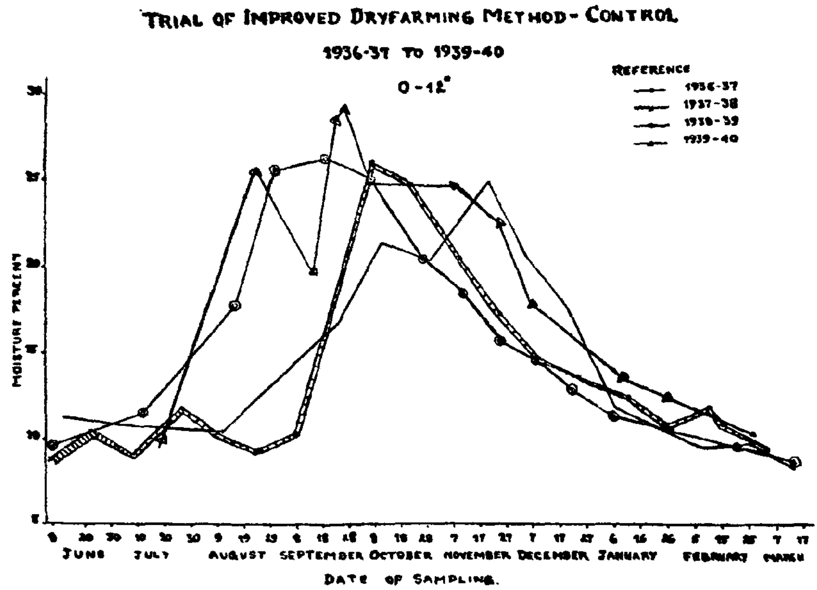

Fig. 3. Soil Moisture curves for four years for the first foot layer. (Double line ; Famine year).

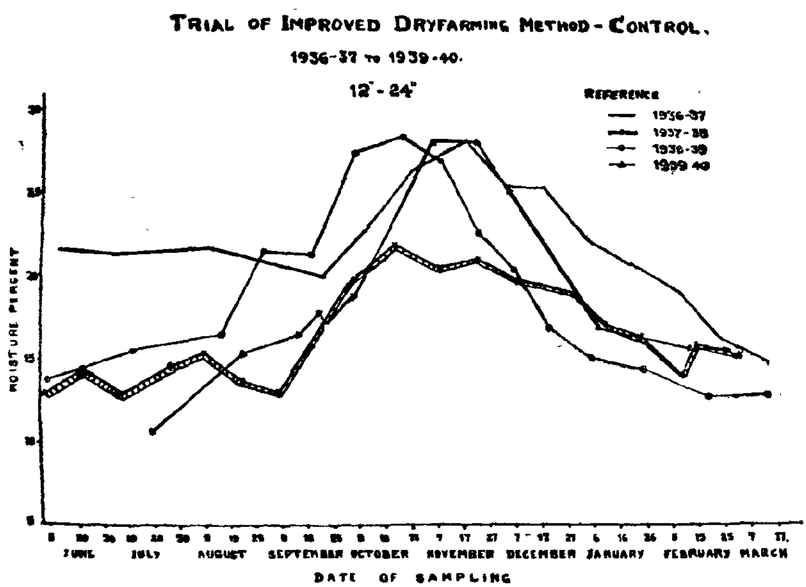

Fig. 4. Soil Moisture curves for four years for the second foot layer. (Doule line : Famine year).

agronomic work done in these experiments, to my staff who assisted me in the collection of the data, to Mr T. R Narayanan, for valuable help in taking the pictures for epidioscopic projection and to Mr. T. Natarajan for help in projecting the pictures during the lectures. Finally I have to thank Mr. R. C Broadfoot, I. A. S., Principal of the Agricultural College, for kindly making arrangements for the lectures, besides presiding over the same.

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A cheap process of preparing charcoal for activated carbon

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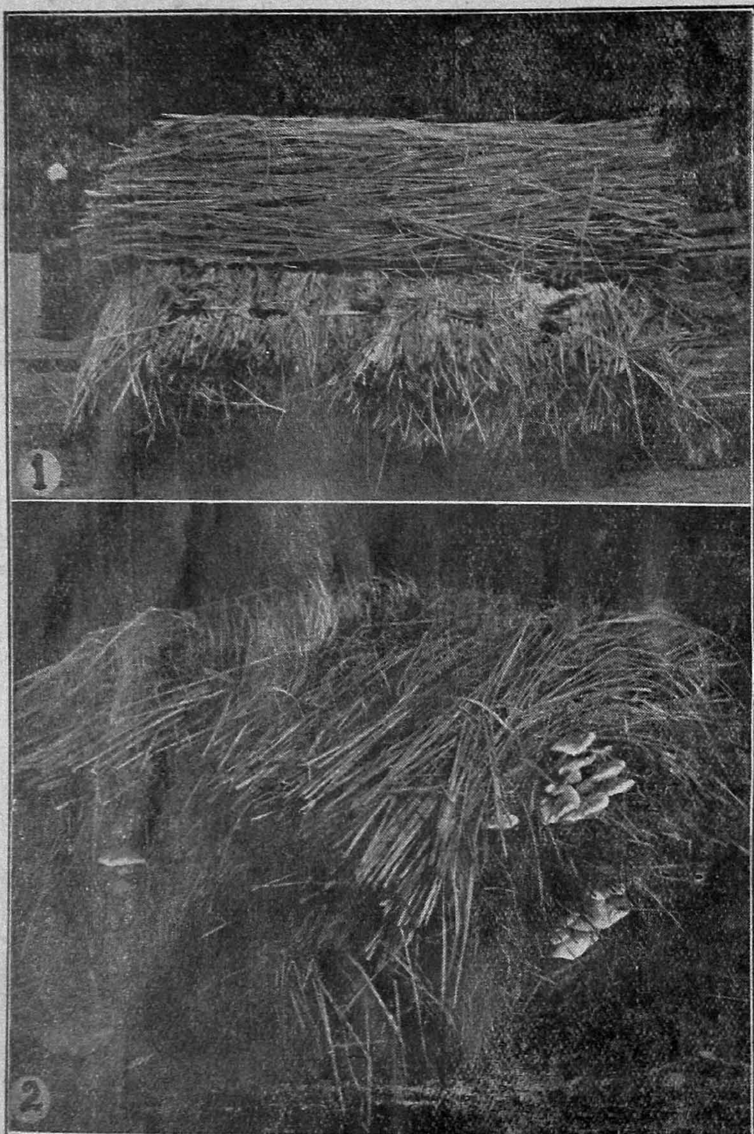
In the manufacture of activated carbon from paddy husk, as carried on at present, the ignition of the first char at high temperature is done in thick iron tubes about 4 ft in length and 8 in in diameter. These tubes, to make them fairly airtight, have to be provided with lids hinged to both ends. Such iron pipes at the present market rate will cost anything from Rs. 30 to Rs. 40 each and even at that high cost are not easily obtainable. As these iron pipes have to be subjected to very high temperature, each time a charge of carbon is ignited they get fire-eaten after 50 to 60 charges and have therefore to be discarded, and new ones substituted. And for the ignition of carbon in such tubes under high temperature it is also necessary to build elaborate and costly furnaces with brick in -mud with the provision of iron gratings, ash pit, etc. To build a furnace of the kind designed by the Government Agricultural Chemist to take in three iron tubes of the dimensions mentioned above, it costs roughly Rs 130. Because of such high cost and intricacy of building such furnaces, it is not possible for the majority of cane growers to prepare their own carbon to clarify their cane juice.

The new simplified method. With a view to simplify and cheapen the process of carbon making and to eliminate iron tubes and elaborate furnaces altogether. the authors tried to find out whether it will not be possible to carry out the ignition of the first char in narrow mouthed earthern pots commonly made and sold by the village potter at an anna each. In the trial conducted a well-burnt earthern pot of about 4 gal. capacity and with a narrow mouth 4 in. in diameter was used. The first char was prepared by the usual process of burning the paddy husk in the open. This first char after cooling was filled in the mud pot and the pot was kept in a shallow pit of about 4 in. in depth. It was then covered with well-dried cow-dung cakes and ignited. Within a few minutes the pot became red hot and the carbon inside began to glow. The ignition was kept up and continued for about 45 minutes before emptying the contents on to a clean floor or cooling. The weight of ignited carbon obtained from each charge was roughly 10 lb. The weight of cow-dung cakes used for each charge was also 10 lb., costing nine pies. The mud pot stood high temperature remarkably well, indeed. There was not the slightest damage to it and it looked that it could be used for igniting several charges of carbon. Even if the pot were to get broken in handling, the replacement charges are so low as to be negligible. Assuming that a pot could be used for igniting a dozen charges and the fuel for each charge of 10 lb. of carbon costs 9 ps, the cost of production of a pound of ignited carbon will work out at a pie a pound. Though cow-dung cakes were used in this experiment as fuel, it does not mean that other kinds of fuel like charcoal and even ordinary firewood could not be used for ignition. It might even be possible to surround the pot with a thick layer of pre-heated paddy husk for igniting the first char. In that case it may be possible to utilise the heat produced in the manufacture of the first char from the paddy husk itself for the ignition of the carbon in the mud pot. In that case the cost of cow-dung cake or other kinds of fuel could also be eliminated.

A sample of carbon prepared by the new method was sent to the Government Agricultural Chemist for treating with caustic soda for activating it, and for his opinion. His opinion was as follows: "The sample of paddy husk charcoal received from you with the letter read above was activated and found to be suitable for the manufacfure of activated carbon. The resulting carbon clarifies sugar juices well."

The results of this trial indicate the possibility of preparing active carbon without the use of costly iron pipes and elaborate furnaces. For large scale manufacture of carbon, one will have to use bigger sized pots and a battery of them, according to the demand for carbon. If costly caustic soda could also be replaced by cheaper alkalies for treating the carbon, the use of activated carbon as a clarifying agent is sure to become very popular, not only in the manufacture of cream jaggery and sugar, but also in clarifying vegetable oils, etc.

Paddy Straw Mushroom.



1. Spawning the bed.
2. Mushrooms appearing after 15 days.

Paddy Straw Mushroom

By

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Mushrooms represent the spore-bearing (reproductive) portions of a group of fungi, coming above ground. The vegetative portion consisting of a system (or mycelium) of thread like branched structures called the 'spawn' remains underground. Mushrooms are of various shapes, sizes and colours. Some of these are edible and can be made into delicious dishes. But there are many which are poisonous and if any of these species are unwittingly consumed, it may lead to fatal consequences Edible mushrooms are cultivated on a large scale in Europe and America *Psalliota campestris* is the species that is grown in most of these countries. The cultivation of this mushroom is a specialised art But this species grows only in cool places with temperature below 70°F. As such it is not possible to grow this species on the plains districts of our province.

In various parts of our province several species of mushrooms come up during the rains or in the cooler months (October—December). These are gathered and used by village folk or offered for sale. But these are available only for a short period and only experienced people can differentiate between edible and poisonous mushrooms.

In Burma and Malaya, a mushroom *(Volvaria diplosia)* known as the 'paddy straw mushroom' is cultivated. As the name implies this is usually grown on paddy straw. It is possible that the same mushroom may be seen coming up in the hay stacks in Malabar during the rainy months but no attempt at regular cultivation of this or other species is evident in our province.

Pure cultures and a bottle of spawn of *Volvaria diplasia* were obtained through the kind courtesy of the Mycologist to the Government of Burma and with these attempts were made to cultivate the fungus at Coimbatore. These were very successful.

The method of cultivation is as follows: To start with, there must be good paddy straw available in sufficient quantities. It would be more convenient if the straw is in bundles (sheaves as made during harvest) each bundle being 8 to 10 in. thick at the base and 3 to 4 ft. in length. A shaded place well protected from winds is selected A corner in a back verandah protected by screens will serve the purpose. The flooring must be well drained. A cement floor, or a slightly raised platform made of bricks or planks may be used. The straw bundles that are to be used must first be steeped in water for 24 hours. To prepare the bed, one layer of straw bundles is first laid on the floor. This layer will be 8—10 in in thickness and must be uniform. The bundles of straw are usually thicker at the base and smaller at the other end Uniformity of thickness can be obtained by placing 4 or 5 bundles side by side with the base pointing in one direction. Over this an equal number of bundles is placed with the bases on the opposite side Both these sets together form one layer of straw of uniform thickness Bits of the pure spawn grown in a bottle are placed over this layer all round the bed 4 to 5 in. from the edge Each bit is about an inch or 1½ in in thickness. The bed is then sprinkled with a handful of *dhal* powder. Next the second layer of straw bundles is placed over the first, these bundles being placed across those of the first The bed is then drenched with water applied through a rose can. Bits of spawn are placed over this layer all round about 4 to 5 in. from the edge and *dhal* powder, sprinkled (as over the first layer). A third layer is formed over the second, the bundles being placed across those of the second layer. Water is applied over this by the rose can Bits of spawn are now spread all over the third layer and not merely round the margin. Again *dhal* powder is sprinkled all over the surface. This is covered by a fourth and last layer of straw bundles placed across the third layer The straw is pressed down and compacted and water is poured over the topmost layer by means of a rose can. The entire bed will form almost a cube 3½ to 4 ft. on each side. A bed of this size can be easily attended to from all sides. The bed has to be watered once or twice a day according to the weather conditions. Too much water should not be applied but the bed must be kept always moist. Mushrooms appear in 15 to 20 days after spawning. These come out in clusters from the sides of the lower layers and from the top. A few mushrooms develop on the first day. The largest number is formed on the second or third day. Usually mushroom formation ceases after the fifth or sixth day. Sometimes a second crop develops from the same bed a week later. But this crop is poor.

The yield from one bed of the aforementioned dimensions varies from 6 to 10 lb of mushroom during favourable seasons. The results of monthly spawning carried out last year show that the heaviest crops are produced in June—July. Fairly good crops are obtained in April, May and August. In March and September few mushrooms develop. During the other months mushrooms are not formed under Coimbatore conditions.

The spawn that is used is a pure culture of the fungus grown on chopped straw in ordinary narrow mouthed bazar bottles The bottles are filled with chopped straw. Then plenty of water is poured in and the bottle allowed to stand for 24 hours Then the excess water is drained off, the bottle is plugged with cotton wool and sterilised by autoclaving at 15 lb. pressure for 2 hours. After sterilisation the bottle is inoculated with a bit of the pure culture of the fungus. The latter grows on the straw in the bottle and in 3 to 4 weeks extends completely throughout the bottle and the spawn is ready for use. One bottle is sufficient for one bed but with two bottles per bed, the yield is better. The spawn is taken out by breaking the bottle. It will be more or less a compact mass of straw and fungus mycelium. This mass is cut into small pieces and used for spawning.

It is advantageous to use the bottle spawn which can be had from the Government Mycologist, Agricultural Research Institute, Lawley Road P. O, Coimbatore In Malaya it is reported that the straw from the bed which had borne a crop of mushrooms is used as spawn for inoculating a new bed. But at Coimbatore this method was not successful.

The cultivation of this mushroom is possible for six months in the year. Since it comes up well only during the warmer months its cultivation can be attempted in the plains tract of our province. It grows in places where the temperature is above 75°F. It is very tasty and delicious. Fresh straw gives a better yield than old straw from hay stacks.

This mushroom is fairly big with a cap 4 to 5 in. in diameter. The cap is dark grey on the top and slightly raised (umbonate) in the centre. The stalk is white 2 to 4 in. in length. At the base of the stalk is a prominent dark grey cup-like structure (volva) from which the fungus receives its name. There is no ring (annulus) on the stalk. The gills are light flesh coloured when fresh.

Our thanks are due to Mr. U. Thet Su for kindly supplying the pure culture of the fungus.

Ref.:- Thet Su, U. and Seth, L. N. *Ind. Farm*, Vol. I, 332, 1940.

SELECTED ARTICLE

The Wealth of India

India is a subcontinent of Asia shaped like a battered triangle, the northern part entirely landlocked and the southern bounded on the west and east by the Indian Ocean and the Bay of Bengal, respectively. The base of the triangle stretches eastward from the Iranian border to the western frontier of Burma, over which the Japanese now stand guard. From north to south, India is 2,000 miles long and from east to west 2,500 miles wide. The total area is estimated at 1,578 000 square miles.

Into this area which is about half the size of the United States, there is crowded a population estimated in 1941 at 389 millions. It is a fast growing population, as indicated by an increase of some 60 millions in the past two decades In any evaluation of the material wealth of India the population factor is of great importance. A mere enumeration of the country's wealth in terms of agricultural and mineral resources makes for very impressive reading, but it is considerably less so when the resources are related to the needs of so huge a population.

The wealth of India is essentially agricultural. Much has been said in recent years about the industrialization of India, but the fact is that now—more so than in the past—the country is predominantly rural. It has been estimated that agriculture provides, directly or indirectly, the livelihood of 89 per cent of the people. The remainder derive their income from industry, which has failed to absorb any of the excess agricultural population. Indeed, the proportion of farm population to the total increased from 61 in 1891 to 73 in 1931. This is the reverse of the process taking place in the Western World and in the economically more progressive countries of the East and it thereby underlines the importance of agriculture in India's economy.

The agricultural resources of India consist of some 320 million acres of cultivated land. Inasmuch as the problem of securing adequate food supplies for India's 400 millions is the most significant, four-fifths, or 250 million acres, of all the cultivated land is under food crops; the remainder is devoted to industrial or cash crops.

Rice is the most essential food crop of India. The diet of approximately 70 per cent of the population consists mainly of rice. India has the world's largest acreage under rice (72 million acres) and is second only to China as a rice producer (57 million pounds). These figures are formidable indeed, but it must be noted that in the past two decades output actually declined by 8 per cent as against an 18 per cent rise in population The decline in output is caused by stationary or slowly declining yields. The average yield per acre in the past two decades ranged from 29 bushels (1922-26) to 26 bushels (1937-41) as against 68 and 75 bushels in Japan. India, therefore, does not produce enough rice to satisfy its requirements, and the per capita consumption has declined from 205 to 162 pounds. Even on this basis of reduced consumption India must import from 6 to 8 per cent of its total rice supply from Burma. With the Japanese occupation of Burma, India's rice supply situation has been weakened still further.

Wheat is India's second important crop, the area averaging 35 million acres and output about 375 million bushels. As in the case of rice, in recent years there has been little increase in acreage and output of wheat. The per capita consumption (60 pounds) has remained practically unchanged, but mainly through diversion of what was formerly an exportable surplus into domestic channels of consumption.

In addition to the two premier crops, India is a large producer of a variety of millets (more than 60 million acres), barley, corn, and legumes. India is the world's greatest sugarcane producer. There are nearly 4 million acres under sugarcane, with an output of 5 million tons of sugar, but of low quality. In terms of volume, India is the world's largest tobacco producer, with 1,497,000 acres growing 1,375 million pounds

Another important source of India's agricultural wealth is its livestock which including sheep and goats, is estimated at 310 million head. Because of the many and indispensable functions assigned to livestock by Indian peasants— "the cow and the bullock have on their patient back the whole structure of Indian agriculture"—their economy is dependent upon the quality of this livestock. The fact is, however, that the livestock is of a poor quality indeed, it is small sized, inefficient, and subject to many contagious diseases. The gradual expansion of the cultivated area at the expense of pastures in the congested areas of India has adversely affected animal husbandry It is contended that the fodder available in India is sufficient for only two-fifths of the livestock. The large number of livestock in India places the country in the position of the world's leading producer of hides and skins, both raw and half tanned. The output is estimated at 20 million cattle and almost 6 million buffalo hides, 28 million goat and kid skins, and 19 million sheep and lamb skins.

India is one of the largest producers of oilseeds, oil cakes, and oils, having planted an area of 23 million acres under a variety of oil-bearing seeds. Chief among these is a yearly output of 3 million tons of peanuts, and a yearly output of 340,000 tons of pea-nut oil. Linseed, castor-beans, rapeseed and sesamum are the other important oilseeds. Approximately a million tons of oil extracted from these seeds is exported. India is perhaps the original home of the cotton plant and has been for many years the second largest cotton producer, with an output of 4·5 million bales per year. Despite attempts to develop substitute materials, jute continues to be the cheapest packing cloth in the world. In this field India enjoys the virtual monopoly, based on an annual output of 9 million bales.

Despite the agricultural character of India, it differs considerably from such agricultural countries as the Netherlands Indies and Malaya. This is because of India's variety of mineral resources, not possessed by the other two countries. India represents a vast potential industrial area, with an abundant labor supply and unlimited market; but these very factors, associated with low spendable income, inefficiency of labour, lack of capital and reluctance on the part of the colonial administration to encourage heavy industries, have so far handicapped the country's industrial development. Yet India has large resources upon which industrialization could feed itself, once the handicaps are lessened or eliminated altogether.

India's mineral resources include enormous easily accessible supplies of high grade iron ore. The reserves are estimated at 3 million tons, and iron content of the ore averages 64 per cent. Coal, cooking coal, and manganese—all basic materials in iron and steel making—are available in abundance. Estimates of the coal resources vary from 36 to 60 billion tons, of which 5 billion tons is of good quality and easily workable. After Russia, India is the largest producer (over 1 million tons) of high grade manganese. The country is the world's largest producer of mica, the other chief producers being the United States and Canada. India's proportion, by value, of the total output of these three countries is over 80 per cent India is one of the world's important producers of chromites, an essential mineral used in the manufacture of stainless steel and of chromesteel for armor plate for warships. Bauxite deposits of considerable extent and of good quality for the manufacture of aluminum, as well as large potential hydroelectric power, must be added to the non-agricultural resources of India.

By far the greater part of the mineral wealth of India is yet in the making. There is altogether too great a gap between the mineral resources of India and their actual utilization. With few exceptions, notably that of the cotton textile industry, India's Industrial development has proceeded at an extremely slow pace. In 1934–38 India mined only 24 million tons of coal annually, 2½ million tons of iron ore, 339,000 tons of copper ore and 8 000 tons of bauxite, while the value of the entire mineral output averaged 65 million dollars. Even under the stimulus of war production India's output of finished steel in 1941 amounted to only 1,250,000 tons.

It is unquestionable, however, that the enormous wartime demands that rise daily have created an urgent need for intensified industrial development of India. It involves also a basic and positive change in the attitude of Great Britain regarding a rapid industrialization of India. This, in conjunction with the material and technical aid received from the United States, may find India in a position to translate at an accelerated rate the country's potential resources into actual wealth.

Such a development is all the more important because not all is well with India's agriculture, now its principal source of wealth. The fact cannot be overlooked that the 320 million acres of cultivated land do not provide all the people with a quantity—let alone quality—of food necessary to meet the minimum requirements of the unpretentious diet prevailing in the Far East or south-eastern Asia.

There is nothing inherent in an Indian peasant that prevents him from becoming an efficient producer of food and other farm products and from realizing all the benefits that follow. But the institutional milieu within which the peasant lives and works militates against such changes. Lack of education, very limited application of agricultural science, and a land-tenure system that burdens tens of millions of Indian peasants, inheritance laws that result in fragmentation of holdings and, what is perhaps most important, a rapid increase in population pressing ever harder against the available resources - all these combine to make output low, both per unit of land and per man. The net result is not enough agricultural wealth to go around, which in practice spells widespread poverty and disease.

No progress in agriculture or in industrialization can appreciably increase the wealth of the people if the growth of population in India continues at the rate of the past two decades, nullifying whatever material advantage is gained. It is well to remember in this connection the conclusion reached by the Royal Commission on Agriculture in India that everything "which we have advocated for the material advancement of the people will merely postpone the effects of the growing pressure of the population on the soil. No lasting improvement in the standard of living of the great mass of the population can possibly be attained if every enhancement in the purchasing power of the cultivator is to be followed by a proportionate increase of the population." W Ladejinsky, Office of Foreign Agricultural Relations (*Agric. Situation, U S A , August 1942)*

The Cultivation of Rubber, *Hevea brasiliensis*, in India

Until about the year 1895 rubber was a forest product obtained chiefly from wild trees in Brazil. Rubber was also obtained from *Ficus elastica* trees growing wild in Assam as early as 1880. By about 1914 *Hevea brasiliensis* had practically eliminated all other kinds of raw rubber from the market. The introduction of this tree into the East from its natural home in the Amazon valley became successful by the fortunate survival of 2000 seedlings despatched from Kew to Ceylon in 1877, out of a total number of 70,000 seeds brought from Brazil to Kew by Wickham in 1876. The first plantation in India of the Hevea trees appears to have been in Poonoor Estate in S. Malabar in about 1900 and the next in Travancore in Periyar Estate in Thattakad. By 1924 the total area under rubber cultivation in India rose to about 71,500 acres. The rubber cultivated area in India as at 30th June 1942 was 136 606 acres of which 104,465 acres were in the Travancore State.

The invention of the pneumatic tyre has been largely responsible for the rapid growth of the plantation rubber industry. It has been estimated that in 1941 the total exports of plantation and wild rubber from all producing countries amounted to 1,560,000 tons.

The price of rubber in 1910 touched 12 sh 9 d. per lb. The rush to plant resulted in over-production. In 1922 the price fell to 6¾ d. per lb. After recovering during the operation of the Stevenson Scheme when 4 sh. 8 d. was reached in 1925, it fell in early 1930 to less than 2 d. per lb. Since the introduction of the International Rubber Regulation Scheme the price of rubber has not fallen below 6 d. per lb. It has recently been fixed at round about 1 sh. per lb.

Hevea is a quick growing, tall, erect tree of the family Euphorbiaceae. It thrives up to an altitude of 1500 ft. but above this the trees are less vigorous, smaller and produce less rubber. It prefers good, stiff loamy soil with sub-soil drainage, but it grows well on peat or clay, on alluvial soils and even on hard gravelly soils. A rainfall of 80 to 100 inches per year is good for the rubber tree It cannot tolerate salt and so will not grow on land liable to flooding with sea water. The tree is not generally fit to tap until five or six years after planting.

In planting an estate from jungle land or replanting areas where old rubber trees are to be replaced by better ones, the land selected is felled and burnt. The usual practice was to allow the timber and debris to become well dried in order to obtain a complete burn. The present tendency is to give only a light burn, so that the scrub jungle and the smaller timber alone are burnt while most of the heavier timber remains. A light burn causes less destruction to the humus in the surface soil and leaves more seeds and roots of indigenous plants capable of rapid new growth. Soil erosion following clearing up of the jungle, is thus prevented to some extent and the timber is useful for an year or two in helping to build up bunds and terraces.

After the land has been cleared, lined, terraced or bunded, drained and silt pitted, planting holes are dug. The number of planting holes or pits may vary from 180 to 250 per acre. This may be increased to 300 per acre for obtaining a higher crop during the first few years of tapping and then thinning down to the required number. The holes are filled before the planting season with surface soil and any manure available. Three to four seeds are placed in the pit to safeguard against loss in germination and until successful budding, and covered up with a small amount of soil. Seeds may be germinated in special beds, planted in nurseries and when the seedlings have reached an year's growth or even more they may be planted in pits in the field. Basket plants may also be used for such planting. In the meanwhile the whole area is planted with suitable cover crops to prevent soil erosion and to provide humus for the soil.

Rubber trees grown from ordinary seed yield variable quantities of rubber, the average in South India being about 300 lb. per acre per annum on well managed estates. To increase the production of rubber various methods are employed. Manuring with suitable mixtures and spraying against leaf-fall disease give good results. By the selection of high-yielding mother trees and by vegetative propagation, *e. g.*, by bud-grafting, a large number of clones of high yield has been established. The production of clove seedlings, that is, seed produced from the cross-fertilisation of one or more proved cloves was recognised early as one of the most valuable results which would be secured from budding. Budgrafted areas are now giving almost four times the yield of ordinary seedling areas. While clonal seed areas give yields fully equal to that of the parent clones, there is the added advantage of no loss of time through budding nor doubts about renewal of bark or any other disadvantages likely to be observed in budded areas.

The budwood is obtained from nurseries planted for this purpose. It is cut up into lengths of about a yard and from each length about 12 to 15 buds can be obtained. The dormant buds are sliced off with a sharp knife giving chips of bark with the bud in the middle and with a thin layer of wood still on the inside. The stocks, that is, the plants which are to be budded should have a diameter of not less than one inch at the base which represents about an year's growth. A narrow flap of bark is detached from the stock at the base by making two vertical cuts and one across the top or preferably at the bottom during the rainy season. This flap is pulled outwards exposing the outside of the cambium or growing layer. The bud patch is then trimmed to a width and length slightly less than that of the exposed cambium on the stock and after the thin layer of wood is gently pulled out with the teeth, it is carefully placed under the flap of bark on the stock, so that the living cambium of the patch and that of the stock are in contact. The flap is placed in position and the whole is then tightly bound up with waxed cloth. An expert budder could bud 200 to 250 plants per 7-hour day in the field, or 250 to 300 in the nursery. After two or three weeks the binding is opened up. The flap of bark is pulled away and the bark of the bud patch gently scraped to see if it is still green which indicates that the budding has been successful and that the bud patch is alive and in organic union with the stock. A good budder could get 90% success. Failures are re-budded. The stock is then cut off a few inches above the budding, which causes the bud to shoot. Although budding in the nursery saves time, budding in the field may be more suitable where weather conditions are uncertain.

Rubber latex is obtained by making an incision in the bark to open out the latex containing cells. The common tapping knife used in South India is the Michil Golledge type designed to remove a thin shaving of bark leaving a surface sloping inwards slightly towards the tree to prevent the latex from overflowing down the bark. After the cut is made the white milky latex exudes from the freshly cut surface and flows down the cut towards the spout—a piece of bent galvanised iron embedded into the bark and it drips from the cut into the cup. The usual system in S. India of tapping large trees is the "half-spiral alternate day system". Recently the "double half-cut, once in three days system," with rest from the beginning of February to middle of March and again during at least two months of the monsoon period beginning from 15th June to 15th August on four estates gave the following increases:—

	Results of "half-spiral alternate day" tapping (lb. per acre)	Results of "double-cut half-spiral once in three days with rest" as above-mentioned (lb. per acre)
Estate No. 1	430	525
,, 2	389	495
,, 3	430	525
,, 4	525	540

These figures definitely indicate that this system could produce better results than the "half-spiral alternate day" system at least during the present emergency period.

Latex preserved with ammonia gas has a ready market. For making smoked sheet, the latex is strained to remove dirt and it is then poured into a large bulking tank, diluted with water to a half or less of its natural rubber content, thoroughly mixed and rubber content checked by a hydrometer in order to know how much acid has to be added to it for proper coagulation. One fluid oz. of acetic acid to 11 lb. of rubber or one fluid oz. of Formic acid to 18 lb. of rubber is added for coagulation of latex by the following day. Larger quantities in proportion are added if sheet is to be made the same day. Before adding any acid it has to be diluted with water. The diluted latex, after the addition of the necessary quantity of diluted acid, is poured into aluminium pans or into tanks with aluminium or wooden plank divisions of proper size so that on coagulation it forms into slabs of coagulum. Such slabs are removed from the coagulating pans and washed in water and after being lightly pressed by hand to remove the water they are passed three or four times through a smooth roller and then through a criss-cross or ribbed marking roller to turn out the sheet with a diamond pattern or ribbed marking. These sheets are then hung on racks in the shade for a few hours to drip and are then carried to a smoke house for drying in the heat and smoke of burning firewood. In a modern smoke house it takes only about four days to smoke and dry the sheet completely. A well smoked sheet is translucent, brownish or dark amber in colour without any opaque patches. In the packing shed each sheet is examined against the light and any obvious pieces of dirt are cut out. Rubber sheets are then sorted into various grades and packed in bales covered with jute hessien, each bale containing 224 lb. nett. Such bales are stencilled with nett and gross weights, grade estate name, etc. and despatched for sale in the market. P. Kurian John (*Travancore Information*).

Hints for Bee-keepers

For March

Favourable factors for the prosperous working of the colonies exist during this month also. *Peltophorum*, maize and palmyrah are in full bloom and these afford a plentiful supply of pollen. Cambodia cotton, wood apple, *margosa*, rain tree, and *pungam* constitute the main sources of nectar. Of these, neem and wood apple are particularly favoured by the bees since numbers of them can be found humming round their flowers *Pungam* is reported to be a very good source of nectar also. The environments continue to be favourable for the bees and as such the hints already given regarding provision of additional space for breeding and honey storing, swarm prevention etc. must be borne in mind. As most of the colonies are expected to be in yielding condition during the month the following hints on the extraction and preservation of honey will be useful.

The bee keeper has to wait until the honey in the comb is in a fit condition to be extracted. It is a well known fact that bees convert the nectar which they collect from flowers into honey within their stomach, and regurgitate it into the cells. This honey contains superfluous quantity of moisture which would spoil its quality in course of time. This is therefore promptly eliminated by the bees and the cells are sealed with wax. The honey at this stage is called "ripe" and for the reasons mentioned above combs having about 75% of the cells sealed are to be taken for extraction. Occasionally the bees take an unduly long time to close the cells and such combs also can be taken for extraction just to stimulate the bees. The honey combs have first to be taken out from the super and the adhering bees driven away. In cases where the owner possesses only one or two hives, the combs can be removed one after another and the bees that may be covering them may either be shaken off or blown out. When there are a number of hives to be handled, the super itself can be removed and held with its upper edge just touching the floor board; while a smoking torch is held below. The bulk of the bees will rush out and enter the hive. In large apiaries the process can be simplified by the use of the "bee escape" – a cheap and simple contrivance. It consists of a screen board, with a metal trap-like device at its centre which allows only the egress of bees. This board is kept between the super and brood chamber with its opening facing up, on the evening prior to the date of extraction. The next morning the bees in the super go out for their foraging, but are not able to get back and the super is thus cleared of the bees. The next process is the uncapping of the sealed combs. This is done by placing a sharp table knife flat on the sealed area and slowly shaving off the thin layer of wax The edge is likely to get blunt while cutting wax and the knife has therefore to be dipped frequently in hot water. When handling a large number of combs, it is better to have two knives, so that one can be used while the other is kept in hot water. Bees have a tendency to unduly lengthen the honey cell with the result that the combs bulge out. These may be sized just up to the width of the top bar of the super frame while uncapping. The honey should be extracted with the help of the honey extractor. The machine is to be rotated slowly at first and the speed gradually increased; otherwise the combs are likely to break by their own weight. Combs which are not properly attached to the frames can be held in position by loops of broad plantain fibre. The extractors which are in use at present remove honey from one side only at a time and the position of the combs has to be reversed for extracting from the other side. The extracted honey should be filtered into a clean and tinned or enamelled vessel and then ripened artificially. The process consists of keeping the vessel with the honey in hot water for about half an hour, maintaining its temperature steadily at about 65° C and that of the honey at 60° C. The process not only pasteurises the honey and removes the superfluous moisture in it, but also clears it of certain impurities which are present in some samples. These collect as a scum at the top and can be easily skimmed off. The honey should then be allowed to cool slowly and bottled in air tight glass receptacles while it is still warm. Metal containers should as far as possible be avoided. Scrupulous cleanliness should be observed during all these operations and honey should on no account be touched with the hand. *M. C. Cherian and S. Ramachandran*

ABSTRACT

Conserving soil and water with stubble mulch H. H. Bennett, (*Agric. Engin.*, *23 (1942)*, *No. 2.* "Stubble mulch" is defined as a process of protecting cultivated or bare land in such a way as to conserve soil and soil moisture and reduce evaporation through the use of a complete or partial surface covering composed of some form of crop stubble or residue. The primary process consists in merely stirring the soil with ploughs without mold boards to turn all the vegetation or vegetative litter under. It leaves much of the vegetable material—crop residue or vegetative litter—on the land as a surface protection against erosion. Comparing this treatment with that of basin listing, the author cites the observation at Lincoln, Nebr., that applying 2 tons of wheat straw per acre and ploughing with a blade or winged implement a few inches beneath the surface without turning the straw under, conserved 54 per cent of the rainfall. Under comparable or duplicate conditions, only 20·7 per cent of the rainfall was conserved with ordinary summer fallow and only 27·7 per cent with basin listing, even though the basin listing permitted virtually no run-off since the losses due to evaporation from the convoluted bare surface tended to offset the gains due to prevention of run-off. (*Exep. Sta. Rec. Vol. 87, No. 1, July 1942.*)

On the antibacterial action of honey. Franco, M. and Sartori, L. (*Ann. Hygiene 50 (5): 216-227 (1940)* All honeys studied were antibacterial to various species. Some were bactericidal especially to *Eberthella typhosa*, *Escherichia coli*, and dysentery organisms; others were only bacteriostatic. Acidity and increasing sugar conc. enhance the effect. The same honey might be bactericidal up to 20% concentration, and bacteriostatic at 10—5%. A specific antibacterial substance is present in the honey which can be demonstrated to be photosensitive, short exposure to sunlight greatly reduces activity, heating destroys it (60 min. at 56°C, 30-20 min. at 70°-80°C, 10 min. at 90°C, 5 min. at 100°C). Aging has little effect. Attempts to trace the origin of the substance to organs of the bee (head, thorax, honey sac) were inconclusive. The evidence points to its origin in the flowers from which the bees collect nectar. Honey from different provinces, and collected during different seasons, varied in antibacterial action. The change associated with seasons when different flowers are in bloom is considered to be indirect evidence for origin in the flower. (*Biol. Abs. Vol 16 No. 3*).

GLEANINGS

Soil-less Cultivation. A review of the recent progress in soil less cultivation has recently been given by Prof. R. H. Stoughton (*J. Min. Agric., 49, 25; 1942*). In spite of many misconceptions and difficulties, steady progress has been made both in the laboratory and on small scale semi-commercial installations, and a stage appears to have been reached when some reliable judgment can be formed on the question. Two types of systems are in use: (1) in which the plants are grown in a tank of nutrient solution with the roots immersed in a liquid medium; (2) where the permanent substratum is an inert material such as sand or gravel, to which nutrient solution is supplied at intervals. Carefully controlled trials have shown that in general the first of these is unsuitable for use in Great Britain, owing to the difficulty of securing adequate aeration for the roots, and the low light intesity. Far more promising results have been obtained with the second method, which may be considered under two main headings, namely, sand and sub-irrigation culture. In sand culture the plants are fed by watering with the nutrient solution from above the surplus liquid draining away. Tomatoes, chrysanthemums, lettuce and a wide range of vegetables gave very satisfactory crops under these conditions, and promising results have been obtained with carnations using a slightly modified and simplified technique.

The disadvantages of the system, however, are the care needed in the control of the moisture content of the medium, and wastage of materials through drainage, but these are to some extent offset by the small cost of the outlay compared with the sub-irrigation method. In the latter case, the nutrient solution is pumped at intervals from below into the growing tank until the gravel is flooded to the top, the pump is then shut off and the liquid flows back by gravity to the supply tank. The watering and feeding can thus be made almost automatic, the aeration of the medium is excellent and considerable economy in fertilizer materials is effected. Further, chemical sterilization of the gravel is easily carried out. To meet the criticism that soil-less cultivation results in crops of lower nutritional value, chemical analysis of the carbohydrate, protein, inorganic constitutents and vitamin C content were carried out. No significant differences could be established between plants grown in gravel and those grown in soil. Experiments are now in progress at the University of Reading, under a grant from the British Electrical and Allied Industries Research Association, to test, among other things, the effect of heating the solution in the sub-irrigation culture of tomatoes. Work is also proceeding on the chemical testing of the solution by simple colour tests, so that its composition may be readily controlled according to the requirements of the crops. *(Nature, Vol. 150, No. 3797, Aug. 8, 1942.)*

Preservation of Eggs. For preservation of eggs the following points should be borne in mind; (i) That eggs when unfertilized keep better and cook better as boiled or scalded eggs than when fertile. so that when the hatching season is over, it is a good plan to pen the cocks; in a week the eggs should be infertile. (ii) The eggs should be absolutely fresh; they may be placed in the preservative as soon as they are laid. This means that the older eggs at the bottom of the vessel would be the last used. To get over this, when the eggs are about to be used there should be another vessel with preservative at hand, and the top eggs put at the bottom of this receptacle, so that the older eggs will be used first. (iii) A kerosene tin should not be used; an earthenware jar is better. (iv) When using preserved eggs for breakfast, always prick the top with a pin before placing in the water to cook. For frying or poaching this is not necessary. (v) Eggs should be used soon after they have been taken out of the solution for preservative. 1. Take 1½ lb. of lime, mix with one gallon of water; stir this well at short intervals until the lime is dissolved as far as possible. Add one lb. of salt; stir, and leave until the liquid becomes clear, then pour the liquid off carefully, leaving any sediment at the bottom; or better still, pour through a sieve. After a month add a little more lime water not lime itself. 2. Another method is to obtain a wooden box of convenient size; place a layer of salt at the bottom about 1½ inches in depth, and put the new laid eggs upright in this, small end downwards. When the bottom layer is full, cover with about two inches of salt. Repeat this process for every fresh layer of eggs. Keep the box in a fairly dry place. Eggs preserved in this way should keep for six months. For our climate method number one is better. *(J. Jam. Agric. Soc. 46,* 107—108).

Press Note

Wheat Rust Control

Investigation on the rust diseases of wheat in India has shown that the main source of infection for the occurrence of these diseases in the main crop in the plains as well as in the hills lies in the hills where the germs of the diseases are able to survive throughout the year. Thus they are enabled to pass on from the first season or April sown wheat or barley crop to the main crop sown from October. The first season crop, its stubbles and tillers as well as the self-sown plants form a continuous line for the infection of the main second season crop of wheat or barley.

In the plains however, the germs of the rust diseases are unable to survive the severe heat of the summer and consequently perish. Though the continuity of the source of infection is thus broken, the main crop in the plains gets infected by wind borne germs from the hills.

In connection with the control of wheat rusts, the Government of Madras propose to bring into operation from April 1943 the Madras Agricultural Pests and Diseases Act of 1919 in order to prohibit the cultivation of wheat or barley crops in the Nilgiri and Palnis hills between April and September and to aid the clean up campaign.

Cultivators are advised to grow *ragi*, *samai*, *korali*, rye or garlic during the period when wheat and barley cultivation is prohibited.

In order to save the wheat crop in India from the ravages of the rust diseases, the cultivators in the Nilgiri district and the Kodaikanal taluk of the Madura district should carry out the following measures:

(1) Do not have a standing crop of wheat or barley between April 1st and September 30th in the Nilgiri district and April 15th and September 30th in the the Kodaikanal taluk of the Madura district.

(2) After harvesting the main crop about February or March 'clean up' the fields by removing all stubbles, ratoon tillers and burn them *in situ*.

(3) Pull out all self-sown or out of season wheat or barley plants in the fields, in threshing floors or residential buildings whenever found between April 1st and September 30th.

If any cultivator fails to carry out the proposed measures in his fields, he will be liable to a fine not exceeding Rs. 50 or in case of default to simple imprisonment for a period not exceeding ten days and the measures will be carried out by the inspecting officer or under his supervision and the expenses recovered from the party.

Crop and Trade-Reports

Satistics—Crop—Groundnut—1942—Fourth or final report The average area under groundnut in the Madras Province during the five years ending 1940–41 represents 44·9 per cent of the total area under groundnut in India. The area sown with groundnut in the Province in 1942 is estimated at 3,260,600 acres. The estimated area for this year is less than the average area of 3,422,210 acres by 4 7 per cent. The increase in area is general outside Vizagapatam, Kistna, Tinnevelly and Malabar and is due chiefly to the prevalance of high prices for groundnut during the main sowing season. The increase in area is marked in Kurnool, Bellary, South Arcot and North Arcot. The harvesting of the summer and early crop of groundnut concluded by the end of October. The harvesting of the winter or main crop is proceeding. The yield per acre is expected to be normal in East Godavari and Tinnevelly and below the normal in other districts due mainly to drought. The crop was also affected to some extent by insect pests in parts of Chingleput and Tanjore. The yield is expected to be 1,207,600 tons of unshelled nuts as against 1,225,310 tons in the previous year, a decrease of 1·4 per cent. The yield in an average year is estimated at 1,710,550 tons.

The wholesale price of groundnut (shelled) per imperial maund of 82$\frac{2}{7}$ lb. as reported from important market centres on the 18th January 1943 was Rs. 10—1—0 in Adoni, Rs. 10 in Coimbatore and Tadpatri, Rs. 9-10—0 in Nandyal and Hindupur, Rs. 9 -7—0 in Erode, Rs. 9—5—0 in Guntur and Salem, Rs. 9-4—0 in Vizianagaram, Rs, 9—0—0 in Vizagapatam and Vellore, Rs. 8—15—0 in Bellary, Rs. 8—13—0 in Cuddapah, Rs. 8—11—0 in Cuddalore and Rs. 7—7—0 in Guntakal.

(*Additional Joint Secretary, Board of Revenue*).

Cotton Raw, in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1942 to 31st January 1943 amounted to 730,433 bales of 400 lb. lint as against an estimate of 559,700 bales of the total crop of 1941—'42. The receipts in the corresponding period of the previous year were 645,424 bales. 725,247 bales mainly of pressed cotton were received at spinning mills and 3,169 bales were exported by sea while 96,939 bales were imported by sea mainly from Karachi and Bombay.

(*Director of Agriculture*).

Thirtyfirst College Day Sports—1943

The annual athletic sports for the year 1942-43 was held on Saturday 30th January 1943 on the College grounds with great success. A large number of visitors were present. Four new records were created as noted below. Mrs. C. R. Srinivasa Ayyangar kindly gave away the prizes. The Managing committee of the Union thanks Mrs. Srinivasa Ayyangar, Sri A. Mariakulandi, President, Sports sub committee and all members who kindly helped in the conduct of the sports.

List of Prize Winners

1. Cross Country Race (5 miles) The Norris Cup—1. G. H. Sankara Reddy 2. K. P. Padmanabhan 3. K. Narasimhalu
2. 100 Metres Hurdles (The Ramaswami Sivan Cup)—1. I. L. Narasimha Rao 2. S. Krishnaswami
3. Shot put (16 lb.)—1. V. D. Kamath 2. I. L. Narasimha Rao (New Record.)
4. 100 Metres Dash (The Saidapet Old Boys' Cup)—1. I. L. Narasimha Rao 2. K. Sundaram
5. Long Jump—1. C. V. Govindaswami 2. S. Krishnaswami
6. Cricket Ball throw—1. Balasubramanian 2. Ebrahim Ali
7. 200 Metres Hurdles—1. I. L. Narasimha Rao. 2. S. Krishnaswami. (New Record 31$\frac{2}{5}$ secs.)
8. High Jump (The Tadulingam Cup)—1. S. Krishnaswami. 2. John Chinniah.
9. Hop Step and Jump—1 C. V. Govindaswami. 2. Suryanarayanan Sastry.
10. 400 Metres Race—1. C. V. Govindaswami. 2. Samuel Sundaraj. New Record 60$\frac{1}{5}$ secs.)
11. Javelin throw—1. V. D. Kamath. 2. S. Ebrahim Ali.
12. 1,500 Metres Race—1. G. H. Shankar Reddy. 2. Annaji Rao. New Record 5 min. 6$\frac{1}{5}$ secs.
13. Old Boys' Race (Handicap)—1. A. M. Kulandai 2. M. D. Azraih
14. 4×400 Metres Relay Race (Intertutorial)—C. M. John's Wards
15. Tug of War (Intertutorial)—C. M. John's Wards

Champion of the year 1943—I. L. Narasimha Rao

Estate News and Notes

Students' Tour In February the second year class camped on the Nilgiris and Mettupalayam for a week. The Class III and the students of the short courses were taken to Tirupur on a visit to the Cattle Show.

Games Inter-tutorial matches—Sri M. C. Cherian's wards won in hockey and Sri C. M. John's wards in football and cricket. *Colours*—The following have been recommended for the award of colours in the respective games. *Hockey*—C. B. Chengappa, C. Vasudeva Reddy, C. H. Sankara Reddy and N. Raghavan. *Football*—R. Bettai Gowder, G. H. Sankar Reddy and S Krishnaswami. *Sports*—I. L. Narasimha Rao.

Students' Club Sri M. S. Sundareswara Ayyar delivered an interesting and thought provoking address on 'Education of the Infant' on the 1st. February under the presidentship of Sri S. V. Viswanatha, Retired Archealogist. On the resignation of Sri H. Shiva Rao of the Vice-Presidentship of the Students' Club, Mr. M. C. Cherian has been elected Vice President.

Literary Competitions An essay competition was held on the 3rd February, the subject being 'The need for the expansion of the University training corps" The winners in order of merit were T. M. Venkataraman, K. V. S. Suryanarayanamurthi, and P. T. Bhaskara Panikker In the extempore speaking competition held on 10th February on the subject, "The influence of Newspapers in moulding public opinion" the winners were as follows in order of merit—I. C. Srinivasan, K. V. S. Suryanarayanamurthi and T. M. Venkataraman. In the intertutorial debating contest held on the 12th February Sri B. M. Lakshmipathi's wards were the winners. The subject for debate was that " The solution for the present day food problem in India lies in the immediate introduction of a system of food rationing."

The Officers' Club The Annual General Body Meeting of the Agricultural College Officers' Club was held on Friday the 12th February 1943. The following office-bearers were elected for the year 1943.

President : Sri V. T. Subbiah Mudaliar. Vice President : Sri C. M. John. Secretary : Sri S. V. Parthasarathy.

Estate Scouts On the evening of the 3rd February a fire broke out in a *cholam* stack in field No. 71 of the Central Farm and the Scouts rendered timely and notable service in extinguishing the fire. In the recent *Radhakalyanam* celebrations on the Estate the scouts did useful work. All the scouts and cubs took part in a district rally held at the St Michael's High School grounds on the 13th February.

Departmental Notifications

Gazetted Service—Appointments

Sri P. V. Ramaiah to act as Director of Agriculture, vice Sri P. H. Rama Reddi granted l. a. p. for six weeks.

Sri C. R. Srinivasa Ayyangar, Paddy Specialist, Coimbatore, to act temporarily as Principal, Agricultural College. Sri H. Shiva Rao, Assistant Agricultural Chemist, to act temporarily as Government Agricultural Chemist. Sri K. W. Chakrapani Marar, Assistant Marketing officer, is appointed to act temporarily as Provincial Marketing Officer. Sri T. Venkatramana Reddi, Asst. in Botany, appointed as Botanical Asst. in Rubber Research Scheme.

Leave

Sri P. V. Ramiah, Principal and Govt. Agricultural Chemist, Coimbatore, l. a. p. for 1 month from date of relief. Sri C. Ramaswami Nayudu, Provincial Marketing Officer, Coimbatore, l. a. p. for 4 months from date of relief.

Subordinate Service – Promotions

Sri M. S. Kylasam Ayyar, Asst. in Entomology to IV grade with effect from 27th January 1943. Sri G. K. Chidambara Ayyar, Asst. in Chemistry to IV grade with effect from 7th February 1943. Janab Syed Ibrahim, Fruit Asst., A. R. S. Anakapalle appointed as Asst. in Paddy in the I grade (new). Janab P. P. Syed Muhamed, A. D., Tiruchengode appointed to the I grade (new).

Transfers.

Name of officer.	From	To
Sri R. Guruswami Naidu,	A. D. Kaikalur,	A. D. Proddattur.
,, S. Sangameswara Sarma,	F. M. Anakapalle,	A. D. Srungavarapukota.
,, P. Satyanarayana,	A. D. Markapur,	A. D. Vinukonda.
,, G. Narasimhamurthi,	F. M. Siruguppa,	A. D. Markapur
,, T. V. Krishnaswami Rao,	A. D. Vizagapatam,	A. D. Srungavarapukota.
,, P. K. Natesa Ayyar,	A. D. Rasipuram,	F. M. Central Farm.
,, S. V. Parthasarathy,	Asst. in Cotton, Coimbatore,	Asst. in Botany, Coimbatore.
,, B. N. Padmanabhan,	A. D (on leave),	Asst. in Paddy, Coimbatore.
,, N. G. Narayana,	Cotton Asst., Nandyal,	Cotton Asst., Koilpatti.
,, U. Narasinga Rao,	F. R. S. Kodur,	Asst. Pomological Station, Coonoor.
,, S. Muthuswami,	Under training. F. R. S., Kodur,	Asst. F. R. S., Kodur.
,, D. V. Reddi,	A. D. Proddatur,	Senior Farm Manager, Central Farm.

Leave

Name of officers.	Period of leave.
Sri V. Satagopan, F. M. Central Farm,	L. a. p. for 3 months from 15—2—43.
,, B. L. Narasimhamurthi, Millet Asst., Anakapalle,	Earned leave for 30 days from 7—2—43.
,, K. Krishnamurthi, A. D. Paravatipur,	Extension of earned leave for 1 month from 31—1—43.
,, M. Somayya, F. M. Samalkot,	L. a. p. for 1 month from 23—1—43.
,, K. P. Anantanarayanan, Asst. in Entomology,	Extension of l. a. p. on m. c. for 1 month. from 4—2—43.
,, G. K. Chidambaram, Asst. in Chemistry,	L. a. p. for 1 month from 1—2—43.
,, K. Saptharishi, Asst. A. R. S., Aduthurai,	L. a. p. for 1 month from 5—2—43.
,, M. Ratnavelu Gownder, A. D. Bhavani,	L. a. p. for 1 month from 12—2—43.

ANNOUNCEMENT

The Ramasastrula-Munagala Prize, 1943.

1. The prize will be awarded in July 1943.

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

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

4. Intending competitors should notify the Secretary of the Madras Agricultural Students' Union not later than the 1st June 1943 with a covering letter showing full name and address of the sender. The author's name should not be shown on the paper, but should be entered under a *nom-de-plume.*

5. Four type-written copies of the essay should be sent.

6. The name of the successful competitor will be announced and the prize awarded at the time of the Conference, if held this year.

7. Papers submitted will become the property of the Union and the Union reserves to itself the right of publishing all or any of the papers.

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

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

S. V. DURAISWAMI AYYAR,
Secretary.