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EDITORIAL

Crop Yields in India There is a generally prevalent feeling in this country that the yield of crops are very low here when compared to those obtained in other countries, particularly with regard to rice and sugarcane. It is also held that the yields of rice and sugarcane could be easily raised to the levels prevailing in Japan and Java respectively. It may be that the yields of these crops could be increased, but it is doubtful whether such yields could be brought to anything comparable with those of Japan and Java, countries that have a naturally favourable environment.

The climate of Japan is pre-eminently suitable for the rice crop and conduces to high yields. There is not much of variation from year to year in the climatic and seasonal conditions. The rainfall ranges from 50 to 100 inches in the year and the rains are well distributed; every month has its quota. The rice crop is not subject to drought and luxuriates under the conditions that prevail. The atmosphere is moisture laden and humid even in summer. The soils are of volcanic origin and fertile. All these factors contribute to the high average yield of 3,415 pounds of rice per acre. Further, the area under rice is compact and limited—79 lakhs of acres only. Conditions in India are entirely different. The area under rice is 706 lakhs of acres, distributed over the entire continent, with wide variations in soil fertility, irrigation facilities, climate and rainfall. A fifth of the area is purely rainfed. The irrigated areas depend in many cases for their water supply on tanks fed by the precarious rains. Drought is not uncommon; there are also periods when water stagnates and both these conditions limit the size of the crop. The rice yields are very varying and the average yield of the country is naturally low,—being only 1,350 pound per acre—nor can it be otherwise. There are deltaic areas in India, like the Tampraparni valley in the Tinnevelly District, where rice yields are phenomenally high and higher than the yields secured in Japan. The conditions prevailing in the two countries are so different that they do not offer any common basis for comparison and any comparison that may be made of the yields of these two countries can at best be only futile.

The average yields of sugarcane are 50 tons per acre in Java and 13 tons only in India. The soils in Java are of volcanic origin, deep, well-drained, friable and highly fertile. The cane crop makes a growth of 18 to

24 months in the field and combined with a suitable climate and rainfall the yields obtained are high. The bulk of the sugarcane area in our country is in North India, where the period of growth of the cane is limited to about 7 months. The canes are planted in March and cold weather sets in by about the end of September, which arrests the growth and development of the cane, and induces ripening. The soils are also of varying fertility and the cane yields are naturally low.

The conditions prevailing in South India are different. The cane areas are fairly fertile and have good irrigation facilities. The canes grow in the field for 10 to 12 months before they are harvested. The average yield is consequently higher than for the country as a whole, and is about 30 tons per acre. In selected areas, Co 419 and other varieties of Coimbatore canes have been known to yield about 60 tons to the acre, an yield higher than Java's average. The conditions existing for the growth of canes in Java and India are so different that a comparison of their yields could not safely be made.

We may state in general that valid comparisons can be made of the yields of crops secured in different countries, only when the soil, rainfall and climatic conditions are similar and analogous. India is a vast stretch of country with wide variations in soil, climate, rainfall, resources, etc., that average yields of crops in general will be low only, when compared to other countries that are small, compact and are favoured naturally in many other ways. This should not be taken to carry the implication that though the yields of crops are low in India, they are satisfactory or that the present yields are the most that could be obtained; far from it. The yields of crops in India are no doubt low, and could be increased very much by better cultivation, manuring and the use of improved strains of seeds, but limits are set to these by the poverty of the cultivating classes—a problem that is in an entirely different category.

Obitury Dewan Bahadur C. V. Venkataramana Ayyangar passed away on the night of 5th March 1944. A leader of the Coimbatore bar in his younger days, he was prominent in all walks of public life in social, political, agricultural and industrial fields. He was a redoubtable champion of the agriculturists and the down-trodden. He was a Patron of the Madras Agricultural Students' Union. We offer our condolences to his bereaved son and daughters.

Some Preliminary Observations on the Effect of Drying the Sprouted Seed upon its Viability and Subsequent Plant Growth in Paddy

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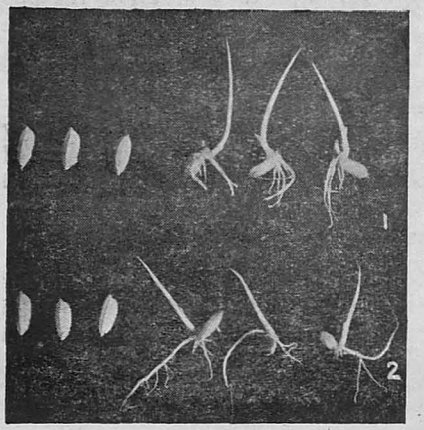
Sprouted paddy seeds were dried in the hot sun for two to three days. This caused complete wilting of the young plumule and radicle, but the seed on regermination produced new shoots and roots (Fig. 1 & 2). The same thing happened also when the young plumule and radicle were partly or fully scissored or injured, under similar conditions.

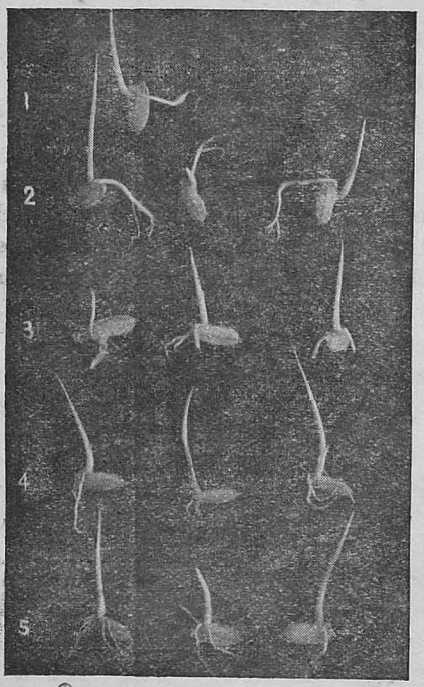


1. Sprouted and dried seed, regerminated.
2. Seedling from untreated seed.

Fig. 1.

It was observed during the course of the present studies that seeds dried and stored in cloth bags in the usual manner lost their viability rapidly. Similar observations have been recorded by previous workers. By retarding germination in cotton, Rangaswami Ayyangar found that the seeds were subject to fungal attack and impairment of viability. In all these cases, the immediate reason adduced for the low viability was mould, while the normal seed, not treated but subject to similar conditions of storage, gave no signs of deterioration. It was then presumed that the treated seed took mould on account of the atmospheric moisture having access to the embryonic region through the minute slit in the glume caused by the bursting out of the initial sprout. To make sure that the presumption was correct, small holes were pricked in the glume of the paddy seeds at the same place and in the same fashion as appeared in the germinated seeds. These were kept in a moist chamber along with the normal seeds with the glumes intact. The seeds were removed from the moist chamber after 48 hours and tested for viability. The treated seeds had lost their germination capacity while

the control seeds had retained it cent per cent. This is also confirmed by further direct evidence.



1. Normal seedling with primary radicle and plumule.
2. Lateral roots induced in the absorptive region by the removal of the tip of the primary radicle.
3. Secondary roots growing in the basic region after the removal of the primary radicle above the absorptive region.
4. Plumule regrown and secondary roots induced after the removal of the tip of the primary plumule and entire radicle.
5. Plumule regrown and secondary roots induced after the removal of the entire primary plumule and radicle.

Fig. 2.

The seeds of Co. 13 paddy were soaked initially for 24 hours and later incubated at 25°C. till the emerging young sprout just appeared as a feathery mass, in which neither the plumule nor radicle was distinctly distinguishable. Further growth was arrested by drying the seed. One lot was dried in the hot sun for two to three days. The sunshine was for about 7 hours every day, the range of temperature during this period being 23° to 31°C. The second lot was initially dried in the sun for 5 hours and later kept in a thermostat maintained at 30°C, till required for subsequent treatment. This lot had the advantage of the maintenance of a high temperature (30°C.) during this storage period, as also the complete exclusion of atmospheric moisture. These seeds were soaked for inducing re-germination and six to eight hours of soaking was found to be sufficient. The subsequent incubation period was regulated so that the germ was just reactivated and not allowed to increase the size of the sprout visibly. An interval of three days was allowed between the successive treatments, and the number of times the seeds were treated repeatedly ranged from one to five. The treated seeds were tested for viability and the results are presented below:

Viability tests of treated seeds

Treatment	Percentage of germination	
	Sun-dried	Sun-dried for 5 hours and kept in thermostat
Once treated	100	100
Twice treated	100	100
Treated 3 times	80	96
Treated 4 times	68	90
Treated 5 times	40	86

It is seen that the exclusion of moisture from the seed, as for instance by keeping in a thermostat, preserves fully the viability of the seed.

The treated seeds were sown in pans to study the reaction, if any, of these treatments on the resulting plant. Ordinary seed material was also sown under identical conditions to serve as control. Similar cultural treatments were given to all the treatments. Irrigation was stopped when the plants were two months old. Observations on growth and reaction to the artificially induced drought were recorded. Observations were also made in a second replicated trial, using similarly treated seeds of Co. 17 paddy. The plants from the treated seed had some extra vigour, in both the trials. The vigour gradually declined with the increase in the number of treatments the seeds received. Further, a certain degree of drought resistance was induced by this seed-treatment, the resistance being more pronounced with the increasing number of treatments. It may be mentioned that Parija (1942) found that the young seedlings from the paddy seeds, that were previously soaked to a stage when the midrib of the palea turned opaque near the base indicating the swelling of the embryo, exhibited certain drought resistance.

The phenomenon of germinal revival in seeds, subsequent to the complete wilting of the initial sprout or its injury, is not without significance to the ryot. His seed-paddy in the field is liable to get spoilt at times by inopportune rains and consequent sprouting. By properly drying such material and excluding moisture in storage, it is possible to maintain the viability of the seed stock, intended for the next season.

Abstract: Drying sprouted paddy seed or mutilation of the young plumule and radicle does not kill the germ of the seed. The same seed could be re-germinated and dried repeatedly a number of times without loss of viability.

2. Sprouted paddy seed loses its viability rapidly when stored in cloth bags in the usual manner. This is because atmospheric moisture has access to the embryonic region through the minute slit kept open in the glume during the bursting of the initial sprout; this induces mouldiness. Proper dryage of the sprouted seed and storage out of contact with atmospheric moisture ensure the viability of the treated seed being maintained for a long time.

3. The phenomenon of germinal revival after drying the sprouted seed is not without significance to the cultivator, whose seed-paddy in the

field is liable at times to get spoilt by inopportune rains and subsequent sprouting.

4. Some extra vigour is seen in the growth of the treated seed. The vigour is most when the seed is treated once and declines with the number of times the seed is re-treated.

5. Certain degree of drought resistance is induced by this treatment; this effect is more pronounced with seeds treated a larger number of times and tends to increase with the number of times the seed is re-treated.

Acknowledgements My grateful thanks are due to Mr. C. R. Sreenivasa Ayyangar, Paddy Specialist, for the many helpful suggestions given during the conduct of these studies.

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Accuracy of Estimates of Yields of Indian Cotton Forecasts with Special Reference to the Madras Cotton Crop

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Under the standing orders of the Government of India, the Director General of Commercial Intelligence and Statistics, Calcutta, issues for all India forecasts for cotton at intervals of two months—in August, October, December, February and April. The exact day and hour of the release of the forecast is announced in a Press Note about one week in advance and arrangements have been made for the publication of the information in Calcutta and Bombay simultaneously and then subsequently throughout the country in the quickest possible time.

Area The forecast is prepared on the basis of the formula — Estimates of yield = area × standard or normal outturn per acre × seasonal or condition factor. Though the acreage figures are considered to be accurate it may be noted that reliable data are lacking in the case of permanently settled areas, lands held on privileged tenure and unsurveyed tracts, though steps are being taken to make good the deficiencies.

Standard outturn Standard outturn per acre, the second element, has been defined as "the crop which past experience has shown to be the most generally recurring crop in a series of years". It is therefore the "mode" and not the average of a series of years' figures which is an arithmetical average or mean. It may be noted that the present standard outturn figures have not been worked out scientifically after a proper classification of soils and a statistical analysis of the various factors that influence yields on a series of years but are based more or less on empirical estimates prepared by the Agricultural and Revenue Departments of the normal or average yield per acre of land of average quality under the two major heads of irrigated and unirrigated land in each district. Crop-cutting experiments

are indeed made every year both by the Agricultural and Revenue Departments for revising the standard yield figure, but recent statistical analyses[1] have shown that these data of crop-cutting experiments are of doubtful value as they are too few in number and are not carried out on modern statistical lines.

Seasonal Factor The third element, known as the Seasonal Factor, is the condition of the crop expressed as a percentage of the "normal" crop[2]. Under the present system, the village accountant reports the condition of the crop as so many "annas" of the rupee, the rupee or 16 annas being taken to represent the normal crop in certain provinces while 12 annas is taken to be the normal in certain other provinces, like Madras. This "anna estimate" is then converted into a percentage estimate[3]. For example, in Provinces like Madras where 12 annas are taken to represent the 'normal', a nine anna crop would give a seasonal factor of 75; and a 14 anna crop a seasonal factor of 116. The chief defect of the "anna estimate" is the unavoidable element of error due to personal bias on the part of the primary reporting agency.

Post-mortem Examination (which cannot be detected[4]) of the Cotton Forecasts

The above review of the methods of forecasting the yields of crops shows that there are elements of error in all the three factors forming the basis of estimates. The Indian Central Cotton Committee has therefore been subjecting the Cotton Forecasts of the Director General of Commercial Intelligence and Statistics to a post-mortem examination in order to trace the sources of error with a view to improve the accuracy of future forecasts. This is done on the basis of the two following formulae: --

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1. A study of Forecasting of Cotton Crops in the Punjab, 1, J. A. S. Vol. IX, Part III, June 1941.

2. In the U. S. A., the primary agency itself reports the condition of the crop as a percentage of the "normal". In England, the Crop Reporters are instructed to relate their estimates of yield of the current crop to the "estimated" ordinary average of their district which is the average of the ten previous years (Economic Journal, Vol. XXX., p. 406)

3. "These estimates being generally in the form of an integral number of annas per rupee when they are first prepared are likely to be in excess of or defect of the true value to the extent of half an anna owing to this cause alone. The error may not be a serious one in the case of a nearly normal crop but for a crop below normal, it will be large....." (Ibid., p. 3.)

For a fuller discussion vide Guide to Current Official Statistics, Government of India, Volume I, p. 3.

4. Experience has shown that there is a definite positive bias when yields are high, and a negative bias when yields are low. This could be eliminated however by a statistical examination of the data from time to time. It may be noted further that a uniform basis is necessary for the Anna Estimate in all the provinces so that the estimates of one province can be compared with those of another. For a fuller discussion, vide Official Statistics, Volume I (second edition), p. 4.

(a) Actual crop = net exports of cotton by all routes + mill consumption + extra-factory consumption + variations in stocks (stocks at the end of the season minus stocks at the beginning of the season.)

(b) Actual crop = cotton pressed + loose cotton consumed in spinning mills + net exports of loose cotton + village or extra factory consumption of loose cotton.

It may be pointed out at the outset that the two formulae for arriving at the figures of actual crop are subject to certain limitations. Complete statistics of road-borne traffic in cotton are not available, though such traffic should be considerable particularly after the advent of motor lorries. Consumption of raw cotton in mills situated in the Indian States is not known accurately as the data relating to the same are collected on a voluntary basis instead of on a statutory basis as in the case of the mills in British India and cannot therefore be relied upon as complete. The data relating to stocks are admitted to be incomplete, being based upon voluntary returns. Stocks of ginned unpressed cotton and kapas are omitted in the calculation according to the second formula on the assumption that they are negligible, an assumption that may not be true in all cases. The method of making a constant allowance of $4\frac{1}{2}$ lakhs of bales for extra-factory consumption for the whole of India on the basis of the enquiry conducted by the Indian Central Cotton Committee in 1933—36 irrespective of the year to year changes in demand is also open to objection.

Even after making allowance for the defects in the two formulae as noted above, it is clear that the approximate actual crop should be far greater and anyhow not less than the forcasted crop, since the errors noted above against the different items entering into the calculation of the actual crop are on the side of deficiency and not on the side of excess.

The Post-mortem Data of the Madras Cotton Crop from 1936 to 1942

A study of the post-mortem data of the Madras cotton crop as published annually by the Indian Central Cotton Committee in its Statistical Leaflet No. 5 (compiled and presented below in Table) would show that the "approximate actual crop" for all the years from 1936 to 1942 has been considerably higher than the "estimates of yield" as published in the Final Forecast Reports of the Indian Cotton Crop.

It may be noted in this connection that the post-mortem data for Madras have become somewhat complete only after 1938 when for the first time statistics of imports by road of raw cotton from Hyderabad were collected and included in the calculations of the "actual crop". These additional data necessitate corrections to the original data shown in Tables I and II of the Reports of the Indian Central Cotton Committee on the accuracy of the All-India Cotton Forecast. Columns 3 and 4 in our Table given below contain a summary of the original data as arrived at by the Indian Central Cotton Committee by the application of its two well-known formulae and we have indicated within brackets the corrections we have made to the original

data in the light of the additional data noted above. Columns 5 and 7 give the simple differences between the "estimates" and the "actuals" as arrived at by the first and the second formulae respectively and columns 6 and 8 their percentages. Figures within brackets represent the corrections.

An examination of the data shows that the "actual crop" according to the second formula (column 4) is higher than that of the first formula (column 3) between 1938 and 1940 (the data of earlier years are not taken into consideration for the reason stated above) but lower than that of the first between 1941 and 1942. In fact, there has been this problem of "two conflicting actuals" in the case of the data of many cotton areas in India and, so far, there does not appear to have been any effort made to explain the causes for these conflicting actuals. As the method of arriving at the average of these two actuals as the "probable actual" is open to objection, it is proposed to examine here the causes for these discrepancies as far as Madras is concerned and then to indicate also the causes for underestimates in Government forecasts.

The second item in the second formula—loose cotton consumed in spinning mills—may be considered quite accurate as the relevant statistics are collected by an amendment to the Indian Cotton Cess Act of 1923. With regard to the third item — net exports of loose cotton — it may be noted that there is very little chance of exports of loose cotton by road, rail or sea from any of the southern districts for the simple reason that the cost would be prohibitive. In fact, the Western Ghats, the Indian Ocean, and the Bay of Bengal provide such natural frontiers that there are no land connections with any adjoining cotton areas as there are, for example, between the Punjab and Sind or between Berar and Bombay. The only part of the Madras Presidency from where exports of loose cotton by road to adjoining cotton areas are possible is the Bellary area. At present complete data of road-borne traffic are not available. It is possible that during years of low prices there may be much export of loose cotton by road and the absence of data on this point will therefore affect the data of "net exports" of the first formula. If this conclusion should be correct, it explains satisfactorily why the actual crop of the first formula shows a higher figure than that of the second formula during the years 1938 to 1940. Similarly, in years of higher prices and brisk local demand, much loose cotton might be imported by road into the Madras Presidency from the adjoining cotton areas and pressed here. As the pressing returns are statutory and therefore very accurate, and as any error in the second formula is likely to arise only from this first item — "cotton pressed" — we may conclude that the main source of discrepancy between the first and the second formulae lies in the data of import and exports by road of loose cotton.

Source of error in the Madras Forecasts

Having explained the probable reasons for the discrepancies between the two actuals as determined by the post-mortem examination, we may now

proceed to trace the source of error in the Government Forecasts of the Madras Cotton Crop.

The Madras figures of cotton acreage are said to be accurate. The necessary corrections are also said to have been introduced to some extent to the "anna estimates" of the condition factor as reported by the village accountants. Hence it is obvious that the main source of error in the Madras Cotton Forecast should be with regard to "standard of normal outturn" per acre. (Estimated yield, as is well known, is determined by the formula, Yield = Acreage × standard yield per acre × condition factor). This prima facie conclusion is confirmed by the fact that the same standard outturn of 250 lbs. lint per acre for irrigated cotton in the Madura area given in 1930 is repeated also for the year 1941—42 in spite of the fact that there has been a large increase in acreage under Cambodia during the last decade and that in certain parts there has also been the introduction of the higher-yielding varieties of Co. 3 and Co. 4. Obviously the crop-cutting experiments conducted by the Revenue and the Agricultural Departments for the revision of the standard yield figure have not been satisfactory or their results have been misleading owing to the obvious defects in the technique adopted at present. The normal discrepancy between the estimates and the actuals according to the first formula is about 15 per cent, and if this is due to an underestimation of the standard yield figure only (the matter requires further examination), there is a possibility of avoiding the error in future forecasts.

Discrepancies between Estimates and Actuals as revealed by the post-mortem examinations of the Madras Cotton Crop by the I. C. C. C. as published in the Statistical Leaflet No. 5 of the Committee (in 1000 bales of 400 lbs. lint)

Years	Fore-casted yields	Actual crop as per		Differences between Estimates and Actuals			
				Simple difference		Percantage difference	
		1st formula	2nd formula	As per 1st formula	As per 2nd formula	As per 1st formula	As per 2nd formula
1	2	3	4	5	6	7	8
1936	455	522	480	−67	−14·7	−25	−5·5
1937	541	743	639	−202	−37 3	−88	−16·3
1938	535	594	533	−59	−11·0	−2	−0·4
			†(550)			(−15)	(−2·8)
1939	505	562	543	−57	−11·3	−38	−7·5
1940	389	477	522	−88	−22 9	−133	−34·2
			†(463)			(−74)	(−18·9)
1941	421	505	529	−84	−19 9	−108	−25·6
		†(489)	†(549)	(−68)	(16·1)	(−128)	(−30·4)
1942	504	593	611	−89	−17·6	−107	−21·2
		*(578)	†(642)	(−74)	(14·7)	(−138)	(−27·3)

Figures within brackets indicate corrections made by us on the basis of the data noted by the I. C. C. C. as shown below:

* After taking into account imports by road of loose cotton from Hyderabad.

† After taking into account exports by road of loose cotton from Hyderabad and variations in stocks of loose cotton by mills and trade.

A Review of the Manurial Experiments on the Agriculteral Crops of the Madras Presidency for the Decennial Period 1930—40 (Contd.) *

By the Paddy Specialist and the Government Agricultural Chemist, Coimbatore

Potato Of all the crops potato has been found to respond to manuring exceedingly well. The cultivation of this crop is confined mainly to the Nilgiris and the area under the crop is about 13,000 acres. It has been the experience at the Agricultural Research Station, Nanjanad, that intensive manuring with artificials, viz., super, sulphates of ammonia and potash, in combination with organic manure in the form of cake or cattle manure is absolutely necessary for raising good crops of potato. As a result of a series of trials, a suitable mixture called the "Nanjanad Farm Mixture" has been prepared which could be used with distinct advantage over other artificial fertiliser mixtures sold by firms. The Farm Mixture is made up of groundnut cake 500 lb., ammonium sulphate 200 lb., steamed bonemeal 350 lb., concentrated super 336 lb., and sulphate of potash 224 lb.; this quantity is applied over an extent of one acre.

The manurial trials during the main crop season (March-September, rainfed) indicate definitely that as regards phosphoric acid and potash the optimum requirement of potato is met by 3 cwt. of concentrated super and 1 cwt. of sulphate of potash per acre. The responses induced by 3 and 5 cwt. of super and by 1 and 3 cwt. of potassium sulphate are alike. Muriate and sulphate of potash tried in 1 and 2 cwt. doses during the second crop season (August-December) behaved alike both as regards yield and quality.

In another experiment cattle manure at 5 tons per acre *plus* Nanjanad Farm Mixture (control) was compared with artificials and groundnut cake supplying equal amounts of nitrogen and phosphoric acid, but varying amounts of potash, with both main and second crop potatoes. In all cases the control and the potash applied plots gave significantly better yields than no-potash plots. Plots receiving artificials and potash tended to be better than the control with the main crop but not significantly. In the case of the second crop however, the effect of cattle manure was marked, being significantly better than the plots receiving 150 or 374 lb. of potassium sulphate and on par with the plots receiving 262 lb. of potassium sulphate.

The effects of inorganic nitrogen and a combination of inorganic and organic nitrogen were compared, both over a basal dressing of cattle manure, and phosphates and potash. The combination of organic nitrogen in the form of groundnut cake (500 lb.) and inorganic nitrogen, ammonium sulphate (2 cwt.) or nitrate of soda, responded better than inorganic nitrogen alone, the yields resulting from the application of the combination of manures

* Continued from Vol. 32, P. 47.

being alike, about 700 maunds per acre, against 650 maunds for the treatment with inorganic nitrogen only.

The Nanjanad Farm Mixture was compared with mixtures supplying an equal amount or half as much of phosphoric acid either as super or as bonemeal. These mixtures had the other ingredients just like the Nanjanad Farm Mixture. The trials were with both the main and second crop potatoes. The following observations are made: (1) between full and half doses of phosphates applied in first and second years, significant results were obtained in favour of full dose only: (ii) Mixture with super as the sole phosphate supplier behaved just like the Nanjanad Farm Mixture; and (iii) Mixture with insoluble phosphate was definitely inferior to the Farm Mixture or the mixture with super as the phosphate supplier. In the case of the second crop it is found that steamed bonemeal mixture was definitely inferior to the Farm Mixture and super mixture in both the years. During the second year, the full dose of phosphate was only as good as the half dose.

Permanent manurial experiments were conducted over a period of four years to test the effect of artificials N, K and P (N—groundnut cake 500 lb. *plus* ammonium sulphate 200 lb., K—potassium sulphate 2 cwt, P—concentrated super 3 cwt. *plus* steamed bonemeal 350 lb.) applied with or without lime at 2 tons per acre, or cattle manure at 5 tons or both, for both the main and second crops potatoes. The main conclusions are: (i) nitrogen by itself has not given any response; (ii) nitrogen with K, P or K *plus* P has increased the yield considerably, the maximum increase being with N *plus* P, and N *plus* K *plus* P (509 maunds and 571 maunds per acre respectively) with an increase of about 400 % over the control yield of 103 maunds; (iii) phosphate alone is significantly better than control; (iv) N *plus* K *plus* P in combination with cattle manure or lime have acted better than when alone; (v) no difference was observed between lime and cattle manure plots in the main crop season but cattle manure plots were a little better in the second crop season; and (vi) maximum yields were obtained from plots that received the full dose of cattle manure, lime and artificials, both during main and second crop seasons.

TABLE XIII Potato yields in permanent manurials.

Treatments	Average yield in maunds per acre (4 years)			
	Without lime	With lime	With cattle manure	Cattle manure *plus* lime
First crop				
No manure	103	260	287	310
Nitrogen (N)	110	296	281	372
N *plus* Potash (K)	154	295	302	374
Phosphate (P)	354	501	504	556
N *plus* P	509	629	631	697
N *plus* K *plus* P	571	569	585	696
General mean	300	425	422	501

Second crop				
No manure	122	217	254	285
N	119	195	243	275
N *plus* K	144	225	295	303
P	309	312	378	401
N *plus* P	497	554	623	617
N *plus* K *plus* P	704	769	705	720
General mean	316	379	416	434

The commercial fertilisers from recognised firms were compared with the Nanjanad Farm Mixture, on equal nitrogen basis at two levels (87 lb. and 116 lb), with and without cattle manure, on the main and second crop potato, for over 3 years. The average yields for the period indicate that the Farm Mixture is definitely superior to other mixtures whether with or without cattle manure.

TABLE XIV Comparative trials with Nanjanad Farm Mixture and other Commercial Mixtures on potatoes.

Treatments	Average yield in maunds per acre (3 years)	
	Main crop	Second crop
1. Farm Mixture (87 lb. N) *plus* cattle manure 5 tons (control)	482	568
2. Parry's Mixture (87 lb. N) *plus* cattle manure 5 tons	450	516
3. Shaw Wallace Mixture (87 lb. N) *plus* cattle manure 5 tons	469	532
4. Farm Mixture only (116 lb. N)	514	611
5. Parry's Mixture only (116 lb. N)	469	567
6. Shaw Wallace Mixture only (116 lb. N)	483	528

With a view to find out the best proportion in which organic and inorganic nitrogen should be combined, and secondly to find out whether the ammonium sulphate in the present Farm Mixture could be substituted by Niciphos, experiments were carried out for three years both on the main and second crop potato. Significant results were obtained in one out of three years only in favour of the Farm Mixture having equal amounts of organic and inorganic nitrogen (groundnut cake 500 lb *plus* ammonium sulphate 200 lb.) for the main crop and with groundnut cake *plus* Niciphos for the second crop. The superiority or otherwise of Niciphos or of any combination of organic and inorganic nitrogenous manures could not be definitely established owing to the variable nature of the results obtained in the different seasons.

Experiments were conducted for three years to test the effects of different kinds of phosphates on potato. The Nanjanad Farm Mixture was the standard. In the other mixtures the phosphoric acid was supplied by different phosphates : concentrated super, dicalcic phosphate, steamed bonemeal or precipitated phosphate ; the other ingredients remained constant. The phosphates were also supplied in half doses keeping the other ingredients

constant. All these mixtures were tried both with and without lime. The results are summarised in Table XV.

TABLE XV(a) Response of potato to different phosphates

Treatments	Average yeild in maunds per acre (average of 3 years)			
	Main crop		Second crop	
	Unlimed	Limed (2 tons lime) per acre	Unlimed	Limed (2 tons lime) per acre
A. *Full dose of phosphate series*				
1. Farm Mixture (control)	687	710	753	762
2. Concentrated super (537 lb.) *plus* groundnut cake (650 lb.)	714	758	763	851
3. Steamed bonemeal (934 lb.) *plus* groundnut cake (250 lb.)	577	564	618	567
4. Dicalcic phosphate (566 lb) *plus* groundnut cake (650 lb.)	724	757	805	780
5. Precipitated phosphate (551 lb.) *plus* groundnut cake (650 lb.)	690	670	810	796
B. *Half dose of phosphate series*				
6. Steamed bonemeal (175 lb.) *plus* concentrated super (160 lb.) *plus* groundnut cake (575 lb.)	559	553	667	669
7. Concentrated super (269 lb.) *plus* groundnut cake (650 lb,)	600	628	706	735
8. Steamed bonemeal (467 lb.) *plus* groundnut cake (450 lb.)	499	492	545	532
9. Dicalcic phosphate (283 lb.) *plus* groundnut cake (650 lb.)	642	664	711	722
10. Precipitated phosphate (276 lb.) *plus* groundnut cake (650 lb.)	582	585	712	715
General mean	627	638	709	713

TABLE XV(b) Summary table of general mean yields for all the three years (main and second crop)

	Unlimed plots		Limed plots	
	Phosphates dose		Phosphates dose	
	Full	Half	Full	Half
Main crop	678	576	692	584
Second crop	750	668	751	675

The findings of the experiment are, (i) the general mean yields for all the three years for the limed and unlimed series show that lime has no beneficial effect; (ii) steamed bonemeal is definitely inferior to the more soluble forms of phosphate; (iii) both in the limed and unlimed series the full doses of phosphate are better than the corresponding half doses, and (iv) the farm mixture with mono-and tri-calcic phosphate is as good as mixtures containing concentrated super or dicalcic or precipitated phosphates.

The relative merits of full and two-third doses of easily available concentrated manures and Farm Mixture together with a basal dressing of cattle manure in both cases either in furrows or woodcast were compared. The results of the experiment covering a period of two years on the main and

second crops indicate that, (i) full doses of all the manures give better yields than two-third doses (Farm Mixture – groundnut cake 500 lb., ammonium sulphate 200 lb., steamed bonemeal 350 lb., potassium sulphate 224 lb., concentrated super 336 lb.; artificials only—ammonium sulphate 428 lb., potassium sulphate 224 lb, and concentrated super 537 lb, per acre); (ii) the application of the basal cattle manure in furrows is better than broadcasting; and (iii) there is no difference between Farm Mixture and the easily available concentrated manures. See summary table of potato yields.

TABLE XVI Summary table of potato yields

	Average yield in maunds per acre (2 years)	
	Main crop	Second crop
A. Full dose manures } Basal dressing {	581	470
Two third dose manures } 5 Tons cattle manure {	501	421
B. Cattle manure (Basal dressing)		
Broadcast	503	415
Applied in furrows	579	479
C. Concentrated manures	540	434
Farm Mixture	542	460

The performances of different oil cakes when substituted for groundnut cake in the Farm Mixture on equal nitrogen basis on the second crop were investigated for two years. The cakes experimented with were black castor, white castor, coconut, neem and pungam cakes. Neem cake was significantly inferior to others, which were all nearly equally effective.

Summary and conclusions

(1) The need for an adequate supply of organic matter as well as nitrogen and phosphoric acid is clearly indicated by the experiments with the important crops of the presidency.

(2) The manurial experiments stress the necessity for applying bulky organic manures for paddy, particularly green manure, together with super and ammonium sulphate or oil cakes in all the tracts.

(3) The oil cakes in conjunction with ammonium sulphate, preferably in the ratio of 3 : 2 or 4 : 1, give a good response with the popular varieties of sugarcane.

(4) In the case of dry and irrigated crops cattle manure in combination with artificials has proved beneficial. The use of artificial fertilisers only is to be avoided, as tending to affect the condition of the soil and the quality of the crop, adversely.

(5) The use of lime is essential in the West Coast and Nilgiri tracts for crops like pepper, potato and *samai*.

(6) The general effect of nitrogenous, phosphatic and other fertilisers on some of the major crops, with the optimum doses of manure recommended for each, are given under.

(i) **Paddy** The nitrogen requirements of the paddy crop are met by ammonium sulphate 150 lb., or green leaves 4000 to 6000 lb., or groundnut

cake 500 lb., or castor cake 750 lb., per acre. Phosphates may be applied with advantange in conjunction with these manures the best combination being super 1½ cwt., *plus* green manure 2,500 lb., *plus* ammonium sulphate 150 lb., per acre. The application of ammonium sulphate one month after planting over a basal application of green leaf results invariably in higher yields.

(ii) **Sugarcane** This crop responds well to cake and ammonium sulphate nitrogen combination applied in the ratio of 4 : 1 or 3 : 2, at 100 to 150 lb. nitrogen per acre, in two doses—one at planting and the other at tillering stage. Basal application of cattle manure tends to maintain the fertility of the soil and improve the quality of the sugarcane juice. Phosphatic manures may also be applied with advantage and they tend to improve the soil and the crop.

(iii) **Plantain** Potash in the form of potassium sulphate or ashes would appear to be necessary besides ammonium sulphate or cake and super for the best yield of this crop, the increase being proportional to the quantity of nitrogen applied. The optimum dose recommended is potassium sulphate [1½ cwt.) *plus* groundnut cake (5 cwt.) *plus* super (2 cwt.) per acre. The quality or the flavour of the fruits is not influenced by potash.

Crops (Irrigated)

(iv) **Cotton** The addition of artificial fertilisers—nitrogen and phosphate—in conjunction with bulky organic manures—green manure, cattle manure etc.—has proved beneficial. Super 1 cwt. *plus* ammonium sulphate 2 cwt. *plus* cattle manure or compost 6 cartloads per acre may be the optimum dose.

(v) **Cholam and ragi** Cattle manure by itself at 5 tons per acre would be sufficient for these crops.

(vi) **Groundnut** Super (1 cwt.) per acre and cattle manure (5 cartloads) would improve the yields.

Dry crops (Rainfed)

(vii) **Cotton** Artificial fertilisers—ammonium sulphate (2 cwts.) and super (1 cwt.) with groundnut cake (250 lb.) or cattle manure (6 cartloads) per acre—would answer the needs of this crop in the Ceded Districts area and the black soil areas of the southern districts. It would be advantageous to apply the manure to the previous cereal crop like *cholam, cumbu* or *tenai.* This has without exception benefited cotton as well as the cereals, the residual effects being felt even in the third year of application.

(viii) **Cholam** Green manure, especially cowpea ploughed *in situ,* as well as artificials with cattle manure have contributed to increase the yields of *cholam* as in the case of cotton.

(ix) **Minor Millets** *Tenai, samai,* maize, *variga, cumbu* and *panivaragu* coming under this group, do well with an application of farm yard manure or compost supplying 50 lb. nitrogen with or without addition of artificial fertilisers.

(x) **Chillies and Tobacco** A full combination of ammonium sulphate 2 cwt. *plus* potassium sulphate 100 lb. *plus* super 2 cwt. over a basal dressing of cattle manure at 4 cartloads per acre has been found very effective in increasing the yields of these crops at Guntur.

(xi) **Pepper** The application of ammonium sulphate $\frac{1}{4}$ lb., potassium sulphate $\frac{1}{4}$ lb., super $\frac{1}{4}$ lb., leaf mould 20 lb. and lime $\frac{1}{2}$ lb. per vine has increased the yield at Taliparamba.

(xii) **Coconut** The best mixture that may be recommended under West Coast conditions is ammonium sulphate 3 lb. *plus* ashes 20 lb. *plus* cattle manure 100 lb per tree. It is preferable to broadcast the manure and plough it in.

(xiii) **Potato** A heavy application of artificials including nitrogen, phosphoric acid, potash and lime is absolutely necessary. The best mixture suited for this crop is the "Nanjanad Farm Mixture", containing groundnut cake (500 lb.), ammonium sulphate (200 lb.), steamed bonemeal (350 lb.), concentrated super (336 lb.) and sulphate of potash (224 lb.) per acre.

SUMMARISED TABLE OF RESULTS AND RECOMMENDATIONS

Locality	Crop	Manures recommended and dosage per acre
		Nitrogenous manures
Maruteru	Paddy	Green manure 4,000 lb. or groundnut cake 675 lb. or ammonium sulphate 100 lb.
Samalkot	,,	Green manure 6,000 lb. or ammonium sulphate 150 lb.
Anakapalle	,,	Green manure 6,000 to 8,000 lb.
Aduthurai	,,	Ammonium sulphate 150 lb. or green manure 4,000 lb.
Coimbatore	,,	Ammonium sulphate 150 lb. or groundnut cake 425 lb. or green manure 6,000 lb.
Pattambi	,,	Ammonium sulphate 150 lb. or groundnut cake 425 lb. or green manure 5,000 lb.
		Combination of organic and inorganic nitrogen
Maruteru	,,	Green leaf 2,000 lb. *plus* ammonim sulphate 100 lb.
Pattambi	,,	1. Green leaf 4,000 lb. *plus* ammonium sulphate 75 lb. 2. Castor cake 700 lb. *plus* ammonium sulphate 75 lb. 3. Groundnut cake 425 lb. *plus* ammonium sulphate 75 lb 4. Neem cake 500 lb. *plus* ammonium sulphate 75 lb.
		Nitrogen and phosphate combinations
Samalkot	,,	1. Green manure 4,500 lb. *plus* super 167 lb. 2. Ammonium sulphate 150 lb. *plus* super 167 lb. 3. Niciphos 30 lb. nitrogen *plus* 30 lb. P_2O_5 4. Green manure 2,250 lb. *plus* ammonium sulphate 75 lb. *plus* super 167 lb.
Maruteru	,,	1. Niciphos 44 lb. nitrogen *plus* 32 lb. P_2O_5 2. Green leaf 2,000 lb. *plus* ammonium sulphate 160 lb. *plus* super 180 lb. 3. Groundnut cake 637 lb. *plus* flur phosphate 48 lb. P_2O_5 4. Milled guano 32 lb. P_2O_5 *plus* groundnut cake 425 lb.
Aduthurai	,,	1. Ammonium sulphate 100 lb. *plus* super 75 lb. 2. Green leaf 2,000 lb. *plus* super 112 lb.

Coimbatore	Paddy	Green leaf 4,000 lb. *plus* super 112 lb.
Pattambi	,,	Do. Do Do.
Anakapalle	Sugarcane	Cattle manure 5 tons *plus* green leaf 2,000 lb. *plus* super 112 lb. *plus* ammonium sulphate 260 lb.
Samalkot	,,	1. Ammonium sulphate 500 lb. *plus* Bonemeal 224 lb. *plus* super 224 lb. 2. Groundnut cake 1,200 lb. *plus* Bonemeal 224 lb. *plus* super 224 lb.
Palur	,,	1. Groundnut cake 1,000 lb. *plus* ammonium sulphate 100 lb. 2. Groundnut cake 800 lb. *plus* ammonium sulphate 200 lb.
Samalkot	Plantain	Ammonium sulphate 2½ oz. *plus* potassium sulphate 2½ oz. *plus* super 3½ oz. per tree.
Palur	,,	Potassium sulphate 168 lb *plus* groundnut cake 560 lb. *plus* super 224 lb. per acre.
	Garden land crops	
Coimbatore	Cotton	1. Cattle manure 15 cartloads. 2. Green manure ploughed in situ (red soil) 3. Ammonium sulphate 336 lb. 4. Potassium sulphate 100 lb. *plus* super 336 lb.
,,	Cholam & Ragi	Cattle manure 5 tons per acre
Palur	Groundnut	Super 112 lb. *plus* cattle manure 5 cartloads
Guntur & Nandyal	Cotton	Ammonium sulphate 224 lb. *plus* super 112 lb. *plus* cattle manure 5 cartloads
Hagari	,,	Compost and cattle manure at 50 lb. nitrogen (3 tons)
Koilpatti	,,	Groundnut cake 259 lb. *plus* ammonium sulphate 112 lb. *plus* super 112 lb. *plus* cattle manure 3 tons
Guntur, Hagari & Nandyal	Cholam	1. Ammonium sulphate 224 lb. *plus* super 112 lb. *plus* cattle manure 3 tons 2. Green manure cowpea ploughed in situ
Koilpatti	,,	Groundnut cake 500 lb. *plus* super 112 lb. *plus* cattle manure 2 tons *plus* cotton compost 1 ton
Hagari	Tenai	Cattle manure 6,000 lb. (50 lb. nitrogen)
Koilpatti	Cumbu	Ammonium sulphate 224 lb. *plus* super 112 lb. *plus* cattle manure 3 tons *plus* cotton compost 1 ton
Guntur	Maize & Variga	1. Kossier phosphate 224 lb. *plus* bonemeal 224 lb. *plus* cattle manure 3 tons 2. Cowpea ploughed in situ *plus* super 56 lb.
Nanjanad	Samai	Nanjanad Farm Mixture
Nandyal	Groundnut	Cattle manure 3 tons
Guntur	Tobacco & Chillies	Ammonium sulphate 224 lb. *plus* potassium sulphate 100 lb. *plus* super 224 lb *plus* cattle manure 2 tons.
Taliparamba	Pepper	Leaf mould 20 lb. *plus* fish guano ¼ lb. *plus* sodium nitrate or ammonium sulphate ¼ lb. *plus* potassium sulphate ¼ lb. *plus* super ¼ lb. *plus* lime ½ lb. per vine.
Kasaragod & Pilicode	Coconut	Ammonium sulphate 3 lb. *plus* ashes 20 lb. *plus* cattle manure 100 lb. per tree.
Nanjanad	Potato	Farm mixture: groundnut cake 500 lb. *plus* ammonium sulphate 200 lb. *plus* steamed bonemeal 350 lb *plus* potassium sulphate 224 lb. *plus* concentrated super 336 lb.

GLOSSARY OF SCIENTIFIC NAMES

Common name	*Scientific name*
Bengal gram	Cicer arietinum L.
Black gram	Phaseolus Mungo L. Var. radiatus
Castor	Ricinus communis L.
Chillies	Capsicum spp.
Cholam (Tam.)	Sorghum vulgare Pers.
Coconut	Cocos nucifera L
Cowpea	Vigna catjang Walp
Cotton	Gossypium spp.
Cumbu (Tam.)	Pennisetum typhoides Stapf and Hubbard
Green gram	Phaseolus mungo L.
Groundnut	Arachis hypogaea L.
Jonna (Tel.)	Same as Cholam
Korali	Setaria pallidifusca Stapf and Hubbard
Korra (Tel.)	Setaria italica Beauv.
Lupin	Lupinus spp.
Maize	Zea Mays L.
Neem	Azadirachta indica A. Juss.
Paddy	Oryza sativa L.
Panivaragu (Tam.)	Panicum miliaceum L.
Pepper	Piper nigrum L.
Pillipesara (Tel)	Phaseolus trilobus Ait.
Plantain	Musa paradisiaca L.
Potato	Solanum tuberosum L
Ragi (Tam.)	Eleusine coracana Gaertn.
Rice	Oryza sativa L.
Sajja (Tel.)	Same as Cumbu
Samai (Tam.)	Panicum miliare Lam.
Sorghum	Sorghum vulgare Pers.
Sugarcane	Saccharum officinarum L.
Tegapesara (Tel)	Phaseolus Sublobatus Roxb.
Tenai (Tam)	Same as Korra
Tobacco	Nicotiana tabacum L.
Variga (Tel.)	Same as panivaragu
Wheat	Triticum spp

The Fluted Scale, *Icerya purchasi* Mask., as a Pest of Wattle in South India, and its control by the Biological Method

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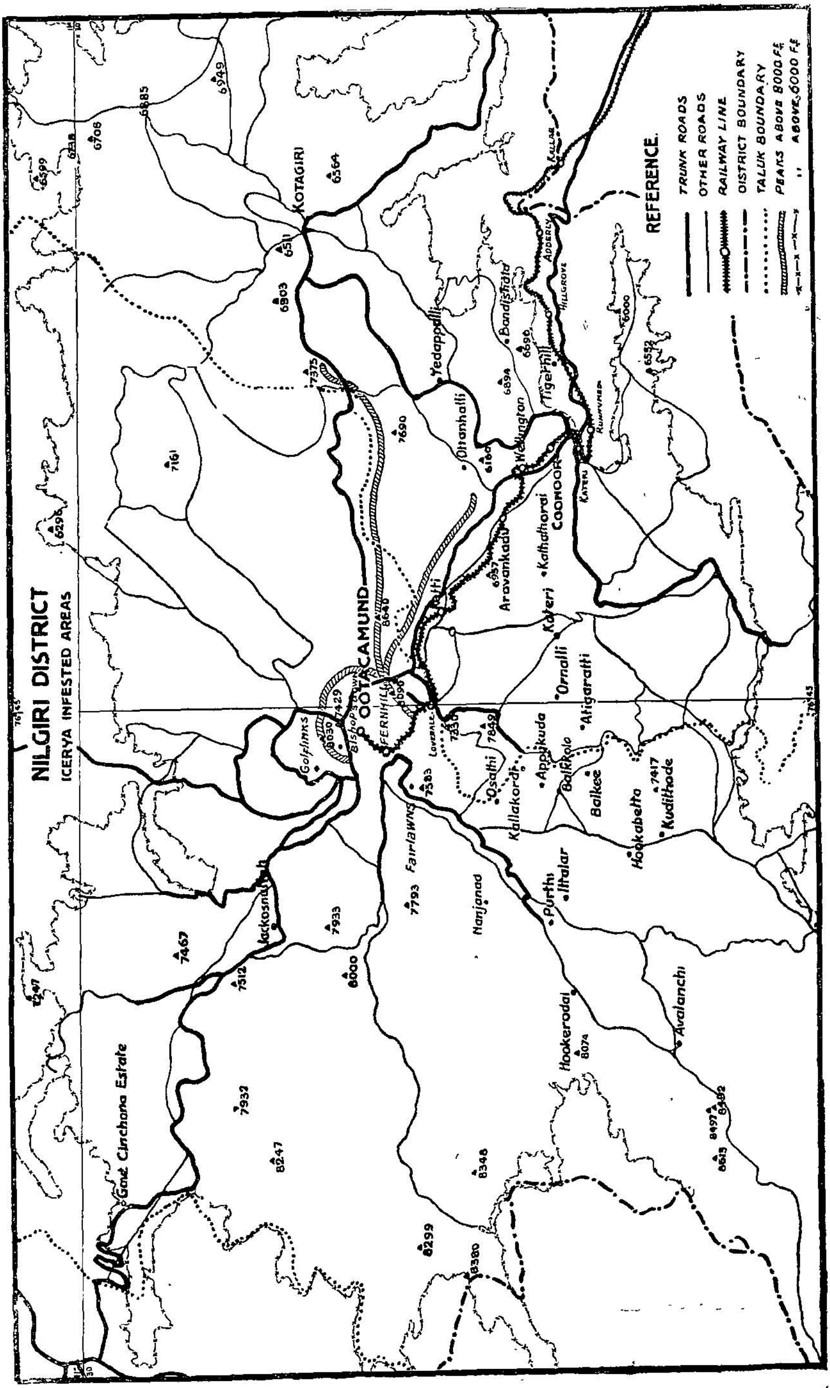
Foreword The Fluted Scale, *Icerya purchasi* Mask., was first reported as a pest on wattle in April, 1928 on the Nilgiris, and during the years 1928 - 1930 measures were taken to check its spread first by the application of the Pest Act and later on by the importation (mainly from California and Egypt) of its natural enemy, the Ladybird--*Rodolia (Vedalia) cardinalis* Muls. A preliminary paper on this subject was prepared and read by one of the authors at the Indian Science Congress at Allahabad in January, 1930, but was not published pending the preparation of a fuller account, which, however, did not unfortunately materialise. After having been under fairly efficient control for over a decade, the scale had again increased in numbers by 1941, when it was reported to be causing much damage on the Nilgiris, and what was even more serious, it was detected on wattle at various places on the Upper Palnis also in 1941-42. Consequently, laboratories were established at Kodaikanal in July 1942 and at Fernhill in September 1943 to breed the Rodolia Ladybird. In view of the likelihood of the spread of the pest beyond its present limits and the consequent threat to the expanding fruit industry of India, it is proposed to present in this paper a short account of the spread of this pest in South India since its first appearance and indicate the present position in regard to its control.

The first appearance of the Scale in South India The presence of the Fluted Scale in South India was first brought to the notice of the Madras Agricultural Department by Mr. J. P. Parry of Ootacamund, Nilgiris, who reported, under cover of a letter dated the 11th April 1928 accompanied by specimens, a serious attack of this scale on his wattle plantation at Mac'vor's Bund near Avalanche on the Nilgiri Plateau. An examination of the specimens confirmed the identity of the scale insect and a reference to available literature revealed that one had to deal with a pest with dangerous propensities for attacking valuable fruit crops such as the orange and the apple, and indeed, Fletcher (1917) had already given a note of warning as early as 1917 of the possibility of its entrance within Indian limits from Ceylon. A prompt visit paid to the infested areas on the Nilgiris showed that the pest was by no means confined to the wattle plantations at MacIvor's Bund but was also to be found on wild wattle (*Acacia de-albata*) at Keti, on

PLATE - 1


NILGIRI DISTRICT
ICERYA INFESTED AREAS
REFERENCE.
TRUNK ROADS
OTHER ROADS
RAILWAY LINE
DISTRICT BOUNDARY
TALUK BOUNDARY
PEAKS ABOVE 8000 Ft.
" ABOVE 6000 Ft.
OOTACAMUND
KOTAGIRI
COONOOR
Wellington
Aravankadu
Kateri
Ornalli
Aligaratti
Appukuda
Balkola
Balkee
Hookabetta
Kudithode
Kallakordi
Osathi
Lovedale
Fernhill
Bishopsdown
Golflinks
Fairlawns
Nanjanad
Purthi
Ittalar
Jackosnadu
Hookerodai
Avalanchi
Govt. Cinchona Estate
Yedappalli
Bandishola
Tiger Hill
Hillgrove
Adderly
Kallar
Runnymede
Othanhalli
Kattabettu

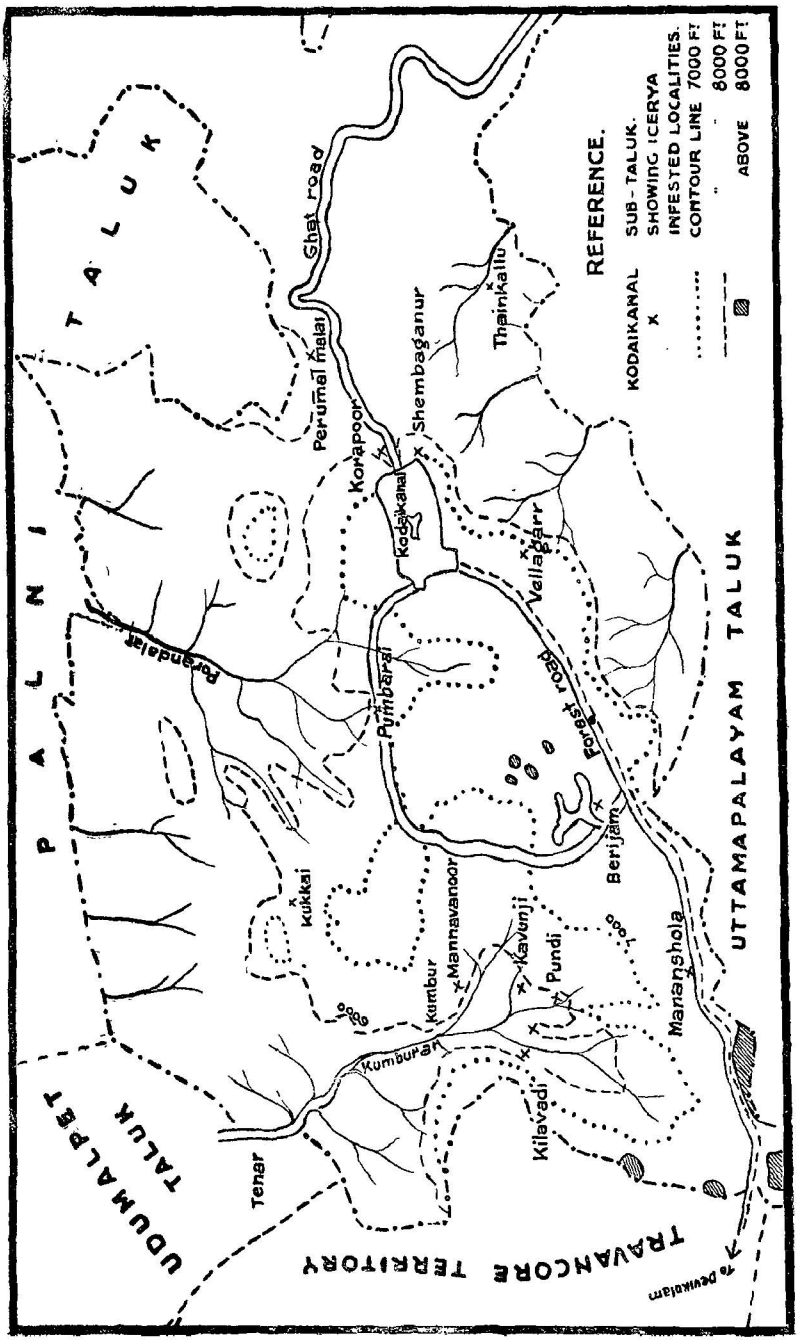


PLATE - II
PALNI TALUK
UTTAMAPALAYAM TALUK
UDUMALPET TALUK
TRAVANCORE TERRITORY
REFERENCE.
KODAIKANAL
SUB-TALUK.
SHOWING ICERYA
INFESTED LOCALITIES.
CONTOUR LINE 7000 FT
8000 FT
ABOVE 8000 FT
Shat road
Perumal malai
Korapoor
Shembaganur
Thainkallu
Kodaikanal
Vellagarr
Poondalai
Pumbarai
Forest road
Kukkai
Kumbur
Mannavanoor
Kavunji
Pundi
Berijam
Kumburar
Kilavadi
Tenar
Manangshola
To Devikolam

broom (*Cytisus scoparius*) and gorse *(Ulex europaeus)* at Fairlawns and other localities. The infestation at Keti, moreover, appeared to be at least three years old, and this estimate was confirmed by the local coolies, who declared (in April, 1928) that they had during the preceding two or three years noticed this "bleeding insect" (Tamil : *Rethappuchi*), so-called by reason of the reddish stains caused on clothes when accidentally squashed in these places.

The present distribution of the Scale in South India—*Nilgiris* In the course of subsequent visits to the Nilgiri area during the years 1928 and 1929, careful surveys were made to note the distribution of the pest, and during 1930 periodical visits were paid to the infested localities in order to examine the results of the liberation of predator beetles. All infested places were marked on a map of the district, and by the beginning of 1931, when the special staff employed on Icerya control work was withdrawn, the distribution of the pest was as shown in Plate I. The infested areas appear to lie mostly in the valleys to the south of the Great Dodabetta Divide that runs from Octacamund eastwards to Kotagiri. Moreover, they are apparently organically connected with the main roads and bridle-paths of this part of the plateau. (1) To the west, we have along the Ooty—Avalanche road : Fairlawns, Nanjanad, Osatti, Hookeradai, Ittalar, MacIvor's Bund and Avalanche ; (2) due south along the road from Ooty to the Kundahs : Fernhill, Lovedale, Kallakorai, Appukkodu, Balakola, Baikee, Oranalli and Adigaratti ; (3) along the Keti—Katteri road : Kollimalai, Katteri and Kothathorai ; (4) along the Ooty—Coonoor road : Tiger Hill, Keti, Aravankad, Wellington, Jakatala and Coonoor ; and (5) along the Wellington—Coonoor—Kotagiri roads : Springfield, Bandyshola, Idaipalli, Banniway, Ottanhatti, Kotagiri and Kodanad Road. A survey recently made by M. S. Kylasam in July, 1942 showed that a new area to the north-west of Ootacamund *viz.* Jachos Nullah, along the Ootacamund—Gudalur road, had also become infected. Most of these localities are between 6,000 and 7,500 feet above mean sea level.

Upper Palnis The first report in regard to the appearance of this scale on the Upper Palnis was from Kavunji (to the west of Kodaikanal) in June, 1941, since which time, it has been found to occur in various other localities in the Kodaikanal area. (1) Kumbur Valley : Kavunji (6,200 ft), Poondi (6,400 ft.), Kailavari (6500 ft), Mannavanoor (6,500 ft), Polur (6,000 ft), and Kumbur (5,900 ft) ; (2) to the north, Kukkal (5500 ft) and Poombarai (6,300 ft.) ; (3) to the south & south-west, Marianshola (7,700 ft), Berijam Lake (7,100 ft), and Vellakamedu (6,500 ft.), and (4) to the east, Kodaikanal (7000 ft.), Shembaganur (6,000 ft.), Korappoor (5,500 ft), Perumalmalai (5500-5000 ft.) and Thainkal (4200 ft.), *vide* Plate II. According to Subbiah the pest was found on wattle in May, 1942 in a neighbouring area at Devicolam (Travancore State), where probably it should have been introduced at about the same time.

Outside the Hills It is rather difficult to say where else the scale has spread in South India, as its presence is not likely to be recognised and reported until the attack has become really serious One of the writers (Rao) recently noted the pest at Bangalore on a small rose bush at Mavalli, and it appears not unlikely that it will be found in some other places in India if a special survey is conducted.

The Origin of the Pest in South India Although no direct evidence is available as to how exactly the pest had made its entry into the Nilgiris, there would appear to be little doubt that the scale has been introduced through the medium of imported orchard stock or flowering plants. At Holly Mount, a bungalow at Wellington, S. Ramachandran found some rose bushes and a potato creeper (*solanum seaforthianum*) infested by this scale in May, 1928, and on enquiry, he was told that an apple plant of origin outside India planted by a former occupant of the property had been killed by an infestation of the scale. If this be a fact, this might well have been the source of the present outbreak of the Fluted Scale, as it could easily have spread from this nucleus in the direction of Keti, Coonoor or Fairlawns through the agency of coolies and cattle At MacIvor's Bund, it was reported that the attack was first noticed around a culvert built of stones brought as head-loads from the neighbourhood of Keti, and an inspection of the stone quarry at Keti, later on, showed that it was situated in the midst of an area of infested wild wattle. An examination of the infested areas on the Nilgiris has clearly indicated that the dispersal of the pest has been mainly along foot-paths, cattle-tracks, bridlepaths and roads. The newly hatched bugs are very active and are capable of wandering some distance over the ground and along the branches of plants in search of fresh feeding places, whence they readily get transferred on to the clothes of coolies or the hairy coat of cattle passing among infested bushes. Sometimes the use of affected branches of wild wattle as packing material carried on head or on pony-back may also be directly instrumental in carrying the pest to new localities. According to Balachowsky (1929), the newly hatched young bugs may, by reason of their extreme lightness, be transported over long distances by heavy winds.

Though it is apparently more likely that the infestation had reached India from Ceylon, the possibility of its having made its entry from other countries of origin cannot be discounted. In any case, the fact of its having reached India from outside would call for stricter scrutiny of imported plants by sea or air.

The host-plants of the Scale The Scale is known to have a very wide range of food-plants in the countries in which it has been introduced, including among them a good many cultivated plants, such as orange, apple, pomegranate, castor, rose, pear, peach, coconut, etc. On the Palnis and Nilgiris, however, although quite a large number of plants have been found

subject to attack, most of them are wild species of no consequence economically The following are the only plants of economic importance among the affected flora :—three species of commercial cultivated wattles *viz : Acacia decurrens, A. mollisoni,* & *A melanoxylon,* rose bushes (*Rosa* spp.), and *Citrus* spp. On the Upper Palnis, Subbiah has found that *Acacia de-albata* is the most susceptible and *Acacia mollisoni* the most resistant among the wattles, and also that wattles growing on rocky areas or on shallow or gravelly soils are more severely infested than those growing on rich and deep soils, which are comparatively free. He also found that new shoots springing up from coppices and root-suckers are badly infested, while seedling plants are generally free. Berijam plantation, consisting of *Acacia mollisoni* was lightly infested, whereas the plantations at Kodaikanal and Marianshola (with other species) were badly hit. The large number of plants liable to infestation would appear, however, to testify to the cosmopolitan tastes of the scale, though the special favourites would appear to be the wild wattle (*Acacia de-albata*), the St. John's Wort, the broom and the gorse. A complete list of the plants found attacked on the Nilgiris and the Upper Palnis is given below, and it is seen that the species attacked are different in many cases in these two areas. The following species would appear, however, to be common to both these hill areas :—*Anaphalis aristata, Artemisia parviflora, Conyza ambigua, Acacia de-albata, Citrus* spp., *Hypericum mysorense, Osyris arborea* & *Rosa* sp.

Host Plants of Icerya Purchasi on the Nilgiris and Upper Palnis

Natural orders	Plants on the Nilgiris	Plants on the Upper Palnis
Compositae	1 *Anaphalis aristata*	1 *Anaphalis aristata*
	2 *Anaphalis neelgheriana*	2 *Artemisia parviflora*
	3 *Anaphalis* sp.	3 *Artemisia vulgaris*
	4 *Artemisia parviflora*	4 *Conyza ambigua*
	5 *Artemisia* sp.	5 *Erigeron mucronatus*
	6 *Bidens pilosa*	6 *Helichrysum bracteatum*
	7 *Conyza ambigua*	
	8 *Eupatorium glandulosum*	
Euphorbiaceae	9 *Euphorbia rothiana*	
	10 *Glochidion velutinum*	
Leguminosae	11 *Acacia de-albata*	7 *Acasia de-albata*
	12 *Acacia decurrens*	8 *Acacia decurrens*
	13 *Acacia melanoxylon*	9 *Acacia melanoxylon*
	14 *Acacia mollisoni*	10 *Acacia mollisoni*
	15 *Cytisus scoparius*	11 *Crotalaria fysoni*
	16 *Sophora glauca*	12 *Crotalaria bourneae*
	17 *Ulex europaeus*	
Solanaceae	18 *Solanum jasminoides*	
	19 *Solanum seaforthianum*	

Labiatae	20 *Leucas helianthemifolia*	13 *Anisochilus argentens*
	21 *Leucas zeylanica*	14 *Leucas vestita*
		15 *Leucas ternifolia*
		16 *Plectranthus coetsa*
		17 *Pogostemon mollis*
Rutaceae	22 *Citrus* spp.	18 *Citrus* Spp.
Rosaceae	23 *Pyrus mali*	19 *Pyrus communis* (Country pear)
	24 *Rosa* sp.	20 *Rosa* sp.
		21 *Rubus* sp. (Rasp-berry)
Rubiaceae	25 *Oldenlandia articularis*	22 *Oldenlandia herbacea*
		23 *Oldenlandia stylosa*
		24 *Oldenlandia swertioides*
Myrtaceae	26 *Eucalyptus susceptibile*	25 *Eucalyptus glaucum*
	27 *Rhodomyrtus tomentosus*	
Acanthaceae	28 *Justicia simplex*	26 *Justicia procumbens*
		27 *Strobilanthus kunthianus*
Santalaceae	29 *Osyris arborea*	28 *Ozyris arborea*
Hypericaceae	30 *Hypericum mysorense*	29 *Hypericum mysorense*
Buxaceae		30 *Sarcococca trinerva*
Sapindaceae	31 *Dodonaea viscosa*	
Geraniaceae		31 *Oxalis corniculata*
Caprifoliaceae		32 *Viburnum coriacum*
Berberidaceae	32 *Berberis tinctoria*	
Ericaceae	33 *Caultheria fragrantissima*	
Loranthaceae	34 *Loranthus cuneatus*	
Umbelliferae	35 *Bupleurum mucronatum*	
Apocynaceae	36 *Carissa paucinervia*	
Rhamnaceae	37 *Rhamnus virgatus*	
Coniferae	38 *Callitris rhomboidea*	

Life-history and habits of the Scale *Icerya purchasi* Mask., popularly known as the Fluted Scale or the Cottony Cushion Scale, is an insect belonging to the Monophlebine group of mealy-bugs. The full-grown female scale is (Fig. 1, Plate III) quite a big and conspicuous insect not likely to be forgotten when once seen, especially when it occurs, as it generally does, in large white masses on the affected twigs. The mature female is about 1/5 in. long and greyish brown in colour, and secretes a large, elongate, fluted mass of white mealy-wax, more than twice as long as the body, inside which 400 to 1,000 small, oval, brickred eggs are closely packed. At Kodaikanal, M. S. Subbiah recently (1942) found 1409 nymphs crawling out of the egg-sac of a female scale under observation, in the course of two months. In large specimens the number of the progeny may exceed even 2,000. The young bugs, which are bright red with elongate black legs, on emergence from the egg-sacs, actively swarm up towards the succulent parts of the branches. The young ones are very active and would appear to be able to crawl on the ground and cover some distance in search of suitable

host plants After fixing itself upon a twig or a leaf, the nymph feeds and grows until it is ready for a moult. There are three moults in the case of the females, and the young bugs would appear to change their feeding places after each moult. Males are very rare, and in most cases reproduction would appear to be independent of fertilisation by the male (Hughes-Schrader, 1930). The duration of the life-cycle is apparently dependent on the temperature conditions of particular localities and of the season of the year. Working at Coimbatore during the months August to November 1928, T. V. Subramaniam found the duration of the egg stage to be 7 to 10 days, the I instar-12 to 23 days, the II instar-12 to 28 days, and III instar — 15 to 32 days. The duration of the life-cycle from egg to adult stage would thus be 46 to 93 days. On the Nilgiris, the shortest period for the egg-stage would appear to be 15 days. Nymphs inoculated on castor on 12—2—30 became adult during the week ending 12—4—30 (about 59 days); on apple on 19—3—30, became adult on 3—5—30 (about 45 days); on orange on 19—3—30, on 17—5—30 (about 59 days); and on Acacia on 1—5—30, between 21 and 28—6—30 (52 to 59 days). The scale is able to oviposit within 10 to 15 days, so that the shortest life-cycle from egg to egg-laying by the adult is 70 to 75 days in the hot season. According to Kuwana (quoted by Hughes-Schrader, 1930), the life-cycle occupies approximately four months under favourable conditions in Japan, and similarly according to Leonardi (*ibid*) three generations annually is characteristic of the species in Italy. On the Nilgiris, the length of a generation may be $2\frac{1}{2}$ to 3 months in the hot season and about two months longer in the colder parts of the year. On the Upper Palnis, Subbiah found in one case, where fresh nymphs were inoculated on Acacia in March, 1943, that nymphs of the new generation crawled out only on the 15th November, 1943 from the egg-sac. In this case a generation has lasted nearly eight months. In nature however, there is a good deal of overlapping of generations, and taking everything into consideration, it may be considered that there may be two to three generations of the scale on the hills.

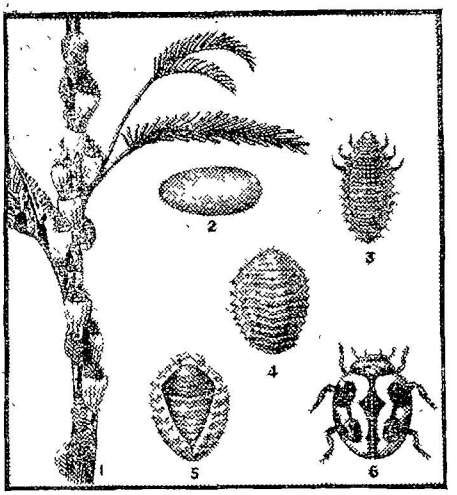
Effect of weather conditions on the Scale Observations made in the course of the control work on the Nilgiris and the Upper Palnis indicate that the pest flourishes best during the dry, hot season, i e., from the middle of January to the middle of June. During the monsoon rains, the insect experiences a set-back. The young ones may be washed down and killed by the impact of rain, and the scales themselves may become subject to fungus-attack, especially during November—December. In the interval between the end of the South-west monsoon and the onset of the North-east monsoon (September—October), warm weather usually prevails on the hills, when conditions are favourable for the increase of the scale, but with the appearance of the cold drizzly weather, characteristic of the North-east monsoon, there is a perceptible decrease in activity.

Natural enemies and diseases Two insect enemies and a parasitic fungus have been found attacking Icerya scales on the Nilgiri Hills:—

1. A lady-bird beetle—*Rodolia (Vedalia) roseipennis*, Muls., 2. a micro-lepidopterous caterpillar—*Stathmopoda melanochra* Meyr., and 3. a *Cladosporium* sp.—a parasitic fungus.

1. *Rodolia roseipennis* Muls. It is an indigenous species of lady-bird which is known to attack various other scale insects in South India. It lays yellowish eggs on the scale, and the rosy grey grubs that hatch out feed on the eggs inside the egg-sac of the bug, very often emptying it completely. (In this connection, it may be noted that the eggs of the imported lady-bird, *Rodolia cardinalis*, are smaller, but bright red, while the grubs are more dusky and can be recognised by the presence of pairs of dorsal black warts, and feed voraciously on the scales themselves). Subbiah has worked out its life-history at Kodaikanal. He found it to be a very shy breeder. There was much variation in the duration of the different stages, the period being shorter in the warmer months: egg-period—6 to 26 days; larval period—20 to 28 days; resting period—7 to 13 days; pupal period—12 to 23 days; and the total period from egg to adult—46 to 77 days. The longevity of the adult varied from 14 to 89 days. This species has been found also in Ceylon, at Bangalore and in various places in the Madras Presidency, and is apparently widely distributed in South India. Though it doubtless functions as a check, it is neither sufficiently prolific nor even efficient enough as a predator to exert any control on the pest.

PLATE III



1. Wattle with the larvae of Rodolia feeding on the scales.
2. Egg of Rodolia.
3. Larvae „
4 Prepupa „
5. Pupa with the pupal skin split up.
6. Rodolia beetle.

2. *Stathmopoda melanochra* Meyr This caterpillar belongs to the family *Heliodinidae*, and has the habit of entering the egg-sac of a mature scale and after attaching the sac firmly to the surface of the twig with a silken web, of feeding on the eggs inside. At first, it was mistaken for a scavenger on dead scales and mealy detritus, but closer observations established that it was a real predator. In fact, its activities in attacking the live material of

Icerya collected for feeding the grubs of *Rodolia cardinalis* in the breeding laboratory have proved a serious impediment in breeding the ladybird. Specimens of moths reared at Keti were sent in 1930 to Mr. T. B Fletcher, Imperial Entomologist, Pusa, and were identified by him as *Stathmopoda melanochra* Meyr. and in his letter dated the 4th November 1930, he remarked as follows: "This is an Australian species, common at Sydney, and nearly related to other Australian species, but without any near relatives in India. It looks, therefore, as if it had been introduced by accident with plants from Australia. The larval habit has not been observed in Australia". Messrs. M. S. Kylasam and M. S. Subbiah made the following observations on its life-history while in charge of the breeding work at Keti:— Parent moths lay their eggs singly on the corrugations of the egg-sac of the scale. The eggs are small, pearly-white when fresh laid, turning pink during development and have a sculptured shell. The young caterpillars burrow into the egg-sac and feed on the eggs. After finishing one egg-sac they find their way to the next one. It is presumed that each caterpillar may account for 6 to 10 egg-sacs. As per observations of Subbiah, the duration of the complete life-cycle may be about 12 to 16 weeks. Pupation takes place in a white silky cocoon among empty egg-sacs. The moths are poor breeders and lay eggs sparingly. It is found both on the Nilgiris and Upper Palnis. According to Subbiah, it is seen on the Palnis only between July and September.

3. *Cladosporium* sp. Scales attacked by fungus were examined by the Government Mycologist, Coimbatore, and identified to belong to the genus *Cladosporium*. It is in greatest evidence on the hills during the damp cold weather prevailing during the North-east monsoon rains.

Control Measures Observations made in the infested areas showed that such natural enemies as were already existent were not capable of bringing the pest under efficient control and it became necessary to devise measures calculated to prevent it from spreading to fresh areas. All ideas of controlling the pest by spraying had to be given up, as the infestation was not confined to cultivated wattle but spread over wide areas of broom, gorse and St. John's wort. The only feasible measure in the above circumstances was that of cutting and burning the infested bushes. With the sanction of the Government of Madras, the help of the Pest Act was invoked, and the destruction of infested broom at Fairlawns was first taken up under the supervision of the Curator, Government Botanical Gardens, Ootacamund, and executed by the Agricultural Demonstrator, Ootacamund. The operation was begun by the end of January, 1929, and by the end of March, 1929 an area of about 149 acres of infested broom had been cleared at a total cost of about Rs. 2,190. With the setting in of rains in April, however, it was found well nigh impossible to ignite the cut bushes and it was felt that nothing could be done till the close of the rainy season in December. As by April, the efforts that were being made to introduce the natural enemy of

the scale promised to bear fruit, Pest Act operations were kept in abeyance for the time being.

Methods of Biological Control Published information on the history of this well-known scale insect shows that it is a native of Australia that has been carried to various parts of the world through the medium of ocean-borne commercial traffic. It was first noted in California in 1868 on wattle but in course of time it spread throughout the state and by 1886 it was a serious menace to the orange and lemon industry. Finding the futility of mechanical methods of control such as spraying, the United States Bureau of Entomology sent an entomologist, Mr Albert Koebele, on a tour round the world to discover the original home of the scale and to search for its natural enemies, if any. Although Koebele found the scale on various islands in the Pacific Ocean, it was only in the south of Australia that he found its natural enemies in action. They included, besides others, the ladybird, *Rodolia cardinalis* and the fly, *Cryptochaetum iceryae*, which kept the scale in such effective check as to render it a harmless insect. The story of the introduction of the ladybird, *Rodolia (Vedalia) cardinalis*, into California and the marvellously rapid and effective control brought about thereby is one of the romances in the development of economic entomology, that has served to capture the imagination of the public and to bring the biological control method into the lime-light.

Since then, the introduction of the ladybird was adopted by various countries into which the scale had strayed and become a serious pest, with similar success, viz. Hawaii, Florida, South Africa, Japan, Brazil, Portugal, Palestine, France, Argentine, Sicily, Egypt, etc. The latest country to be invaded by the scale was Ceylon, where it was first noticed in December, 1915, and later on was found to have spread all over the highlands of that island. The importation of the Rodolia beetles was effected from South Africa in the course of six consecutive consignments during the years 1918, 1919 and 1920 (Hutson, 1920), and the efficiency of the work of the predator beetle is testified to by the fact that Dr. Hutson, the Ceylon Entomologist, wrote in 1928, in response to a request from Coimbatore for a supply of ladybirds, that it " was difficult to find either the scale or the beetle anywhere in Ceylon ".

(To be continued)

The Culture of Exotic Vegetables

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"Grow more food" is the order of the day and the present food position is such that everybody who can is asked to contribute his share, inclusive of the production of vegetables. Vegetables form an important group of food. They are essential protective foods, whose consumption in greater quantities is recommended, not only for their food value, but also for the important vitamins and mineral matter they contain and which are lacking particularly in the common South Indian staple diet. The use of more vegetables at present has a meaning and a significance: it tends to reduce the consumption of rice and thus make the existing supplies do a greater duty. Further, vegetables could be suitably grown in the backyards of houses with little effort or expense, to meet one's own requirements and possibly a little to spare for neighbours and the needy. Vegetables that combine quantity and quality of produce with an economic return are to be preferred, whether they are indigenous or exotic types, which in popular parlance are referred to as 'English vegetables'. Judged by that standard and from the experience of the cultivation and marketing of exotic vegetables, it could be stated that the exotic vegetables easily score over the indigenous types. Some of the aspects of the production of exotic vegetables that would interest the would-be cultivator are included in this short note.

There is a generally prevalent idea among many people that exotic vegetables can be grown only in very cold climates met with in the hills, and not in the plains. That is not correct, as most of them can be grown in the plains as well. The exotic vegetables, no doubt, require a comparatively cooler climate than the indigenous vegetables. The summer in the plains may be too hot for them; severe winter conditions in the hills are also not suitable. They may therefore be omitted from the scheme of cropping for summer in the plains and winter in the hills. But in places where the temperature ranges between 45° F. and 100° F., the exotic vegetables can be grown all through the year. There are many such localities in the Madras Presidency that can take up the production of exotic vegetables. The climate is therefore not a serious obstacle. Cabbages, carrots, beans and peas have been successfully grown by the writer in the Kurnool District, and other districts in the presidency are not worse off than Kurnool climatically.

The present need of the hour is the production of vegetables quickly and plentifully, to relieve the shortage of food. The duration of the crop selected for planting is therefore an important consideration. The shorter the duration of the crop, the sooner will the produce be ready and the greater the produce that one can manage from the same land in an year. Further,

an amateur, who is now induced to 'grow vegetables', may not have the patience to wait long for the fruits of his labour. Quick results alone can arouse in him a zeal and fervour to grow more. From this point of view the exotic vegetables are ideal, for their average duration is 60 days. Many come to bearing even earlier; radishes are ready for the market in 30 days, lettuce takes the same time after transplanting, peas and beans give the first picking in about six weeks, turnips take the same time, cabbages, cauliflower, beet root and tomatoes are ready in about eight weeks from planting. Carrots, potatoes, marrows, parsnips and bush-lima take a longer time, but many of them are ready in about 90 days. For those who are anxious to accelarate production, exotic vegetables would come in handy and be ideal. There are also the long duration drags and the cold weather pets.

Many people are sceptical about the exotic vegetables, their yield and capacity to give reasonable returns. It must, however, be emphasised that they need not be apprehensive; the yields of most of the exotic vegetables are something phenomenal. The average yield of the various crops is furnished in the appended statement. It is seen that very many of them yield more than 20,000 lb. per acre and enormous profits are thereby assured. At times, the profit may mount up to Rs. 1,000 per acre. The indigenous vegetables are comparatively poor paying crops. This aspect of large returns of the exotic vegetables has so far escaped the notice of the cultivators.

The war situation has brought in to our midst considerable military forces that consist of men from other countries—America, Australia, Great Britain, Italy etc. They require exotic vegetables for their consumption; the present production is not enough and the tendency is for the prices to range on the high side—a viss of peas sells now at one rupee, a viss of beans at 5 annas, carrot at 6 annas a dozen, turnips and beet root at 12 annas a dozen, cabbage at 12 annas and cauliflower at 3 to 4 annas each. These are, no doubt, profiteering prices. Even if the ruling prices run down to half the present level, as a result of increased production, the cultivator can safely expect a decent return and profit by the cultivation of these vegetables.

The cultivation of the exotic vegetables has to be taken up not merely as an expedient measure for the duration of the war, but also as a permanent feature of cultivation. It must be emphasised here that the demand for these vegetables will be there even after the war. For, our people also relish them as well as others and would prefer them to the indigenous vegetables; the demand for them is limited only by the extent of availability. They are not at present produced in quantities large enough to become available for all classes of people. Its use is limited to the richer classes only. The writer has produced large quantities of the exotic vegetables, tons and tons of them, and found that the local people also were eager to purchase them. Of the different types, the peas are in greatest demand from the local people. Tomatoes, cabbages and cauliflower rank next in the order of perference.

Beans of all kinds, French, broad, and runner beans, are the main vegetables with which the customers fill their basket first. Carrots, knol-khol and beet root are not so well known, but the demand from people who have used them is considerable. Cauliflower is not known to many people and it is easily one of the most delicious vegetables. Radishes and turnips are rather piquant and do not appeal to all palates alike, being rather too strong for some. It is seen that there is an extensive market for the exotic vegetables, whose potentialities have not at all been tapped properly. There is no doubt that in course of time these exotic vegetables will be cultivated widely and will find their place in any scheme of cropping.

From the point of view of nutrition, the exotic vegetables easily score over the indigenous vegetables. Lettuce, parsnip, spinach and carrots are rich in vitamin A and their carotene value is over 2,000 international units. Cauliflower is noted for its content of vitamin A, B and C. Turnips are rich in vitamins B and C. Potatoes are very valuable and the nutrition authorities recommend the inclusion of 4 to 8 oz. in the daily ration of every individual. Artichoke is equal to potato in nutritive value. The peas and beans are rich in protein and mineral matter.

Wherever the soil and climatic conditions permit, the cultivation of the exotic vegetables deserves to be taken up. The writer believes that they are going to play an important part in the post-war dietary of the country. Large number of Indian soldiers, returning from Europe after the war, would have developed a taste for the exotic vegetables and there is bound to be an increased demand for such vegetables. The cultivation of exotic vegetables would then be taken up in a large scale in India and become a permanent feature of the country.

Short notes and a guide for the cultivation of these vegetables are appended.

Short notes on the cultivation of exotic vegetables

Artichoke Open trenches 9 in. wide and 9 in. deep, 2 ft. apart, fill with the removed soil and cattle manure at 30 cartloads per acre. Plant setts or whole rhizomes. Irrigate once a week. Earth up after 45 days. Pick off flowers as they form and lift the rhizomes for use, when required.

Some people consider this to be delicious and some class it as a useless vegetable; possibly a matter of taste.

Beans—French Manure with cattle manure at 30 cls.* per acre. Earth up the plants after 25 days. Irrigate once in 5 days and oftener at the time of the formation of pods and collect half developed pods once in 3 or 4 days.

The tender pods may be boiled with a little salt, dried and preserved for use, as and when required. When the pods are mature, they may be shelled and the seeds used for cooking.

Beans—Lima Dig pits and plant seeds as for the ordinary garden variety of Dolichos. Train the climbing varieties on *pandals* or trellis work. Bush Lima is suitable for growing in large areas.

* cls.—cartloads

Beet root Beet is a hardy plant and comes up well in all classes of soils. Sandy loams are the best. Apply 30 cls. of well-rotted cattle manure. Irrigate once in 6 days; over-irrigating to be avoided.

Prefer the imported seed for sowing. Locally produced seeds tend to run into flowers rather early.

Chow chow Allow the plants to trail on *pandals* The mature fruit containing the bud is planted. This is known as "Bangalore Kathirikaye" in the southern districts.

Cabbage Cabbage is a voracious feeder. Apply 50 cls. of cattle manure per acre. Give liquid manure at 5 cls. per acre just before earthing up. Ripe leaves may have to be removed twice or thrice. Plant lice are the worst enemies of cabbage. Spray tobacco decoction and fish oil soap emulsion in the early stages.

Cauliflower Apply 50 cls. cattle manure. Irrigate once in 5 days. Earth up the crop 25 days after planting, after applying liquid manure. Snap the leaf next to the flower and cover the flower with it to prevent the curd from breaking and getting discoloured during summer. Sow only imported seed for obtaining quality heads.

Carrot Deep sandy soils are the best. Sow the seed in beds and cover just as for onion seed. Potash application is advantageous. Sow the seed on ridges in clayey soils. Keep the crop free of weeds.

This crop has few pests and diseases. Imported seeds do well. Thinning the crop may not be necessary, if sown at the rate of 4 lb. per acre.

Celery Plant in trenches 9 in. × 9 in. filled with rotten cattle manure at 50 cls. an acre. Start blanching when the plants are one foot high by embanking earth, as it grows, up to the top leaves, but do not allow the earth to press the stems hard. Remove lateral shoots, as they appear. Irrigate copiously. Used as a seed and as a vegetable.

Maize Earth up the plants when they are a foot high, after applying 5 cls. cattle manure. Collect the cobs when they just pass the milk stage. Remove all the bracts, excepting the last whorl before selling.

Knol-khol Apply 50 cartloads cattle manure initially and liquid manure once a month. Irrigate once in 4 days. Two weedings may be necessary. Control plant lice, as it appears, even in the early stages.

This is a favourite vegetable with Indians. Harvest before the tubers turn woody or too big.

Leek Plant the seedlings 4 in. below ground level in trenches dug 9 in. wide and 10 in. deep and filled with well rotten cattle manure (50 cls. per acre). Irrigate copiously. As the plant grows, earth up to ensure proper blanching.

The white underground well blanched fleshy stem, is a good flavouring for soups and sauce.

Lettuce Heavy manuring and frequent watering are essential for promoting good growth and retarding flowering. Heading varieties should be assisted by drawing the leaves together and tying. If the leaves are coarse, it is a result of over-manuring.

Lettuce is a perfect salad vegetable. The cabbage lettuce may be planted in cold weather and cos lettuce at other times.

Onions Apply 30 cls. of cattle manure. Use a slightly higher seed rate, if you are sowing straight in beds. Irrigate once in 5 days. Pull out the bulbs when mature, indicated by the withering of the leaves. The maturing could be hastened by snapping the tops without breaking them and leaving the crop thus for a few days.

Parsnip Dig deep for good results and when large areas are to be planted, use a large plough, dibble the seeds straight in the field and irrigate once a week. Manuring may be done at 30 cls. per acre. The seeds lose their viability soon, and fresh imported seeds should therefore be preferred.

Peas Stake with brushwood when the plants are 15 days old, after lightly earthing up the plants, so that irrigation water may not touch the stem. The success of the crop depends on keeping off mildew and aphids.

Potato Dig up the soil well to facilitate weathering. Select good seed material and cut it to pieces with at least two eyes in each piece. Irrigations should be light by splashing till the crop comes up well over the ground.

Radish Radish is a quick growing crop, easy to grow. Good manuring and copious irrigation help immensely.

Spinach (New Zealand) tends to rot if water stagnates in the field. Prefer a well drained soil, especially in the rainy season. Sow in beds.

Spinach beet Thin the crop when sown straight in the field and remove the leaves often whether required or not to prevent flowering.

Soya beans Can be sown as a dry crop during the N. E. monsoon. The tender pods are used as vegetable. Use just like Peas.

Sweet potato Plant vines with about 3 nodes. Manure with 20 cls. cattle manure per acre and irrigate profusely. Turn the vines to prevent the formation of adventitious roots.

Tomato Open trenches 9 in. by 9 in. and fill up with cattle manure at 50 cls. Drive in stakes six feet long and plant one seedling to each stake. Rub off the side shoots or branches and allow the main shoot alone to grow. Top the plant at about $5\frac{1}{2}$ feet. Liquid manuring definitely improves the yield. Collect when the colour is turning lightly especially for the market.

Turnip Turnip prefers a soil with good lime content. Good tilth and heavy manuring tend to give good results. Plant seeds straight in beds and irrigate once in 4 days.

Vegetable marrow Dig pits 3 ft. × 3 ft. × 2 ft. Fill with well rotten manure and dug-up soil. Sow six seeds in each pit and finally thin out to three plants per pit. Hand water in the beginning, earth up after 30 days and irrigate copiously later, particularly in summer. There are distinct summer and winter varieties.

Name	Season for sowing	Seed rate per acre	Nursery area sq. ft. per oz. of seed	Duration in the nursery in days	Planting Distance	Time taken to yield	Average yield lb.	Highest yield recorded by the writer lb.	Varieties which have given good performance
1	2	3	4	5	6	7	8	9	10
Artichoke "Jerusalem" (*Helianthus tuberosus*)	All the year round	150 lb. of rhizomes	...	...	2′×1′–6″	120 days	15,000	25,000.	Jerusalem
Beans 'Dwarf French', 'Kidney beans' (*Phaseolus vulgaris*)	Avoid cold season and rainy months	40 lb.	...	...	1′–6″×9″	45 days	6,000	12,000	Local variety
Beans 'Lima' 'Double' 'Buller' (*Phaseolus limensis*)	June—July	6 lb.	...	...	Pits 10′ apart;	4 months for Bush Limas and 6 months for tall growing varieties	6,000	...	Improved Florid, butter speckled, and Large white
Beet root (*Beta vulgaris*)	All the year round	2 lb. for direct sowing and 1 lb. 8 oz. for nursery sowings	100	25	1′–6″×1′	75 days after direct sowing and 60 days after transplanting	10,000	20,000 with Crimson Globe and 30,000 lb. with Mangel Ursel	Early Wonder and Crimson Globe
Chow-chow (*Sechium edule*)	All the year round	300 pits with one fruit planted in each pit	...	...	12′×12′	100 days after planting	15,000	...	Local variety

Cabbage (*Brassica oleracea* var. *capitata*)	August to December in plains and February to May in hills	2 to 4 oz.	100	20 to 30	2'×1'–6"	75 days after planting	10,000	20,000	Pride of Asia, early and late Drum head and Copenhagen Market
Cauliflower (*Brassica oleracea* var. *botrytis*)	do	2 to 4 oz.	100	25	2'×1'–6" for late and 1'–6" ×1'–6" for early varieties	45 & 90 days for early and late varieties respectively	5,000	...	Early Snowball, Earliest of All and Pasali
Carrot (*Daucus carota*)	Avoid rainy season	4 to 6 lb.	...	...	6" either way	90 days for full development	10,000	16,000	Chantenay Imperator America and Early Nantes
Celery (*Apium graveolens*)	Cold weather	2 to 3 oz.	200	45	2'×1'–6"	90 days after planting	8,000	...	White Plume
Indian corn (*Zea mays*)	June—October	16 lb.	...	...	1'–6"×1'	75 to 90 days	6,000	...	Golden bantam
Knol-khol or Khol-Rabi (*Brassica oleracea* var. *caulorapa*)	Severe summer and heavy rainy months not fit for planting	4 to 6 oz.	100	20 to 25	1'–6"×1'	45 to 60 days after planting	12,000	20,000	Early white, Vienna and Khol-khol Green
Leek (*Allium porrum*)	June—December	1 lb.	100	40	1'–6"×9"	90 days after planting	8,000	...	American Flag and Improved Musselburgh
Lettuce (*Lactuca sativa*)	January—June	2 to 4 oz.	400	25	1'×1'	30 days after planting	10,000	18,000	Cos lettuce and Perfection
Onions (Bellary) (*Allium cepa*)	May—December	2 lb.	100	40	1'×6"	90 to 120 days	8,000	14,000	Bellary onion
Parsnip (*Pastinaca sativa*)	Cold weather	1½ to 2 lb.	...	...	1'–3"×9"	90 days	12,000	...	Hollow Crown

Peas (*Pisum sativum*)	June—December	20 lb.	...	...	3'×3"	45 to 60 days	800	1,000	Local Dwarf Early
Potato (*Solanum tuberosum*)	May—December	750 lb.	...	...	1'-6"×9"	75 to 90 days	6,000	14,000	Rangoon ricket
Radish (*Raphanus sativus*)	All the year round	3 to 4 lb.	..	...	9" apart for country varieties; 6" apart for Table Radish	30 to 45 days	15,000	25,000	Local White Long. Table varieties are Scarlet Globe and French Icicle
Spinach (New Zealand) (*Tetragonia expansa*)	do.	12 lb.	...	...	1'-6"×1'	6 weeks	10,000	...	...
Spinach Beet (*Beta cida*)	do.	2 lb.	100	20	1'-6"×1'	6 weeks	15,000	...	Acclamatised seeds
Soya beans (*Glycine soja*)	August—September	15 lb.	...	...	1'-6"×9"	100 days	4,500 (green pods)	...	Burmese
Sweet potato (*Ipomoea batatas*)	All the year round	1,000 to 1,200 lb. of haulms	...	...	1'-6"×1'	120 to 150 days	10,000	15,000	Local Red
Tomato (*Lycopersicum esculentum*)	May—December	2 to 3 oz.	200	25 to 30	3'-2'	2 months after planting	15,000	25,000	Carters Fruit, Break a day, Early Market and Ox heart
Turnips (*Brassica rapa*)	January—June	6 to 9 oz.	...	...	1'×9"	45 to 60 days	14,000	24,000	Red Turnip, Bronze Top, Purple Top and White Globe
Vegetable Marrow (*Cucurbita pepo C. maxima*)	All the year round	2 lb.	...	...	Pits 12' apart and three plants in a pit	60 days	15,000	30,000	White Long

Cattle Nutrition in War Time

By C. BALASUBRAMANIAM, B.A., B. Sc. (Ag.),
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The prices of cattle feed have increased enormously and the supply of suitable feed to the cattle in sufficient quantities has become a major problem for cattle owners. The prices of cattle have also risen considerably, that people could not afford to allow their cattle to run down in condition and get inefficient and to substitute them by fresh purchases. It is however felt that by suitably adjusting the feeding programmes, the feeding of cattle could be done in a fairly satisfactory manner, and with this hope the following suggestions are offered.

Pastures In many districts grass can be successfully grown for grazing. If the rainfall is adequate and its distribution favourable, the growth of grass will be satisfactory. The grass growth over and above the immediate requirements can be usefully converted into hay.

Grey loamy soil, popularly called Sambal mannu is considered to be best suited for raising pastures, since it is rich in lime. Next in the order of preference come the red loamy and sandy soils (4). If the soil is deficient in lime or phosphoric acid, it could be corrected by the application of suitable manures; if not, it will be reflected in the pasturage. Cattle grazing in such pastures will be unthrifty and easily contract deficiency diseases caused either by a deficient or imbalanced intake of minerals, notably calcium and phosphorus. Grass does not stand waterlogging and pastures should therefore be laid in well drained lands. It would be an advantage if the pasture is secure against winds. Controlled grazing gives satisfactory results.

Composition of grass It is well known that (i) the dried young grass is as valuable as concentrates for sheep and cattle and (ii) the silage from young leafy herbage can even replace concentrates in the ration of the dairy herd (1). These statements are borne out by the chemical composition of the grass determined at various stages of growth. In the early stages of growth the plant cell walls are thin and tender, being composed of simple forms of cellulose. This is easily digested and has a nutritive value for ruminants comparable with that of starch. Further, the nutrients in the cell, namely, proteins, carbohydrates, and fats are released and are throughly digested by the cattle. Hence the proportion of nutrients digested is rather high in young grass. Young grass is rich in protein, which gets reduced as the grass matures. Further, lignification sets in and the cell walls get thickened and tough, due to the conversion of the cellulose into complex forms like ligno-cellulose. Ligno-cellulose cannot be digested by cattle and hence the meagre nutrients in the cells do not become easily available for the nutrition of cattle. That is the reason for straw, a typical

example of a highly lignified material, having a low nutritive value. The advice that can therefore be given to livestock owners is that, ignoring the bulk, the hay crop should be cut before it matures and lignification sets in. Such a hay, rich as it is, will have a concentrate-saving value.

Raising leguminous crops for fodder A discreet farmer should bear in mind the requirements of his farm animals, when he plans his cropping. In view of the non-availability of some concentrates and the prohibitively high prices practically of all the conentrates, he should include protein-rich fodders in his cropping. There are a number of crops that will yield protein-rich herbage, chief among them being the leguminous plants. These possess the unique capacity to assimilate atmospheric nitrogen and fix it in their tissues. The legumes selected must be capable of making luxuriant growth, without being fastidious about its requirements of soil and climatic conditions, *i. e.*, only those that are best suited for the different localities must be chosen.

Lucerne (*Medicago sativa* L.) and sweet potato (*Ipomea batatas* Poir) can advantageously be substituted for concentrates (8). Two and a half pounds of lucerne hay can replace one pound of groundnut cake as a source of protein. But it should not entirely replace the groundnut cake in the ration, based on this calculation. Das Gupta has noted that there is no variation in milk yield, when an ideal grain and cake mixture is replaced to an extent of 75 per cent by green berseem (2). Green leguminous feeds in large quantities are likely to set up tympany and they may be largely fed as hay preferably. Almost all the leguminous hays can be safely fed to cattle. In Circars, *ryots* raise a hay crop of sunhemp (*Crotalaria juncea* L.) in summer, in wet lands making use of the moisture in the soil. A practice akin to this may be possible in other localities as well. Sweet potato is a familiar tuber crop, conspicuous for its vigorous growth. The succulent young vines contain 2·58 per cent protein, equivalent to 19 per cent on a dry basis (8). It is estimated that 20 lb. of green vines a day would supply as much protein as one pound of groundnut cake or 3 lb. of cotton seed. The vines cannot entirely replace the concentrates in the routine ration of cattle, as they exercise a laxative action. Cultivation of sweet potato for fodder will solve the fodder difficulty particularly during summer, when fodder is scarce. This is a practice adopted at the Agricultural College Dairy at Coimbatore.

Tamarind Seed Tamarind seed is available everywhere at a nominal cost and could be used as a concentrated feed, though this is not widely practised. It is used for feeding cattle in the Krishnagiri Taluk (Salem District), in the North Arcot District and in parts of Tinnevelly District. There are many small scale factories, processing the seed for feed purposes at Krishnagiri. The seeds are roasted in small furnaces and the seeds are dehusked by pounding. The testa or outer integument of the seed contains an astringent mucilagenous material, which is likely to induce choking, and should therefore be removed. Roasted seeds contain 3·6% ash, 16·12% crude proteins,

6·32% fat and 61·47% carbohydrates. The roasted and dehusked seed could be soaked and used as a concentrated feed, which is relished by cattle very much, possibly because of its peculiar appetising flavour. To start with one-fourth the quantity of protein in the concentrates may be substituted by an equivalent in tamarind seed and later the tamarind seed could replace half the quantity of concentrates.

White Babool (*Acacia alba* Willd.) The white babool pods contain 14·86% of crude protein, 57·8% of carbohydrates, and 6·84% of ash. includ- 1·61% of lime (CaO) and 0·44% of phosphoric acid (P_2O_5). The pods have a good feeding value and can be included in the dietary of cattle as a concentrate. This is a regular practice with the Pattayagar of Palayakottai, the famous Kangayam cattle breeder.

Seldom do cattle take to new feeds kindly. They should therefore be gradually introduced in the dietary of animals, in the place of the usual concentrates.

Tobacco Seed Cake This is not generally known to be a feed for cattle. The tobacco seed cake contains 30 to 35% of crude proteins and 16 to 17% of fat, and is free of nicotine. This could substitute the usual gingelly and groundnut cakes as cattle feed. Tobacco seed cake feeding trials conducted at the Agricultural Research Station, Guntur, indicate that the cake is without deleterious effects on the cattle fed with it (9).

Fish Meal There are several grades of fish meal and their nutritive value depends on the type of fish used, the method of drying and the care bestowed in the manufacture of the meal (3). It usually contains about 60% of protein and 20% of mineral matter, which is mainly made up of bones. The calcium in the bones is in an easily available form and the protein content is high. The fish meal is noted for its vitamin contents, chiefly A, D and G. It is not in common use as a livestock feed owing to the belief that the fishy flavour is imparted to the milk of cows and to the meat of the animal fed with it. No such experimental evidence is however forthcoming, but its inclusion in large amounts in the diet might taint the milk and meat. In consideration of the present high prices of concentrates, it is worthwhile including it in the feed of cattle, setting aside the unfounded prejudices against its use.

Molascake Molasses have been utilised in preparing cakes, called 'Molascakes' for feeding cattle, in the chemical laboratory of the Agricultural Research Institute at Coimbatore. Cane molasses contains 25—29% of moisture, 9·4% of ash and 61·9% of carbohydrates, chiefly as sugar (3). It is palatable and is very much relished by cattle, so much so that rancid groundnut cake mixed with it will be readily eaten by cattle. Molascakes are made by mixing thoroughly equal parts of finely ground groundnut cake and molasses and moulded into convenient shaped bricks. Mineral mixture and salt at one oz each per pound of molascake may also be incorporated; such a cake would contain 4·7% fat, 29·9% protein, 40% carbohydrates, 3·7% lime and 1·8% phosphoric acid.

Mineral matter in feed However adequate the ration may be from the point of view of meeting the energy and protein requirements of cattle, it is advisable to include mineral mixture and common salt, in the feed, at the rate of one oz. per animal per day. The heavy milkers may be given two ozs. of mineral mixture advantageously. The mineral mixture is made up of equal parts of burnt shell lime and steamed bone meal, ground to a fine powder and can be purchased from Messrs Stanes & Co., Coimbatore, and other firms. Common salt tones up the system and the mineral mixture makes up the deficiency of lime and phosphorus in the feed. Mineral mixture has a smell which may not be liked by animals and it has therefore to be mixed with the concentrated feed. In areas where the soil is deficient in minerals like Malabar, Kurnool, North Salem and possibly Tanjore also, the quantities recommended normally may safely be doubled to make good pasture deficiencies (6). The mineral mixture should preferably be fed continuously. It is cheap and its inclusion in the feed, along with common salt, would not cost more than a pie or two per day per animal.

Important points to be remembered while purchasing concentrated feed for cattle The cheapest concentrate must be purchased, consistent with quality. While adjudging the value of a concentrate special consideration must be paid to its protein content, since it is the most valuable nutrient present in it. The kind of concentrate to be purchased depends upon the type of animal, the availability of the material in the market and its cost. For instance, for feeding working bullocks cotton seed or oil cake, whichever is locally available for a reasonable price, can be used, preferably in combination with cereals and legumes. It is not economical to feed young calves with cotton seed. In any locality the availability of the concentrates depends upon the types of crops grown. It will be observed that cotton seed is invariably fed to all classes of cattle in the cotton growing areas and that gingelly and groundnut cakes are likewise preferred in places where these crops are largely cultivated (7).

The concentrates should not be stale or rancid. A ready method of testing the freshness or otherwise of a concentrate like cotton seed or oil cake is to chew a small quantity for noting the degree of rancidity.

It is customary to include in the ration for cattle rice bran and wheat bran, and these may be adulterated with sand and husk. The freshness of the bran is easily detected, but not necessarily the admixture of husk and sand. When a sample of bran is put in a glass of water, sand will settle down quickly at the bottom of the glass and husk will float on the surface and the quantities settling down fast and floating will respectively measure the quantities of sand and husk in the feed. The ingestion of large quantities of inert matter upsets the digestive system of animals.

Cereals, pulses, cotton seed and cakes should also be tested for damage by insects, as to that extent their value is lowered.

Summary The present high prices of feeding stuffs and fodders and their non-availability preclude the inclusion of the ingredients, to which the

animals were accustomed previously. Some suggestions have been given for the maintenance of pasture, inclusion of legumes in the cropping, inclusion of materials like tamarind seed, babul pods, tobacco seed cake, fish meal and molasses in the dietary of cattle and the addition of mineral mixture and salt in the feed. It has been pointed out that grasses and leguminous crops intended for feeding milch animals and growing stock should be cut before they mature fully. Some important points about the purchase of concentrated feeds are also mentioned.

Acknowledgement The writer wishes to acknowledge the help rendered by Sri H. Shiva Rao, The Government Agricultural Chemist, in preparing this paper.

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Abstract

Nature and uses of sea weeds, By R. E. Delf, *Nature, 152, No. 3849, 149 (1943)* Generally speaking, sea weeds are utilised in three principal ways :—In connection with agriculture, as food or medicine, and for industrial purposes. In agriculture sea weeds are used as fodder or manure. They may be fed fresh. In Scotland Pelvetia is boiled with oat meal and then fed to calves. Dried sea weed ground to meal or stored in layers with hay between is used in some districts. Laminaria saccharina was fed to horses with varying success in France during the war of 1914-18 In New Zealand, sea weed (Macrocystis, Hormosira) is found to benefit cattle grazing on poor pasture land In America, sea weed meal has improved health and fertility in cattle and in chickens when fed as a small proportion of the daily diet. The use of algae as manure in maritime situations is widely practised. Driftweed is largely collected but harvesting is also practised where the coast is suitable. The manurial value is probably due to the organic constituents as well as for mineral salts. There is little nitrogenous value in most sea weeds except in Ulva and Porphyra.

Sea weeds are greatly valued in the East-Japan, Coasts of China and Malay and also in the North and North-west coasts of Europe. Pink laver is produced commercially in Japan. In Great Britain, Carrageen moss is the most widely utilised sea weed. It is usually considered that their mineral content is of value, especially the iodides; their gelatinous substances are probably not digested by man but may be useful in providing bulk without irritation.

The manufacture of potash and other snbstances from *kelp* (brown algae) fell into disuse when cheaper mineral deposits were discovered. In the present

century algae are used as a source of mucilaginous substances utilised in many ways, especially in Great Britain, Japan, and United States.

Algin from algae is utilised in the preparation of a transparent film resem. bling cellophane. A kind of artificial silk is also prepared from sea weeds. The Japanese claim to have produced an artificial wool from Sargassum spp. In recent years salts of alginic acid are used in the manufacture of Cosmetics-textiles, transparencies and plastics. In Japan a kind of sea weed glue is prepared which is used for sizing paper, fibre or cloth.

A more valuable product is agar-agar, the commercial name given to gelatinous substance extracted by boiling water. During the last two decades, agar has been widely used in connection with foods and medicines. As a laxative, it absorbs and retains water, besides acting as a lubricant. It is almost universally used as a basis for bacterial and fungal cultures, resisting liquefaction. Recently, however a strain of bacteria, *Vibrio agarlyticus*, has been isolated which liquefies agar but not cellulose.

By far the greater part of the world's supply of agar came from Japan, but a considerable quantity has also been manufactured in California, though much is not sufficiently pure for bacteriological purpose. At the present time, investigations are being carried out in the United States and other countries, with the view of developing local supplies. The rich algal flora of the coasts of South Africa and New Zealand and of the west coasts of North America and Canada offer many possibilities, but even in the U. S. S. R. during the last ten years, an agar-producing industry has apparently been developed, utilizing algae which occur on their maritime coasts and on the shores of the Black Sea. It has recently been announced that agar suitable for bacteriological purposes has been obtained from certain sea weeds in South Africa, New Zealand and in Britain. This is being further explored.

To obtain a pure agar, the freshly collected algae are bleached in the sun for some days, the process being hastened by sprinkling at intervals with fresh water. The bleached algae are then boiled with water (Japan) or treated with steam (United States) and the resulting mass strained through cloth. The clear liquid is poured into shallow troughs to set, and the jelly cut into narrow strips. In Japan, the process is carried out in cold weather, so that the strips contract, expelling water; in the United States the same result is obtained by artificial refrigeration. In either case, the expelled water is drained off, and the remaining jelly dried and shredded for packing.

The commercial utilisation further demands much work on the biochemical and technical side before the final stages of marketing can be reached. We thus require the services of the botanist, the ecologist, biochemist, the technician and the financier. Yet the last word remains with the botanist, who combines the experience and judgment of a systematist with the practical knowledge of the ecologist.

S. N. C. & S. V. P.

Gleanings

British war-farming To summarize the concrete achievements of agriculture is not easy with a ban on official statistics. But the following facts will give some idea of what has been done. Whereas before the war Britain was barely growing one ton of food out of every three tons she consumed, she is now growing two tons. Reduced consumption of some commodites has helped in this result, of course, but on the other hand the increase has been achieved with the loss of over seven million tons of imported raw material, in the form of feeding stuffs for livestock that no longer come here to be processed into milk, meat and eggs This result represents an increase of some 70 per cent in the net output from the

soil of Britain. An extra 7 million acres of grassland will have been ploughed and sown by this harvest...and Britain's total arable acreage was only 12,000,000 when war broke out. The net increase in tillage will bring the arable acreage in the United Kingdom up to something like 19,000,000. But even in 1942 higher yields, obtained largely through more efficient farming, gave Britain the greatest harvest in her history, greater, even, than in the '70's. Never have we had so little land to farm; never has it produced so much food.

Despite the loss of over 5 million acres of pasture and the cutting off of most of the imported feeding-stuffs, British dairy farmers have beaten all previous records with their milk sales and have met a demand for fresh milk that is far above the consumption figures for any previous year. Last summer, it was 45 per cent over any pre-war summer. The sugar beet factories are working to capacity, dealing with a record beet acreage. In the last war we grew, for all practical purposes, no sugar; we are now producing all the sugar for the domestic ration, though not the sugar for manufacturing purposes, such as jam. The 1943 wheat acreage has increased by 25 per cent above the 1942 acreage and is nearly double the pre-war average. The 1939 potato acreage of over 700,000 has been very nearly doubled; the oat acreage has risen from under 2,500,000 to over 4,000,000; there has been a corresponding increase in the acreage of barley. The 2,500,000 tons of vegetables we grew before the war has been raised to some 4,000,000 tons, and we have added about 2,000,000 h. p. to the land with the use of machinery. We are maintaining a bigger population of dairy cattle than in any other year in our history and our beef cattle show only a small decline. Sheep show a decline of under 20 per cent from the top of a high curve on the outbreak of war. Pigs have been heavily reduced, by over 50 per cent, but the reduction in poultry, taking into account the increase in those kept by households, is about 20 per cent. Commercial poultry flocks are down by some 25 per cent. Some thirty or forty thousand acres of bog and swamp have been added to the usable land of Britain; hundreds of thousands of acres that had fallen completely derelict have been reclaimed, tens of thousands of miles of farm ditches have been cleaned out and the old field drainge system made to work again after a generation of neglect. An extra 4,000,000 acres or so have been rendered fit for food growing.

All this has been achieved with the 40,000 skilled men away from the land and their replacement by girls whose acquaintance with agriculture is limited to one month's training. A few more men, and some of them none too skilled, have been added to the regular labour force on the farms, but the total number of male workers is less than in 1939. Gang work on jobs, such as land reclamation, has been carried out by conscientious objectors, men unsuitable for calling up with the Services, and Italian prisoners. It has been achieved, too, in some counties in spite of quite considerable attention from the enemy. In one county alone for example, 70,000 bombs fell on farms in six months, not to mention German aeroplanes. Land Girls have been machine-gunned on their tractors, and steel helmets have had to be borrowed for their protection.

More crops and better livestock For the fifth year of war, Britain is planning a yet further increase in her production of food. But this time it has to be a slightly different programme.

Hitherto, the main thing has been to win back for the plough some of the millions of acres of permanent grass to which so much of the land had tumbled back between the two wars. But a considerable amount of grass is needed for Britain's very big livestock population, and grass is her most important crop. Also there are limits to the gross amount of land under crops that can be dealt with under the limitation of man and woman power in wartime.

So, in the coming season some acres that are now arable will be reseeded to temporary leys. Many of them have borne three successive whitestraw crops and need a rest. At the same time there are some million acres of grassland most of which are ploughable. They will be ploughed and provide fresh land for cropping, while the leys will provide better grass than the acres that will now be ploughed up. Mr. Hudson has told British farmers that this will be the programme for the next four years, because the world situation is such that even if the war were to end this year, Britain would have to grow all the food it can for that period at least. More crops and more livestock can be obtained by such a programme.

It means that livestock will come much more into the picture, and at present that means cattle and sheep, mainly cattle. A grading up of commercial herds is to take place, getting rid of the passengers that give poor milk yields or are 'bad doers', and raising the milk yield and increasing the number of animals of the right type. It will not, of course, bring such quick results as the ploughing compaign, but they will be lasting results, of special value to Britain where livestock will always be agriculture's sheet anchor.

Farmer members of county and district committees who have had to go round every farm examining fields that might be fit for ploughing have now to make another pilgrimage, inspecting the herds. They will recommend whether more or fewer stock should be kept, report on milk yields, herd management, state of farm buildings, arrangement of calving dates and other such details. Special attention will be paid to the bulls that are being used, for there are too many without a satisfactory milk record in their pedigree, and also the re-crossing cross-bred cows to get more saleable bull calves in dairy herds has been getting rather out of hand lately in some districts. Farmers with unsuitable bulls will be told to change them, to get a bull of the right breed, and to stick to it. Arrangements are already in hand for building up a larger supply of good young bulls that can be brought by the ordinary farmer at a reasonable price.

It is a big undertaking, bigger in some ways than the ploughing progromme. It puts rather drastic powers in the hands of the county committees. But the farmers are accepting it, because the committee have proved themselves practical men, and they have acted with tact and human understanding.

The households of Britain have also played their part in food production, providing healthy, fresh food for the family, saving transport, making wasta lend and building sites release land on the farms for other food production, converting refuse from kitchen and garden into eggs, bacon and rabbit's meat. Women and the older children have taken an active part in this. Never before have householders had so little spare time; never before have they grown so much food.

Changes within and without The whole landscape of Britain has been changed, and with the change has come a new spirit in the hearts and minds of its inhabitants. It can best be expressed briefly by saying that they are now ready to do and dare to achieve and to experiment—whereas before they were bent upon preserving their existence as farmers. Returning confidence, and the feeling that the nation is looking to them and placing a great responsibility upon them is mainly responsible for this, together with the fact that the force of circumstances has compelled them to be farmers again and use their brains, instead of being the mere processers of imported raw material. It shows itself in many ways, such as increasing efficiency, greater readiness to learn and to show initiative. In one word throughout the British countryside today there is a greater 'alive-ness', both in the people and, somehow, in the land itself. It is not strange. It is only what was to be expected if the spirit of the countryside were given the chance to express itself, and what we see today is only

the beginning of what might be, should we continue to give the land the opportunity to contribute to our civilization. But that new spirit could very easily be put to sleep again, and the next time we may try too late to awaken it. But this the war has proved up to the hilt—Government may make their plans, and County Committees issue their orders, but the best plans and most drastic orders will avail little unless at the same time the old self-dependent, resourceful spirit of the English yeoman can be re-kindled; for ultimately it is he only who can make the peculiar conditions of every individual farm conform to central direction It is no small achievement that a Government Department should have devised a plan that would create that spirit among 400,000 scattered units; but the greatest achievement of all is that those units have made the plan work, with results that have astounded the Ministry of Agriculture and the world. (*Achievement in British Farming* by L. F. Esterbrook: The Pilot Press Ltd., 45, Russel Street, London W. C. 1).

Value of lime in chewing The question has often been raised whether the calcium ingested during the chewing of betel leaves coated with slaked lime is available for body needs or not. This information is important especially in the rice eating areas because rice is extremely poor in the element and the habit of betel-chewing is fairly prevalent among rice eaters. Basu *et al** have studied this question in detail and found that calcium ingested in this manner is assimilable to a great extent. The assimilation of calcium ingested with 6 betel-leaves is stated to be equivalent to that from 10 ounces of cow's milk. (*Biochemical and Allied Research in India*, Vol. 13, 1942),

Reviews

Achievement in British Farming by L. F. Esterbrook, Published by the Pilot Press, Ltd., 45, Great Russell Street, London W. C. 1—Price 2 s 6 d. In this small book of 35 pages has been compressed the salient features of British farming during the War. Strictly speaking the book deals with the revolution in agriculture that has been brought about in Britain during the stress of War, from 1939 up to publishing. Every sentence speaks of some piece of achievement of which every Briton should be proud of. The book is a small pen picture album of the revolution, a revolution not less in magnitude than the revolution in Russian agriculture, and where everybody concerned is happy—the Ministry of Agriculture dictating through the various county and district committees what each farm shall do for the nation, the part-time voluntary workers from the schools, offices and factories and from cottages and houses of all sizes, the army of Land Girls, the regular army men who too lend a hand, as well as the farmer who is being dictated to and who may occasionally be asked to quit and give place to another, more able to carry out the programme chalked out for the farm. All this is done without any fuss or murmur. National necessity and requirements come foremost and all other considerations sink into the background. England was producing one-third of her food pre-war, while she produces fully two-thirds now. Her milk production has been increased 45%, besides other things. The first section deals with the past, the nine sections that follow speak of the various branches of farming and the last section ably sums up the achievements.—(Gleaned elsewhere in this journal.—*Ed.*). Numerous photographs, strewn right all over the book, puts additional life interest into this achievement. This is one of a series of *Achievement Books*. Other publications of this series are: Achievements in arming the army, Achievements in British aircraft, Achievements in British ship-building, and Achievements in feeding Britain. V. T. S.

* Basu, K. P., Basak, M. N. and De, H. N. (1942), *Indian J. Med. Research*, 30,309.

Annual review of biochemical and allied research in India, Vol. XIII for 1942, published Dec. 1943. The Society of Biological Chemists, India, Malleswaram post, Bangalore, Pp. 101; Rs 3 or 6s. This review, in a small compass of 101 pages, gives abstracts of published research work done in India during 1942 in biochemistry and allied subjects. Primarily intended for the research worker, only the salient points in the individual items of research work have been touched upon, but sufficiently to indicate the type of work done and results obtained; it should prove a valuable book of reference. The review is in 10 sections written by workers in the respective branches. The different sections are enzymes, vitamins, general nutrition, human physiology, animal nutrition, metabolism of proteins, fats, carbohydrates and minerals, pharmacology, human pathology, plant-physiology, chemistry of plant products, and soils and fertilisers. The printing, get-up and finish should be considered good for a war-time publication.

V. T. S.

Correspondence

To

The Editor, Madras Agricultural Journal

Dear Sir,

Sea-weeds After reading the abstract on sea weeds published elsewhere in this volume, it will be of interest to the readers to know about the algal flora in Madras and how we could use and make wealth out of waste.

The Gulf of Mannar has been known to be extremely rich both in flora and fauna. In April 1943, the sea weed, *Gracilaria lichenoides*, which is found in abundance in the shallow waters of the coast of Ramnad was collected by me, and given to the Government Agricultural Chemist for the preparation of agar-agar and it is reported that the quality of agar-agar produced is in no way inferior to the imported stuff. The algae is found in abundance and there is great scope for the manufacture of agar-agar in our own country.

The *ryots* in parts of Ramnad are manuring coconut trees with marine algae and their experience is that the crop is always a rich one with algal manure. In the present drive to employ economically every so called 'waste plant', it is up to us to make the best use of the marine flora in which the Gulf of Mannar is about one of the richest in the world.

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S. N. Chandrasekharan.

Crop and Trade Reports

Statistics—Crop—Cotton—1943-44—Fourth forecast report The average area under cotton in the Madras Province during the five years ending 1941-42 represents 9·8 per cent of the total area under cotton in India.

The area under cotton up to the 25th January, 1944 is estimated at 2.013,900 acres. When compared with the area of 2,127,900 acres estimated for the corresponding period of last year, it reveals a decrease of 5·4 per cent.

Three hundred and thirty-two thousand and five hundred acres have been reported as sown since the last December forecast was issued. This extent comprises chiefly 178,200 acres under Tinnevellies including Karunganni in Coimbatore, 68,100 acres under Cambodia, 13,300 acres under Warangal and Cocanadas; 59,500 acres under Westerns, 7,000 acres under White and Red Northerns, 5,800 acres under Salems and 600 acres under other varieties. The area sown in December, 1943 and January, 1944 is more than that sown in the corresponding period of the previous year by 68·9 per cent.

The decrease in area in the current year as compared with that in 1942-43 occurs in all the important districts of the Province except in Trichinopoly and Bellary. The decrease is marked in Tinnevelly (-44,800 acres) and Coimbatore (-66,700 acres).

The area under irrigated cotton, mainly cambodia is estimated at 239,900 acres as against 272,800 acres estimated for the corresponding period of the previous year, a decrease of 12·1 per cent.

Pickings of the *mungari* or early sown cotton crop in the Deccan are nearing completion. The yield per acre was slightly below the normal due to bad bursting of bolls.

The crop was affected by drought in parts of Vizagapatam and Kistna, by excessive rains at flowering time in parts of Kurnool, Bellary and Anantapur and by insect pest in parts of Kurnool. The yield per acre is estimated to be normal in East Godavari, West Godavari, Guntur, Nellore, Cuddapah, North Arcot, Tanjore, Madura, Ramnad and Malabar, and below the normal in other districts of the Province.

The seasonal factor for the Province as a whole works out to 90 per cent of the average as against 81 per cent in the previous year. On this basis, the total yield is estimated at 452,300 bales of 400 lb. lint as against 430 400 bales for the corresponding period of the previous year. It is, however, too early to estimate the yield with accuracy as the harvest has not yet commenced in the major portion of the area and much will depend upon the future weather conditions and the toll taken by insect pests.

The estimated area and yield uuder the several varieties are given below:—

(Area in hundreds of acres, i. e., 00 being omitted; yield in hundreds of bales of 400 lb. lint, i. e., 00 being omitted).

Variety	Area from 1st April to 25th January		Corresponding yield	
	1943-44	1942-43	1943-44	1942-43
1	2	3	4	5
	Acres	Acres	Bales	Bales
Irrigated cambodia	2,287	2,588	1,527	1,574
Dry cambodia	2,336	2,836	626	567
Total cambodia ...	4,623	5,424	2,153	2,141
Uppam in the Central Districts	170	216	25	31
Nadam and Bourbon	180	330	10	16
Total, Salems ...	359	546	35	47
Tinnevellies*	5,418	4,868	1,195	1,206
White and Red Northerns ..	1,540	1,800	164	158
Westerns	7,070	7,385	771	540
Warangal and Cocanadas ...	1,067	1,182	198	203
Chinnapathi (short staple) ...	62	77	7	9
Total ...	20,139	21,279	5,523	4,304

* Includes Karunganni cotton grown in the Coimbatore district and Uppam, Karunganni and mixed country cotton grown in the South.

The average wholesale price of cotton lint per imperial maund of 82⅔ lb. (or 3,200 tolas) as reported from important markets on the 5th February 1944 was Rs. 37—1—0 for Cocanadas, Rs. 32—7—0 for White Northerns, Rs. 32—15—0 for Red Northerns, Rs. 25—10—0 for Westerns (*mungari*), Rs. 25—15—0 for Westerns (*hingari*), Rs. 72—15—0 for Coimbatore Cambodia, Rs. 58—13—0 for Coimbatore

Karunganni and Rs. 38–5–0 for Nadam cotton. When compared with the prices published in the last report, i. e., those which prevailed on the 8th January 1944,. these prices reveal a rise of approximately 4 per cent in the case of Cocanadas and 1 per cent each in the case of White Northerns. Westerns (*mungari*) and Coimbatore Cambodia and a fall of approximateiy 3 per cent in the case of Westerns (*hingari*), the prices remaining stationary in the case of Red Northerns, Coimbatore Karunganni and Nadam cotton. (*From the Commissioner of Civil Supplies, Madras*).

Cotton Raw, in the Madras Presidency The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1944 to 31st March 1944 amounted to 51 356 bales of 400 lb. lint as against an estimate of 406,500 bales of the total crop of 1943–44 The receipts in the corresponding period of the previous year were 5,728 bales. A total quantity of 93,806 bales mainly of pressed cotton was received at spinning mills and 170 bales were exported by sea while 31,056 bales were imported by sea mainly from Karachi and Bombay. (*From the Director of Agriculture, Madras*).

Moffusil News

Exhibitions Agricultural Exhibitions were held in February 1944 in the following places:--

At Udipi on the occasion of the local Parayam festival, at Kalipatti in Tiruchengode Taluk during the Thaipoosam festival and Cattle Fair, at Rasipuram in connection with the Rural uplift and Taluk Tournaments, at Omalur in connection with the annual Taluk Tournaments, at Koodali Village in Tellicherry at the time of a local festival, and at Bonukote in the Pulivendla Taluk, at Kotappakonda in the Narasaraopet Taluk and at Pattisam in the Polavaram Taluk during the Mahasivarathiri festival.

Agricultural exhibitions in March An agricultural exhibition was held at Dharmapuri and another at Ellore, where stress was laid on "Grow more food" and the need for saving money and investing for national defence.

Imperial Dairy Research Institute, Bangalore The Government of India have sanctioned a scheme for the Imperial Dairy Department by which the Imperial Dairy Research Institute at Bangalore will be taking two honorary research workers from July 1944 for carryiny out advanced research work for a period of one year. The problems for research will be confined to those bearing on the Chemistry and Bacteriology of milk and milk products, Technology of milk processing and manufacture of milk products and Cattle husbandry and coming within the purview of the present activities of the Institute. The workers will be exempt from payment of any fees but subject to the other conditions and rules of discipline prescribed at the Institute. They will also have to make their own arrangements for boarding and lodging. The candidates will have the facilities of doing post-graduate work for the M. Sc and Ph. D. degrees of the Bombay University and other Universities by whom the Institute has been recognised as a suitable centre for the purpose. Intending candidates, who are graduates of Indian or European Universities, and preferrably with First class M. Sc. or B. Sc. Honours qualifications may apply to the Director of Dairy Research, Bangalore, at an early date giving full particulars of their age, qualifications, research experience, nature of problem desired to be studied, etc. etc.

College and Estate News

Students' Club A meeting of the members of the Students Club was held on 24–2–44 under the presidency of Sri S. N. Chandrasekhara Ayyar and a condolence resolution was passed bemoaning the loss of Mrs. Karturiba Gandhi and conveying their heartfelt sympathies to the members of the bereaved family.

University Examinations The B. Sc. Ag. degree examinations, theory and practicals, were held from the 1st to the 28th April and the students' hostel closed for the vacation from the 29th.

Farewell The Gazetted officers of the Agricultural College and Research Institute were 'At Home' on the evening of 8th April to Mr. P. H. Rama Reddi, C. I. E. Director of Agriculture, going on leave preparatory to retirement.

The Hostel Day Celebration The annual Hostel Day was celebrated on 27--2—44 with great eclat. Several games and sports were held on that day. The annual dinner was held at 8 -30 P. M followed by an entertainment. The celebration came to a close with the distribution of prizes by the Principal.

H. E. The Viceroy's Visit H. E. The Viceroy accompained by H. E. the Governor of Madras and the Collector of Coimbatore visited the Agricultural College and Research Institute on 22—2—44 between 5—55 and 6—5 P. M. The Director of Agriculture and the Principal were introduced to H. E. Lord Wavell on his arrival by H. E. the Governor of Madras. Then His Excellency was taken to some of the sections of the Research Institute and the College.

RETIREMENT

Sri T. Budhavideya Rao Nayudu, Deputy Director of Agriculture, Northern Division, retired from service on 8th February 1944, just after 30 years of service in the agricultural department. He was considered an ideal student while studying at the Agricultural College, Coimbatore. He served from 1914 onwards in various capacities, as farm manager and teaching assistant in Agriculture. He was made Assistant Director of Agriculture in 1922. He was superintendent, live stock research stations at Chintaldevi and Hosur for about 8 years and Deputy Director of Agriculture for 9 years at Guntur, Madura and Cuddapah districts, He was Deputy Director at headquarters for $1\frac{1}{2}$ years. While he was Deputy Director of Agriculture he was known to be an officer with an amount of drive and initiative, very valuable in demonstration and propaganda work. He was responsible for starting a large number of agricultural associations in the Presidency. These, we believe, have been immensely helpful in carrying forward the present 'grow more food campaign'. We trust that with his very good health and inordinate energy he will continue to help the ryots of his place with his rich practical experience. People who contacted him could not fail to be impresed by his transparent sincerity. We wish him many years of useful life.

V. T. S.

Departmental Notifications

Gazetted Service—Postings

Rao Bahadur B. Viswanath, C. I. E., D. Sc., F. I. C., has been appointed Director of Agriculture, Madras, *vice* Sri P. H. Rama Reddi, C. I. E., granted leave preparatory to retirement.

Sri K. Avidainayagam Pillai D. A. O. (on leave) to be D. A. O. Sattur.

Sri C. Sakkarama Rao, D. A. O. Sattur to be D. A. O. Bellary *vice* Sri R. N. K. Sundaram granted leave from 1st April.

Sri T. G. Anantharama Ayyar, to officiate as D. A. O., Coimbatore, *vice* Sri M. U. Vellodi granted leave from 27th March 1944 preparatory to retirement.

Sri C. R. Srinivasa Ayyangar, Paddy Specialist, on return from leave to be Paddy Specialist, Coimbatore.

Sri T. K. Balaji Rao, on relief by Sri C. R. Srinivasa Ayyangar to be Assistant, Paddy Specialist.

Sri B Ramayya, Deputy Director of Agriculture on return frem leave on 1st April 1944 to be Deputy Director of Agriculture, Central Division, Chittoor.

Sri S. S. Katchapeswara Ayyar, Superintendent, Potato Manure Scheme, Ootacamund, to be Special Officer for the Scheme of Supply of Indian Vegetables to the Army, Coimbatore.

Sri M. V. Raghava Rao Nayudu, D. A. O. (on leave) to be D. A. O. Nellore.

Sri R. N. K. Sundaram on return from leave to D. A. O. Bellary.

Sri G. Sakharama Rao, D. A. O Bellary to be D. A. O. Trichinopoly.

Sri N. Subramania Ayyar, D. A. O. Trichinopoly to be D. A. O. Coimbatore.

Sri T. G. Anantarama Ayyar, D. A. O. Coimbatore to be D. A. O. Madura.

Sri P. Sankaran Nambiar, D. A. O. Madura to be D. A. O. Calicut *vice* Sri A. Gopalan Nayar granted leave.

Sri M. Kantiraj on return from leave to be D. A. O. Chittoor.

Janab Muhammad Obaidullah Sahib, D. A. O. Chittoor to be Special D. A. O. for Cauvery-Mettur Project area.

Sri G. Venkatanarayana, Superintendent, A. R. S. Kasargod appointed to act as Oil Seeds Specialist temporarily *vice* Sri C. M. John granted leave.

Sri S. G. Ayyadurai, Upper Subordinate, III grade is appointed to act temporarily as Superintendent, A. R S. Kasaragode.

Subordinate Services - Appointments

The following candidates are appointed to officiate as Upper Subordinates Agricultural section, III grade, with effect from 11—3—44.

Sri W. S. Ramarathnam, Recorder under the Marketing Assistant, Madras	Co. 3 Cotton scheme, Salem District
„ J. Subrahmanyam, Fieldman, Rice Reserarch Station. Buchireddipalayam	Assistant, Rice Research Station, Buchireddipalayam.
„ T. Venkateswara Rao, Recorder under the Grain Purchasing Officer, Bezwada.	Marketing Assistant, under the Grain Purchasing Officer, Bezwada, *vice* Sri G. Ramakanta Reddi on leave

The following three candidates are appointed to officiate as Upper Subordinates in the Agricultural section, III grade, with effect from 25th February 1944.

Sri D. Radhakrishna Rao	Kistna District
„ S. Ramanadham	Guntur District
„ M. Ramalingam	Bellary District

Sri I. L Narasimhalu, Temporary Assistant, Mycology section is appointed to officiate as Assistant in the same section with effect from 1—3—44, *vice* Sri P. Vishnusomayajulu due to retire from service.

Promotions

Consequent on the confirmation in the M. A. S. of Sri R. Vasudeva Rao Nayudu, on 31—7—41, Sri D. Bapayya, F. M. Guntur to IV grade (old) with effect from 3—9—41.

Consequent on the retirement of Sri K. M. Jacob, on 30—8—43, Sri M. Subramanya Pillai to II grade (old), Sri M. P. Sankaran Nambiar to III Grade (old) and Sri P. Parameswara Menon to IV Grade (old).

Consequent on the demise of V. Karunakaran Nair IV grade on 8—5—43, Sri K. Sivasankara Menon to IV Grade (old) with effect from 9—5—43.