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EDITORIAL

Freedom from Want. The spectre of hunger and famine is stalking the world today. The peoples of the world are clamouring for food in a 'thousand various tongues'. All the hot disputes—Greece, Indonesia, Persia—are stilled at the macabre vision of hunger. India, South Africa, Argentine, Australia and Europe are the worst affected countries.

In India, Madras, Bombay and Mysore are facing starvation. It has already affected us in Madras by the recent cut in rations. His Excellency, Lord Wavell decided to see for himself the nature of the crisis, toured by air the affected areas and later conferred with the representatives of Mysore, Madras and Bombay at Bangalore. The decisions arrived at the conference were, (1) immediate tightening of the food rations and (2) exploitation of all possible food resources to the full, throughout India. Referring to Madras, His Excellency stated "I am glad to see the way Madras is tackling the problem. The situation is being faced with foresight and efficiency". At the same time he stated that we are now in a very dangerous position and that the way out is only through help from Washington and London. In accordance with these decisions, a 25% reduction in the scale of rations was ordered by the Government of Madras to take effect from 17—2—46.

The situation in Madras Province can be best described by giving Sir S. V. Ramamurthy's talk to the Press on February 6th on the eve of his departure from Madras to join the Government of India Food Delegation to London and Washington. He stated that the food situation in Madras was quite satisfactory until the beginning of October last when the estimated deficit was only a lakh of tons of rice as compared with the pre-war consumption. The cyclone in October brought about a loss of two lakhs of tons in production and a meagre rainfall in the central districts caused a further loss of two lakhs of tons. Again the fall in the level of Mettur Reservoir and the failure of adequate water supply for irrigation in the Cauvery Delta entailed a loss of another one lakh of tons. The millet crop in Anantapur and Bellary districts also failed to the extent of two lakhs of tons making a total deficit in food grains of eight lakhs. But the unprecedented failure of the north-east monsoon made the food situation in the province change definitely for the worse, causing by January a deficit of 8·7 lakhs of tons of rice and 7·3 lakhs of tons of millets.

The pre-war consumption of cereals gave 1·1 lb. per adult in this Province. In order to maintain the ration at one pound, one million tons of cereals are required till the end of October. Bombay, Mysore and certain other parts of the country are equally affected and their requirement is another one million tons. Hence, the representatives of Madras, Bombay and Mysore have been asked by the Government of India to join the delegation to London to press their claims for two million tons of cereals.

Sir S. V. Ramamurthy also stated that the production of crops for trade rather than food in the past four or five decades and the consequent reduction in food crop area by two million acres, has naturally had a deleterious effect on the total food production in Madras. "We must recognise", he declared, "that production of food and clothing is the first charge on land and water in this Province".

We fervently hope that the Food Delegation will meet with entire success and that famine will be kept away from our doors. It is a matter of satisfaction to note that in our time of need friendly voices are lifted on our behalf. The recent speeches on the floor of the British Parliament and the very able championing of our case by Mr. Peter Fraser, the Premier of New Zealand before the General Assembly of the U. N. R. R. A. bring to us the grateful realisation that our cries are heard and are taken up by our more powerful friends.

But we, on our part cannot be idle and complacently await the help from abroad. True we have now tightened our belts and we may have to tighten them many more notches. This we can do cheerfully and receive thankfully the little that we get. We are not the first to walk this path; Bengal staggered along this way two years ago. So we will accept the calamity if it comes, bear with hunger uncomplainingly and cheer our weaker neighbour to a better spirit. We will grow all the food we can in garden and lawn and even in flower pots. In this way we can help in making a little go a long way.

Cross-breeding experiments with cattle in the Madras Presidency (South India)*

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Introduction. It is difficult to state when exactly cross-breeding as such was started in this Presidency. The European military, officials and settlers including missionaries have no doubt been pioneers in trying to bring breeds from Europe in order to evolve better milk breeds in this Presidency. The Livestock Section of the Agricultural Department, however, did not start the experiment with cross-breeding until early 1923 when 32 half-bred cows were acquired from the Military Dairy Farm at Bangalore. The object was to evolve a cross-bred herd which would give better yield than the indigenous breeds like the Ongole and Sind, so as to solve the growing demand for milk in the cities.

Material. There were two herds maintained at the Livestock Research Station, Hosur for this experiment. One herd called the Bangalore herd named after the place from where the foundation stock was acquired. With this herd, Ayrshire bulls were used for producing halfbreds and these halfbreds were mated to produce various generations, but it would be mentioned that perhaps owing to difficulties with regard to number of animals available and funds for purchasing them, breeding from the point of view of pure genetical science was not possible always. It should be borne in mind that this is a point which is not widely known to people who are not actually working with cattle. The other herd called the Coimbatore herd, again named after the place of origin of the foundation stock. These are really grades consisting of various proportions of bloods.

Most of the experiment was done at the Livestock Research Station, Hosur which is about 28 miles from Bangalore, about the same altitude of 3000 ft. above sea-level and having that equitable climate experienced on similar elevations in the tropics. The herds were maintained under ideal conditions from all points of view. There was always a Veterinary Assistant Surgeon who was available on the spot. The calves, except the first generation calves born to indigenous cows, were weaned as in the case of European cattle and hand-fed. In the method of hand-feeding, all possible care was taken but there is always the difficulty about the humane factor especially when dealing with untrained and illiterate cattlemen. It is just likely that some of the deaths among calves may have been caused by this factor.

In the case of adult stock, irregular breeders and poor milkers were eliminated from the herd and bulls were used for work. Large number of bull calves were however sold away so as to minimise the cost of maintenance of the herds.

*Paper read at the Seventh International Congress of Genetics, 1939, at Edinburgh.

Discussion. *Colour:*— As the foundation stock was purchased from Bangalore it was not possible to note the colour of the parents in all cases. The following diagramatic explanation is given in the actual known cases:—

	Sire.		*Dam.*
Ayrshire Sind.			
(1)	Red and white	X	Fawn and white
		F. I. Light brown.	
(2)	Red and white	X	Red.
		F. I. Dark brown with or without star.	
(3)	Red and white	X	Roan.
		F. I. Red and white.	
Ayrshire Montgomery.			
(1)	Red and white	X	L. Red and face and chest white
		F. I. Red with white star.	
(2)	Red and white	X	Red
		F. I. Black with white patches.	
(3)	Red and white	X	Fawn.
		F. I. Red.	
(4)	Red and white	X	Red.
		F. I. Brown with white star.	

Second Generation.

	Sire.		*Dam.*
Ayrshire Sind.			
(1)	Brindle and white	X	Brindle and white.
		Red with white belly.	
(2)	Brindle and white	X	Dark brown.
		Red.	
(3)	Black	X	Red and white.
		Light Red	
(4)	Dark red	X	Dark brown.
		Dark brown & white.	
(5)	Dark brown	X	Red & white.
		Red.	
(6)	Dark red	X	Red & white.
		Red & white.	
(7)	Dark red	X	Fawn & black.
		Red with white patches on chest.	
Ayrshires Sahiwal.			
	White with black ears and eyes	X	Brown.
		Brown.	
Ayrshire Sind Sahiwal.			
(1)	White with black ears and eyes	X	Black and white.
		White with brown ears.	
(2)	White with black ears & eyes.	X	Red and white.
(3)	White with black ears and eyes	X	Dark brown.
		Black and white.	

Third Generation.

Ayrshire Sind.			
(1)	Red	X	Light red.
		Light red or Red and white.	
(2)	Red	X	Red and white.
		Red.	
(3)	Red	X	Red.
		Red.	
(4)	Black	X	Brown.
		Dark Red.	
(5)	Red	X	Brindle & white.
		Light red & white patches.	
Ayrshire Sind Sahiwal F. 3.			
(1)	White with black ears and eyes.	X	Dark brown & white.
		Red.	
(2)	Black and white	X	Dark brown.
		Red.	

Fourth Generation.

Ayrshire Sind.			
(1)	Red and white	X	Dark Red.
		Black & white.	
Ayrshire Sind Sahiwal.			
(1)	Black	X	Brown.
		Red.	

As the number available are so few and there is the difficulty of not being sure whether the nomenclature with regard to shades of colour used is constant, the colour factor has not been worked out on Mendelian lines. It is, however, apparent, that the colour factor is inherited in the Mendelian fashion.

Humps. The 'Bos Indicus' cow has a prominent hump and when it is crossed with European cattle the hump disappears but traces are seen in some of the third and fourth generations in the half-breds. In the case of grades when back crossing with the Sind is adopted as in the case of $\frac{7}{8}$ or $\frac{15}{16}$, the humps soon appear.

Coat. The coat of indigenous breeds is generally very short and the skin fairly tight, but the half-breds and grades which do not resemble the indigenous breed, as a rule have thick coat and the skin more loose.

Udder. The shape and capaciousness of the bag and the placing of the teats in the case of Indian cows are not ideal. In the case of Sind, the shape of the udder and placing of the teats are much better, but in the elder animals there is a tendency for the former to be pendulous. In almost all the crosses, however, the formation of the udder is more after types possessed by the European breeds

Milk Yield. Much has already been said by workers in other parts of the country and abroad but remarks made here will be confined to the data on hand.

The milk yield in the first generation is invariably higher than the average yield for the indigenous breed, but it is not known how the yield compares with the herd from which the bull was purchased. Lack of information on this point slightly mitigates the accuracy of the data. As a rule,

however, one can generalise and say that in the case of F. 1. they are robust (due to heterosis) and thrive under Indian conditions and give appreciably high milk yield. In the case of further generations, not strictly filial crosses, there are large numbers of animals with various faults as conformation and general weakness and a tendency to be stunted in size. As regards milk inheritance however, conclusions cannot be definite as the number involved are small. However, some of the animals have given large quantities of milk which goes to show that in the half-bred herd where the proportion of blood which is thought to be equal may not be true to facts.

In the case of grades those animals with high proportion of indigenous blood have a tendency to be robust and there is the difficulty of recognising the differences between $\frac{15}{16}$ Sind-grade and pure Sind which is to be expected.

Fat in Milk It will be seen from the data that the fat percentage of all crossbred animals is generally above 4. 'Bos Indicus' generally gives above 4 per cent fat while all the European breeds do not tend to give a high percentage. It would therefore appear from the data on hand that the factor for fat inheritance is dominent

Stamina and Resistance to disease. The first cross bulls and bullocks are generally robust and halfbreds and grades which have no defects seem to stand up to Indian conditions There are a number of such animals working both here and on the hills in the Presidency. It is just likely that the nature of the skin and cost of crossbreds are not favourable to them under tropical conditions. As a rule however, the crosses as a whole cannot be expected to compete with Indian breeds on the plains under semi-starvation conditions and intense heat. Compared with the Indian breeds, greater care is essential for successful management of crossbred animals.

Data have been obtained to show how the crossbred stock fare under ideal conditions with regard to resistance to disease. As the numbers and stock of crosses under consideration are few, no definite conclusions, can be drawn from the point of view of resistance to disease. The losses however, among crossbreds are somewhat higher.

Summary. The history and the nature of the crossbreeding experiments in the Madras Presidency have been explained. Inheritance of colour, hump, shape of udder and placing of teats, milk yield, fat and stamina and resistance to disease have been discussed.

Note. My thanks are due to Sri A. K. Annaswamy Ayyar, B. Sc. (Ag.) who compiled the data under my guidance and to Captain T. J. Hurley, M. R. C. V. S., D. V. S. M., I. V. S., Director of Veterinary Services for kindly permitting to present this paper to the Seventh International Congress of Genetics.

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Review of Experiments done on Cultivation at the Agricultural Research Stations in the Madras Presidency.

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Cultivation is the most widely practised agricultural art; but its effect on crop yields is not yet fully understood. In a series of articles appearing in the Journal of Agricultural Science, B.A. Keen, E. W. Russell and others have discussed the effect of cultivation on increasing crop yields. They have drawn the important conclusion, in this series of papers, that "the yield of field crops is, in general, either unaffected or actually reduced by extra cultivation operations". They draw a distinction between cultivation operations which are absolutely necessary, such as preparing a seed bed and those that are considered desirable but are not absolutely essential. The latter are spare time operations carried on by the cultivator.

In view of these observations it would be interesting to review the results obtained on cultivation experiments conducted at the various Agricultural Research Stations in the Province. The agricultural practices vary from place to place depending on the type of soil, climate and system of cropping. These have been evolved as a result of generations of experience by the cultivator and his system of cultivation is called 'Local Practice' in the following review. The review is based upon information on the following points furnished by the officers in charge of the various Agricultural Research Stations at which the experiments were in progress and covers the period upto 1942-43.

1. Type of soil.
2. Annual rainfall.
3. Main crops grown.
4. Normal rotation.
5. What is the local practice in regard to preparatory cultivation, and after cultivation ?
6. Have any experiments been conducted at the station with any variation of the local practice in regard to preparatory cultivation and after cultivation (inter-cultivation) ?
7. If so, over how many years was the experiment conducted ? What was the layout—arrangement of plots, replications etc. ?
8. What was the result ?
9. Is any improvement in the cultural practices advocated to the ryots as a result of work conducted at the station ?
10. General remarks, if any.

Experiments on cultivation were carried out at the following twelve Agricultural Research Stations; the type of soil, rainfall and crops studied are given in the following statement: -

S. No.	Name of Station.	Nature of soil.	Annual rainfall.	Crop studied.
	DRY CROPS			
1.	Central Farm, Coimbatore	Red sandy loam	24	Cotton & Cholam
2.	Cotton Breeding Station, Coimbatore	Red soil & medium black clay	26"	do do
3.	Agricultural Research Station, Koilpatti	Black clayey soil	30"	do do
4.	Agricultural Research Station, Hagari	do	20"	do do
5.	Do Nandyal	do	28"	do do
6.	Do Guntur	Clayey loam	33"	Cholam, tobacco & chillies
7.	Do Tindivanam	Light sandy loam	39"	Groundnut
8.	Do Nanjanad	Loamy soils	55"	Potatoes
	GARDEN CROPS			
9.	Do Kasargod	Red sandy loam	145"	Coconut
	WET CROPS			
10.	Do Adutburai	Alluvial Clay	40"	Paddy
11.	Do Pattambi	Sandy to red loam	106"	do
12.	Do Samalkot	Heavy alluvial clay	37"	Sugarcane.

The following is the summary of the results obtained at each of the stations mentioned above:—

(1) **Central Farm, Coimbatore**. An experiment (Cotton and cholam —red sandy loam) was started during 1942-43 with the object of determining the minimum preparatory cultivation to be adopted to obtain the best crop yields in dryland red soils. The following six treatments were replicated four times in randomized blocks.

A. Ploughing by the country plough thrice-control (Ryot's practice).
B. Country ploughs six times
C. P. S. G. 16-c plough once followed by country plough once.
D. P. S. G. 16-c plough twice followed by country plough once.
E. Guntaka whenever necessary to keep down weeds—not more than four times on the whole.
F. No ploughing but hand removal of weeds.

Results of one year only are available as the experiment was started in 42-43 season. The results from Sorghum were vitiated by extensive attack of Striga, while in that for K. 1 cotton, the differences due to the treatments were significant.

B F D A E C

In other words the effect of these treatments in enhancing crop yields was in the following order:—

Country plough six times—Hand removal of weeds—P. S G. 16-C plough twice followed by country plough once—Country plough thrice—Country Guntaka four times—P. S. G. 16-C plough once followed by country plough once.

The experiment has just commenced and no definite conclusions could be drawn from one year's results

Experiments have just been started under garden land conditions with similar treatments in field No. 60 and no results are yet available.

(2) **Cotton Breeding Station, Coimbatore**. (Cotton and cholam—Red and Medium black soil).

Preparatory cultivation. Experiments on preparatory cultivation were done with the object of finding (1) the best method of preparing the field after the harvest of cholam and (2) the best preparatory cultivation to be given to cotton and cholam on red and black soils.

In regard to (1) it was found that removing the cholam stubbles with the guntaka immediately after the harvest of cholam was better than waiting for good soaking rains to be received as is done by the cultivator.

A number of methods of preparing the land were compared both on red and black soils between the years 1940-41 and 42-43. The treatments were ten as detailed below:—

1) No ploughing.
2) Country plough—twice.
3) Do: 4 times.
4) Do. 6 times.
5) Do. 8 times.
6) Cooper 26 • once.
7) Do. twice.
8) Guntaka once.
9) Do. twice.
10) Standard victory plough—once, and country plough—once.

In the red soil experiments the results are not conclusive; as in 1940-41 the plots where Cooper plough was worked twice gave a higher yield of straw alone but in the next year the plots that received no ploughing, the plots where Guntaka was worked once and the plots where Cooper plough was worked twice, were all found to be equal.

In the black soil, experiments conducted in two different fields gave different results. In one case the plots that received 'no ploughing' the plots that received 'country ploughing' twice, the plots that received 'Guntaka' twice and the plots that received 'Cooper' ploughing twice were all alike while in the other case Cooper plough twice was better than no ploughing.

In another field under cultural and rotational experiment with the following cultural operations (1) No ploughing, (2) Victory plough,

(3) Country plough and (4) Guntaka, carried over a period of three years, the different cultivation methods did not affect, the yields of cotton or cholam. The indications are that 'no ploughing' is as good as 'Victory plough', 'Country plough' or 'Guntaka'. The results are not significant in all the three years. The experiment has to be continued for another 6 or 9 years so that there may be a cycle of at least 3 croppings for each of cholam and cotton.

No final conclusions can be drawn from the experiments on preparatory cultivation.

After cultivation Between 1932-33 and 1935-36 experiments were conducted to determine the nature and frequency of after cultivation necessary for cotton in red and black soils. The following were the ten treatments:—

1) Control.
2) Removal of weeds only.
3) Deep cultivation thrice.
4) Shallow cultivation thrice.
5) Very shallow cultivation thrice.
6) Hand hoeing thrice.
7) Deep cultivation weekly.
8) Shallow cultivation weekly.
9) Very shallow cultivation weekly.
10) Hand hoeing weekly.

In the experiment on the most economical method of after cultivation it would appear that mere removal of weeds and keeping the land clean of weeds was quite satisfactory. Intercultivation with bullock power seems unnecessary. Under conditions obtaining at Coimbatore intercultivation to cotton would seem to be unnecessary.

(3) **Agricultural Research Station, Koilpatti.** (Cotton and cholam).

Preparatory cultivation. An experiment on cultivation was started in 1935-36 and is being continued for the 9th year in 1943-44. The treatments were:—

a) Monsoon plough.
b) Guntaka.
c) No ploughing.

Out of 8 years over which the results are available the results of one year alone are significant in favour of deep ploughing for cholam.

Interculture experiment. Experiment was conducted for three years from 1934-35 to 1936-37. The treatments being

1) No hoeings (control).
2) One hoeing.
3) Two hoeings.
4) Three hoeings.
5) Four hoeings.

The results are not significant in any year.

(4) **Agricultural Research Station, Hagari.** (Cotton and Cholam—black clayey soil).

Ploughing and bunding experiment Called the trial of Improved Dry Farming Methods was conducted: one series was started in 1936-37 and another in 1937-38.

The treatments were as follows:—

A) Deep ploughing once in 4 years and Bunding.
B) Deep ploughing once in 2 years and Bunding.
C) Bunding alone.
D) No ploughing and no Bunding (control).

Results of first series were significant the "ploughed and bunded" plots being superior to the rest while those of the second series were not significant. The results are not conclusive; season had the maximum influence over the results.

2. *Ploughing experiment.* This experiment was conducted since 1938-39 for three years. The treatments were

A) Ploughed every year with P. S. G. 16-A (to a depth of 4").
B) Ploughed in alternate years with the same plough.
C) No ploughing (control).

The results were not significant.

3. *Bunding experiment.* The experiment was in progress for 8 years since 1934 to 1941. The treatments were

A) Putting up bunds about 7" in height with the bund former.
B) No bunds—control.

Bunding is superior to unbunded in normal years but in years of excess rains or subnormal rains (below 15") bunding has not shown its superiority.

4. *Scooping trials*: was in progress for 4 years since 1938. The treatments were

A) Control (No bunds—No scoops).
B) Bunded.
C) Scooped with Basin lister and bunded.
D) Scooped with the Pathi guntaka and bunded.
E) Scooped with danthies and bunded.

There were no differences between the treatments.

After cultivation. With the object of determining the maximum number of intercultures that have to be given to cotton and cholam two sets of experiments were started in 1936-37.

The following are the treatments for the Cotton set and Cholam set respectively.

Cotton.	*Cholam.*
A. Three intercultures.	A. Two intercultures.
B. Four »	B. Three »
C. Five »	C. Four »
D. Six »	D. Five »
E. No interculture-hand weeded.	E. No interculture-hand weeded.

The results of the Agronomic experiment as well as those on soil moisture go to show that weeding is a necessary operation. Two intercultures for sorghum and 3 intercultures for cotton as given by the cultivators seems the best. In areas of precarious rainfall like Hagari the season plays the most dominant part. The treatments given were effective or ineffective depending on the distribution of rainfall. Excessive rains after sowing of crops encourage weed growth and necessitate a greater number of intercultures than in normal years. In years during which rainfall after sowings is scanty an increase in the number of intercultures does not produce a corresponding increase in crop yields.

Bunding as a measure of conserving rain water is being advocated to the ryots.

(5) **Agricultural Research Station, Nandyal.** (Cotton and cholam—clayey loam).

Preparatory cultivation—(Ploughed vs. Guntaka).

Cultivation experiments on cotton. In 1932-33 an experiment was started to compare the yield of cotton on ploughed and Guntaka worked plots. The results show that the yields from the ploughed plots are significantly better than those from the Guntaka worked plots.

Bunding experiment. For two years an experiment on bunding was conducted on cotton and cholam. There was no difference in the treated and untreated plots (Bunded and non-bunded) in cotton (1935-36) and sorghum (1936-37).

Interculture experiment. Over three years an experiment was conducted with the following treatments.

A) No interculture (Weeding).
B) Interculture once.
C) Do. twice.
D) Do. thrice (control).
E) Do. four times.

The treatment differences were found to be not significant.

A new cultural experiment. With an object of determining the minimum limit to which the preparatory cultivation operations can be cut down an experiment was started in 1940-41 with the following twelve treatments.

1) Working gorru guntaka twice (control).
2) Working country guntaka twice.
3) H. M. 2 guntaka twice.
4) Country guntaka once.
5) Gorru guntaka twice and blade guntaka once.
6) Buddala guntaka once.
7) Country plough twice.
8) Cooper No. 11 once.
9) Cooper No. 11 once and Guntaka to break down clods.
10) Cooper No. 21 once.
11) Cooper No. 21 and nolla to break clods
12) No cultural operations—hand weeding.

The results of the three years show no significant differences due to the treatments.

Remarks. In Nandyal valley and adjoining tracts there is a wide variation in soils; and the farm soils are not quite representative of the tract. On account of this, results of the station are to be taken with caution in so far as their applicability to neighbouring tracts is concerned.

(6) Agricultural Research Station, Guntur (Cholam, Tobacco and Chillies—black clayey soils).

Ploughing experiments. Experiments conducted prior to 1940 were on single plots and no definite conclusions could be drawn. This fact was noted by the committee of the Research Council, which reviewed the experiments done at the station in 1940.

An experiment with the object of determining the best possible cultivation was started in 1940 with the rotation, cholam—tobacco—chillies. The treatments in this experiment were eight.

1) 4 ploughings and 2 guntakas and Gorru twice
2) Gorru twice and guntaka twice.
3) Ploughing twice and gorru twice.
4) Ploughing twice and guntaka twice.
5) Two ploughings only.
6) Gorru twice.
7) Guntaka twice.
8) No ploughing.

In all the 3 years No. (1) gave the best results. Maximum cultivation gave the highest yield and this is the local practice. With an assured well-distributed rainfall as occurs in Guntur, cultivation has benefited all the crops that appear in the rotation. The cultural practices are fixed with due regard to seasonal factors and the crops grown.

Bunding experiment. Bunding has not given any enhanced yields and it appears not necessary in these areas of well distributed rains

(7) Agricultural Research Station, Tindivanam. (Groundnut—light sandy loam).

Cultural experiment. An experiment is in progress for one year only the treatments being

A) Ploughing with country plough four times.
B) Country plough twice.
C) Country plough once and Iron plough once.
D) Country plough once.

Differences between the tillage treatments are not significant Instead of giving a large number of ploughings with the country plough it is considered more economic to give fewer ploughings with iron ploughs

Intercultivation experiments. It was found hoeing and weeding once was better than hoeing and weeding twice.

(8) **Agricultural Research Station, Nanjanad.** (Potatoes—loamy soils).

From the inception of the farm fixed cultivation, proper tillage, judicious manuring and planting along contours instead of along the slopes and rotation of crops were adopted.

An experiment with deep ridging and shallow ridging as the two treatments was conducted over a period of six years from 1934—35. The results are not significant. An experiment has just been started in order to determine the evil effects of erosion, with the following treatments in the cultivation of potatoes Farm method potato followed by lupin, samai during the 2nd year planting along contour, bunding, terracing catch drains and silt traps (vs) Local method potato, samai during 2nd year, planting along slopes, no bunds etc.

(9) **Agricultural Research Station, Kasargod** (Cocoanut—Red sandy loam).

There are no experiments on preparatory cultivation but one plot is under regular cultivation since 1917, being worked with monsoon plough three times a year and the cultivator twice a year while another plot received no cultivation at all. In each of these plots there are five experimental trees with border trees all round and the mean yield of nuts in the cultivated plot is 53·65 over a period of 20 years against an yield of 11·7 nuts from the uncultivated plot for the same period.

Regular cultivation is being advocated to the ryots.

(10) **Agricultural Research Station, Aduthurai**—(Paddy—Alluvial clayey).

Preparatory cultivation experiment:— An experiment was conducted for two years comparing the iron plough with the country plough.

The treatments were as follows —

1) Country plough twice.
2) Do four times.
3) Do eight times.
4) Cooper No. 11 once.
5) Do twice.
6) Do four times.

In 1941—42 the results were not statistically significant. In the next year the results were as follows:— 3, 2, 4, 5, 6, 1. In plots ploughed once with iron plough and twice with country plough there were weeds which had to be pulled out by hand.

Interculture experiment. There were two treatments.

1) Control.
2) Intercultivation twice.

There were three crops studied—

	Name.	*Sowing time*	*Duration.*
a)	Kuruvai	June	(100 days).
b)	Thaladi	August—September	(170 days).
c)	Samba	July—August	(170—180 days)

In the case of the Kuruvai crop the control was significantly better than the treated, while it was not significant in the other two cases.

General. "The Burmese Settun" and the puddler. The advantages of their use being obvious no experiment was conducted; but their use along with iron ploughs like Cooper 11 and 25 has been advocated to the ryots.

It may not be advisable to reduce the cultivation to less than 3 ploughings before the application of green leaf

(11) **Agricultural Research Station, Pattambi.** (Paddy).

In the dry lands no experiments were done. In the single and double crop lands an experiment to study the effect of intercultivation on broadcast crop of paddy was laid out in 1942-43 with the following four treatments:—

1) Raking lengthwise and breadthwise with a toothed rake.
2) Shallow ploughing one way with country plough.
3) Trampling by animals.
4) No treatment (control).

The results for 1942-43 are not significant and for 1943-44 it is not yet available.

(12) **Agricultural Research Station, Samalkot.** (Paddy and sugarcane).

Cultivation experiments in paddy. (Puddling vs. no puddling). The treatments were

1) Puddling.
2) Dry ploughing.

Puddling was found to be better than no puddling and this is the practice followed by the ryots.

Ploughed fallow vs. Unploughed fallow in summer. Unploughed fallow is better, and this is almost a general practice in the tract.

Dry ploughing vs. Puddling. An experiment was conducted for six years since 1928-29 to 1933-34. The results are only indicative and not definite Dry ploughing tends to reduce the yields, and puddling is a necessary operation which increased the yields of winter series but not for Tholakari series. Winter ploughing was worse than Tholakarai dry ploughing. Application of green leaf and bone meal improved the yields in Tholakarai.

Sanding experiment Sand at the rate of 400 cartloads per acre, was found to depress the yields for the first three years.

Sugarcane: Trench vs. flat bed planting. The experiment was in single plots with no replications for 4 years. Bed planting was found to be better and this is also the ryots practice. Ridge planting also was tried but not found superior to planting in beds as the canes are cultivated amongst paddy fields. Propping and wrapping are necessary and are being practised in the District. It is found that unwrapped canes are harder to mill.

General remarks. It is seen from the above review that the results of cultivation in dry areas are influenced largely by seasonal conditions, especially the distribution of rainfall. In years of low rainfall, increased cultivation does not appear to enhance crop yields. On the other hand, if the rainfall is well distributed, as occurs in Guntur, the maximum cultivation gave the highest returns. Similarly with regard to interculture, intercultivation as a necessary operation for the removal of weeds is desirable. It has not, however, been possible, to fix definitely the number of intercultures to be given to crops, as this is dependent largely on the conditions obtaining during the particular season. As weeding is absolutely necessary for most crops, interculturing cannot be dispensed with. It may also be considered as part of the spare time operations of the cultivator.

Regular cultivation of coconuts has given higher yield of nuts Green manuring and puddling in the case of paddy and bed planting in the case of sugarcane gave good results. In addition to the use of iron ploughs, "The Burmese Settum" and the puddler were found to be very useful in preparing the land for paddy at Aduthurai.

Acknowledgments Our thanks are due to the officers in charge of the various Agricultural Research Stations, who have kindly furnished information in regard to the experiments conducted at their respective stations.

Contour Embankments in Dry Lands.

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Dry lands situated in low rainfall areas, can be permanently improved by providing contour embankments. During rains a good deal of the water runs off the land carrying with it large quantities of silt. Much of this water if impounded on the land, will increase the moisture content of the soil, especially in low rainfall areas where it is badly wanted and result in the production of larger yields of crops. In addition to this, if the water is held the soil also is not removed. When the soil is retained, it stops deterioration by erosion.

Much care is taken by the cultivators of wet lands and garden lands to level and terrace the lands for irrigation. If levelling is done, the maximum benefits of rainfall and the least losses from soil-erosion occur. Generally speaking such areas are not extensive as compared to the dry lands. The population in the area is large, the area of each holding is small and the economic position of the cultivators is much more favourable when compared to the dry land cultivators. Terracing the extensive dry lands is out of question owing to the magnitude of the work. It is unremunerative when applied to dry lands where the value of crop yields is low. But, it

has long been recognised by the cultivators that some thing should be done to prevent deterioration of the land caused by the loss of much rain water and soil. It is a common sight in some of the richer dry lands to see a huge single embankment at the toe of large and extensive fields with a big weir. It is also common to see the weir quite intact and a large vent down the bund through which rain water finds a frequent discharge. This system of bunding is inefficient and does not serve the purpose for which it is intended. This only concentrates the stagnation of rain water in one place and has no effect on the land above it beyond a certain limit.

Contour embankments provide the best distribution of rain-water throughout the entire land, the bunds being on level. As the bunds are at frequent intervals of say 300 or 400 feet, the rain water is held in various places and at various levels in the catchment and the water thus held naturally soaks down into the soil for the benefit of the crops. Thus contour bunds, properly made achieve the double object of utilising larger quantities of rain water for increased crop production and of holding the silt in the land itself instead of its being carried away.

The advantages of contour embankments are:—

1. In areas of low rainfall, where it is necessary to conserve rain water as much as possible, these embankments help to hold rain water for the benefit of the land and thereby increase crop production from these dry lands.

2 In years of low rainfall, as all the water is held on the land, it will be possible to produce good crops in the embanked areas whereas in areas not embanked, the low rainfall results in partial or complete failure of crops. In other words the embankments counteract and correct the adverse effects of low rainfall.

3. Soil is held instead of its being washed away and soil erosion is minimised.

4. In non-embanked dry lands, it is common to see pellets of manure being washed away from the land either to the lower fields or streams still lower down. When the field is protected by these embankments, the manure is held in the field itself and the proper response from the manure is obtained, resulting in heavier crop yields.

5. In these dry lands, when the lands are ploughed and there is heavy rain soon after, the soil is washed away quickly resulting in loss of soil constituents This is evident to every one who has looked at the colour of the flowing water from the fields. It is cloudy and muddy from ploughed fields and fairly clear from undisturbed fields and grass land. Therefore when the contour embankments are put up, ploughing can be taken up, where ever possible, without fear of soil waste, i e., intensive cultivation by ploughing and manuring with good effect will become possible.

6. Contour embankments help in raising the water level of the wells situated lower down and will also help in the formation of better springs.

7. Contour trenching, i. e. trenches dug on the contour, in uncultivable waste lands in the margins of hill slopes, hold rain water which is otherwise lost. Trees are planted on the margin of these trenches and they will grow by the help of this water. This is one way of solving the fuel problem of villages and release the cow dung cakes for being utilised properly as manure.

8. It may be considered that contour bunding in the dry lands, of low rainfall in areas like Coimbatore, Ceded Districts, North Vizagapatam etc, is the threshhold for further development of these areas. Bunding when followed up by intensive cultivation will result in better crops, better cattle, a more self-sufficient agriculture and will help in raising the standard of living of the dry land cultivator.

How to put up contour embankments. The land-scape consists of several ups and downs which are called water-sheds or catchments. Levels are taken starting with the "ridge point", i e. highest point in the catchment. The successive falls are decided, say if bunds are to be put at a fall of every 3 feet, these drops in level are bench-marked and the lines of the same level are marked on the ground at each successive fall. The bunds are put up by digging earth from the sides. The bunds are about 3 feet in height and their basal width varies with the nature of the soil. Waste water weirs will have to be provided in certain types of land. The fall between 2 successive bunds depends upon the slope of the land. In slopes which are about 1%, a three-foot fall is convenient. The distance between any two bunds will be decided by (1) the width necessary for cultivation of dry land and (2) the slope of the land. Generally in a 1% slope, a width of 300 feet between 2 bunds is practicable. The size of the bund varies with the soil. In deep black soils the height of the bund will have to be 3 feet while the base should be sufficient to give the proper angle of repose and also allow for natural shrinkage and settlement. It may vary from 8 feet to 15 feet according to requirements. In red soils and loamy soils the size of the bunds can be smaller than in black soils, because owing to better percolation the volume of water dealt with is smaller and the bunds made up from this soil are also stronger. Waste weirs will have to be provided in stiff black soils where water percolates into the soil only with difficulty.

Contour embankments were put up in cultivator's fields near the Hagari Farm in an area of 75 acres (in 1942) as an experimental measure to see their effects on crop yields. Equal areas were left side by side in the same catchment and the yields were recorded for 2 years now. The year 1942 was a famine year in Bellary owing to failure of rains. The embankment work was started by employing famine labourers. The area was surveyed, block levels were taken and contour lines marked at 3 feet falls by the authors of this note. The sharp curves of the contours were smoothened to a certain extent to facilitate easy cultivation. Famine labour was employed for digging and putting up the bunds in 1943 a further area was added and the work was done on contract labour, under supervision.

The results of two years are now available, on the effect of embankments on crop yields in this area and these are given in the following table.

Results of experimental contour bunding at Hagari (Bellary District) 1944 & 1945.

Crop.	Embanked area		Non-embanked area		Increased yield per acre.		Percentage increase in yield.	
	Acre yield in lbs.		Acre yield in lbs.					
	1944	1945	1944	1945	1944	1945	1944	1945
M. 47-3 Jonna (cholam)								
Grain	295	415	263	352	32	63	12	18
Straw	1371	1175	708	983	663	192	93	20
H. 1 Cotton	240	303	190	275	50	28	26	10

Note:—Rainfall in 1943-44 = 13·98 inches.
„ 1944-45 = 26·08 „

It will be seen that contour embankments have resulted in increased yields both in the year of low rainfall 1943-44 and in the year of high rainfall 1944-45. In addition to this, the bunds have yielded an additional produce of vegetables like Gourds and Castor, which were planted on them in the rainy season. The cultivators of this tract who have seen these embankments and crops, are convinced about the efficacy of these bunds in increasing crop yields.

It will be seen from what has been written above, that this kind of bunding cannot be taken up by individual cultivators. To get the best results, the whole catchment should be the unit. In a catchment several hundreds of cultivators and their fields are involved. The work also requires a certain amount of technical skill which is not possessed by the cultivators. The work has to be done as a collective effort or by the Government and the costs shared by the individuals. In the Bombay Presidency contour bunding started in the same famine year as Hagari, i e. 1942. The work at Bombay has progressed by leaps and bounds and several lakhs of acres are now reported to have been bunded under the auspices of the Government, in the Bombay Deccan.

The object of this article is mainly to stimulate the interest of the dryland agriculturists in this new kind of work which has not been tried in arable dry lands so-far. Terracing has been done on the hill slopes. Contour cultivation has been extensively applied in America. (Contour cultivation gives some protection against soil erosion.) But it is only contour bunding that helps to retain larger quantities of rain water on the land which is so necessary in low rainfall areas and it is well suited to our local conditions of cultivation, extent of holdings, and economic position.

Summary. Contour embankments put up in the drylands of low rainfall areas have increased crop production. They have held rain water which is much needed and also held soil which would otherwise have been washed away. Deterioration of land under natural influences is arrested. A general account to stimulate interest in the work, is given.

SELECTED ARTICLES

Fertilizer Industry in India.

India is a country where 80 per cent of the pupulation are dependent directly or indirectly on agriculture. Yet she is not self-sufficient as regards foodstuff even on a very low standard of diet. Before the war, we used to import about 2 million tons of rice from Burma, Indo-China and also a large quantity of wheat from Australia. Partial failure of rice-crops and stoppage of supply from Burma led to disastrous consequences in Bengal last year. The Government of India and the public are therefore anxious that production of cereals should be so increased in the country as to ensure food to all not only on the existing low standard of diet but on a somewhat higher level considered adequate by experts on nutrition. The Bombay plan of economic reconstruction aims at increasing agricultural income by 130 per cent. Government's present plan is, however, far less ambitious. As envisaged in the recent report of Dr. Burns, a 30 per cent increase in production is urgent, and there is no reason why it should not be achieved even in war time as a result of the grow-more-food campaign.

Need for Synthetic Fertilizers in India. As an illustrative example, we shall take the most important food crop—rice. We grow on an average 28 million tons of rice in an area of 76 million acres, about 750 lbs. per acre. This is the most depressing fact about our agriculture. In U. S. A. the average production is 1,500 lbs. and in Japan 2,300 lbs. per acre. This is mainly due to lack of water and manure. The agricultural experts are convinced that, given ample water and ample manure, rice yields can be forced very much higher. There are indeed some well-managed farms in Coorg which is so near to us, where a yield of 3,000 lbs. per acre is not un-common The statistical average of all manurial experiments carried out all over India between 1933—1939 indicates that 80 lbs. of ammonium sulphate applied per acre to land containing sufficient humus increases the production of paddy by 280 lbs. which is equivalent to 210 lbs. of rice, i. e. roughly 30 per cent increase in present production. If ammonium sulphate is given along with super phosphate, the yield is generally higher. At pre-war prices of ammonium sulphate paddy and straw, the increased net profit per acre was Rs. 7 (ammonium sulphate to cultivator Rs. 200, paddy Rs. 2—4—0 for 80 lbs., and straw 4 annas for 80 lbs.). If the price of ammonium sulphate to cultivator remains the same, Rs. 200, the increased profit per acre at present prices will be far greater--about Rs. 28. 76 million acres of rice lands in India will require annually about 2·55 million tons of ammonium sulphate in order that we may reach our target of production which is 36 million tons of rice. Government of India hopes to establish factories under State auspices which will produce 350,000 tons of ammonium sulphate by June 1946. It is also hoped that once this Government enterprise is successful, private enterprise will be soon forthcoming to produce the balance required, i, e., 2·2 million tons of ammonium sulphate.

In 1938—39, India imported 76,000 tons of ammonium sulphate from Great Britain, the cost at port being Rs. 110 per ton. There is something thoroughly rotten in a distribution system which exacted from the cultivator Rs. 200 per ton as retail price. With this experience, one cannot be too alert about consumer's interest. There is no reason why the price or the price to the consumer should exceed the factory price or the price at port by more than 10 per cent plus the cost of additional transport.

In 1938—39, the internal production of ammonium sulphate was only 25,000 tons. This was obtained from the coal distillation industry of Behar and Bengal as a by-product. On distillation of coal to form coke, nitrogen of the coal is released in the form of ammonia, which is removed from the coal-gas by scrubbing with sulphuric acid. Those interested in the details of the process developed in India may read the interesting memoir of Wilson Haig, General Manager of the Bararee Coke Oven Co.

Fertilizer Industry in Mysore. It is to the Government of Mysore that we owe the establishment of the first synthetic ammonium sulphate factory in India. The factory in Mysore at Belagula started producing 5 tons of ammonia per day since 1941. The sulphuric acid plant can produce 27 tons of sulphuric acid per day; the total capacity for production per year is 7,000 tons. We shall only outline the broad features of the process:— The manufacture of ammonium sulphate consists firstly of the manufacture of ammonia by interaction of nitrogen with hydrogen and then the conversion of ammonia into ammonium sulphate. In Mysore (Belagula), the hydrogen is obtained by electrolysis of caustic soda solution using nickel plated anodes. For 1 ton of ammonia we require 2250 cu. metre of hydrogen gas. We also require 750 cu. metre of nitrogen gas, which in Belagula is obtained by burning 380 cu. metre of hydrogen in 940 cu. metre of air. We thus require 2630 cu. metre of hydrogen and 940 cu. metre of air for the synthesis of 1 ton of ammonia. Taking into consideration losses and impurity of oxygen in hydrogen, we require 2700 cu. metre which will consume 15,200 KWh. D. C. power. The mixture of nitrogen and hydrogen is compressed to 300 atoms, perfectly dried and freed from impurities and passed through converters of special steel containing more than 2 per cent chromium, which contained the catalyst. The catalyst is obtained by fusing from oxide and then impregnating it with promoters like Al_2O_3 and K_2O. The cold mass is broken to requisite grain size, and porous but rugged structure is obtained by reducing in a current of hydrogen at about 500°C. This catalyst at a space velocity of 40,000 cubic feet per hour per cubic feet of catalyst will give about 16 per cent conversion into Ammonia. The converter is so designed that under these conditions, the heat of reaction maintain the catalyst at about 480°C. The ammonia is removed by refrigeration which in general commercial practice amounts to 80 per cent of the ammonia present. The uncombined gases containing the residual ammonia is recycled. Auxiliary power necessary for compression and other purposes amounts to 1300 KWh per ton of ammonia. The cost of production of ammonia per ton may be estimated thus:—

16,500 K Wh at ¼ anna	...	Rs. 260
Cost of repair and maintenance		10
Salaries and wages		5
	Total Rs.	275 per ton.

If KWh costs 1/10th of an anna, the cost becomes Rs. 18 per ton.

This is exclusive of depreciation charges which are very heavy and interest on capital invested If A. C. power in bulk is already available in factory site, as was the case in Mysore (Belagula) the capital cost per ton year of ammonia would be Rs. 500. Taking depreciation at 15 per cent and interest at 5 per cent, the running cost of production has to be increased by Rs. 100 per ton to give the fair selling price of ammonia ex-factory.

In Mysore (Belagula) sulphuric acid is manufactured by burning sulphur vapour with air to SO_2 and passing SO_2 with excess of air over V_2O_5 catalyst in a converter which is maintained by the heat of reaction at about 500°. There is complete conversion into SO_3 which is dissolved in 98·3 per cent H_2SO_4 to give fuming sulphuric acid. This is continually diluted with requisite water to maintain constant the process is that it is practically continuous and automatic and requires only equipment made of iron.

The capital cost of a plant is Rs. 50 per ton year, and the fair selling price of sulphuric acid at factory should not be more than 40 per cent of the cost of pure sulphur and Rs. 20. If sulphur is purchased at Rs. 100 sulphuric acid should sell at Rs. 60; if bought at Rs. 200, the acid should sell at Rs. 100.

Ammonium sulphate is obtained in the crystalline solid state by combination of ammonia with sulphuric acid in the ratio approximately of 1:3 by weight. The fair selling price of ammonium sulphate per ton should be ½ of that of ammonia plus ¾ that of sulphuric acid plus Rs. 5 as processing cost. Taking the higher values Rs. 375 and Rs. 100, the selling price of ammonium sulphate should be Rs. 175 per ton. Taking the lower values 218 and 60, the selling price ex-factory is Rs. 105 per ton.

Manufacture of Ammonium Sulphate in Travancore. We owe to the Government of Travancore the next advance in our synthetic fertilizer industry. The State is densely populated and only produces 40 per cent of the food requirements. It is the deliberate policy of the State to increase food production to at least 60% of its requirements. The State possesses several advantages. There are tropical monsoon hard wood forests which can be regenerated in a cycle of 30 years, and it is estimated that 100 tons of charcoal containing 75 per cent fixed carbon could for ages be delivered at a factory site (near the Alwaye Railway Station) at a cost not exceeding Rs. 20 per. ton. There are extensive deposits of gypsum of 85 per cent purity in Trichinopoly which can be carried by rail (to Alwaye) and delivered at factory at a cost not exceeding Rs. 15 per ton. It is not at all difficult to wash this gypsum off its clayey matter and raise the purity to 95 per cent. Electric power in bulk can be had from the Pallivasal Hydro-electric Station at 1/5th an anna per unit. Alwaye is within 25 miles by rail of the magnificient Cochin Harbour and also has waterways which are extensively used by cheap country craft transport.

The method of making hydrogen by the action of carbon on steam is far more complicated than simple electrolytic preparation. The Standard method consists of two processes:—

(1) Blowing air over a bed of coke and raising the temperature to 1200° by the reaction

$$(C \text{ plus } O_2 — CO_2 \text{ plus } 96 \text{ Cal})$$

Then passing steam over hot coke and getting water gas, CO plus H_2 according to reaction.

$$(C \text{ plus } H_2O - CO \text{ plus } H_2 - 19 \text{ cal.})$$

Steam is stopped as soon as the temperature of coke bed falls to 900° and then air blown in and the cycle repeated.

(2) The second stage consists in converting carbon monoxide of water gas by interaction with steam to carbon dioxide and hydrogen.

$$(CO \text{ plus } H_2O - CO_2 \text{ plus } H_2 \text{ plus } 8 \text{ Cal.})$$

This is done in presence of catalyst at temperature of 500°.

The total reaction is therefore

$$(C \text{ plus } 2H_2O — CO_2 \text{ plus } 2H_2)$$

In actual practice, water gas is mixed in suitable proportions 3:2 with producer gas which is obtained by passing moist air over heated coke and has the composition N_2 equal to 51 per cent, CO equal to 26 per cent, H_2 equal to 14 per cent and CO_2 equal to 9 per cent. The mixed gases having the average composition 23 per cent N_2, 70 per cent CO plus H_2 and rest CO_2 hydrocarbons etc. are passed through water gas converter chamber which gives a gas mixture containing H_2 and N_2 in the ratio of 3:1 and considerable quantity of CO_2. This CO_2 is removed by high pressure scrubbing with water. We shall soon see that this CO_2 recovery is essential in the manufacture of ammonium sulphate with the aid of gypsum.

In the process that will be adopted in Travancore, this separate preparation of water gas and producer gas and then mixing them together in the requisite proportion will be avoided. The only reason why water-gas is made by a discontinuous alternate blow and run process is that ordinary metallic converters cannot stand the extremely corrosive action of steam and CO at 1100°, and hence furnaces lined with fire bricks had to be used which cannot be economically heated by external firing. The American engineers now claim to have developed suitable alloys which can stand this severe corrosive action; and it is intended to gasify with requisite steam and air 57 tons of charcoal every day in such alloy tubes externally heated with powdered charcoal. Standard methods will be adopted for the purification of N_2 and H_2 mixture before they enter the catalyst chamber at a pressure of 300 atmos and 475°C.

The ammonia converter at Travancore will differ from that at Belagula in that its capacity will be 8 times larger and that it will not be forged from a single alloy steel cylinder. It will have a laminated structure with several concentric cylindrical forgings pressed one over another to give it the requisite strength. The subsequent stages in the manufacture of ammonia is the same as that at Belagula.

There will be a marked difference, however, in the manufacture of ammonium sulphate. Instead of allowing ammonia to react with sulphuric acid a mixture of ammonia and carbon dioxide in equivalent proportions will be passed through a suspension of very finely powdered gypsum in water.

$$2NH_3 \text{ plus } CO_2 \text{ plus } CaSo_4 \text{ plus } H_2O — CaCo_3 \text{ plus } (NH_4)_2\, SO_4$$

In this process, the conversion is complete and a solution containing 35 per cent by weight of ammonium sulphate can be obtained. It is interesting to note that CO_2 obtained in the water gas conversion, if recovered, is sufficient for carrying out this reaction. Hence the gypsum process is always associated with the manufacture of hydrogen from water gas. If, as is anticipated, $CaSO_4$ of 95 per cent purity is used for this process, the calcium cabonate sludge can be used for the manufacture of cement in an associated cement factory. In the Travancore factory the sulphate making plant will consist of the following units:— One carbon dioxide recovery unit, one ammonia vaporising unit; one rotary reaction unit, filters, evaporators, crystallizers, gypsum grinding equipment and bagging plant.

The factory will have to be supplied with 5500 KW of electric power at a continuous load.

It has been estimated that the capital cost for this factory which will produce 40 tons of ammonia per day and hence 160 tons of ammonium sulphate will cost 1·7 crores of rupees, i. e., Rs. 300/- approximately per ton of ammonium sulphate produced in a year. This is rather on the high side, as the pre-war cost was of the order of Rs 200 per ton year. It is difficult to forecast the economics of the process. The Imperial Chemical Industries for their 250,000 ton plant at Billingham obtain coke at Rs. 25 per ton and gypsum at about the same price. On this basis they could land ammonium sulphate at an Indian port at Rs. 110 per ton. It is probable that the fair selling price of ammonium sulphat ex-factory (at Alwaye) will be about Rs 90-100 per ton.

Technical Mission on Fertilizers. The Government of India have invited a Committee of experts to come from England and advise them on a site or sites suitable for putting up ammonium sulphate plants which will produce in the aggregate 300,000 tons per year and also recommend the most economical process for adoption in British India. The Mission came to Bangalore sometime ago. As far as could be judged, they would recommend practically a duplication of the Billingham plant in the coal fields of Behar and Bengal so far as the production of ammonia is concerned. Whether this ammonia should be converted into ammonium sulphate by sulphuric acid or by gypsum is not yet settled. The extensive

gypsum deposits of India are in Rajputana and are at a distance of 1300 miles from the coal fields. It may be cheaper to manufacture sulphuric acid from imported sulphur pyrites and use it for making ammonium sulphate.

Some of the Indian technologists have urged the Mission not to use coke for making hydrogen but to use cheap non-coking second class coals, in view of the imperative need of conserving our slender resources of coking coal for metallurgical purposes. Pointed attention has been drawn to the remarkably efficient processes that have been developed in Germany for making water gas from lignite which have brought down by 33 per cent the cost of production of hydrogen. It has also been urged that if American engineers could use charcoal containing 30 per cent volatile matter for making water-gas in Travancore, there should be no difficulty worth mentioning, in using cheap non-coking coal of Bengal and Behar for the same purpose. The plant in the coal fields will have one great advantage; coal can be had there at Rs. 4—5—0 a ton as against Rs. 20 per ton of charcoal in South India. But this advantage may be counterbalanced by costlier labour and transport charges to consumers' centres.

Ammonium Nitrate as Fertiliser. Ammonia is a key industry as nitric acid is now manufactured exclusively by the oxidation of ammonia. Nitric acid is the basic chemical for all modern explosives and its manufacture has increased enormously during the last five years. The possibility of keeping these nitric acid plants active in peace time is engaging the serious attention of chemical technologists in every country. Nitric acid can be made to combine with ammonia to give the solid salt of ammonium nitrate. So far as providing food to plants is concerned, nitrogen fixed as ammonium nitrate has the same property as that fixed as ammonium sulphate. The use of ammonium nitrate in India will have the additional advantage that the ammonia industry will be absolutely self-contained independent of any import of gypsum or sulphur to the factory which will in most cases involve long haulage. But there are difficulties in its use as fertilizer; firstly, it is hygroscopic, it absorbs moisture from the air, forms solid lumps which may end in explosion if the cultivator tries to powder it. Secondly, it is said that it is easily leached away from lands subjected to heavy flooding. If these two defects can be removed ammonium nitrate will be the ideal nitrogen fertilizer for India and will be much cheaper for the same fixed nitrogen content than the ammonium sulphate.

Phosphatic Fertilizers. The emphasis on nitrogen fertilizer in India has almost made us unremindful of another important fertilizer—the phosphatic fertilizer. In 1939, the world's consumption of phosphatic fertilizer containing about 20% citric acid soluble phosphates was about 18 million tons which is double the production of ammonium sulphate. The consumption in India was however, meagre of the order of 12,000 tons. This industry will rapidly expand in India as the cultivator becomes more and more fertilizer conscious. There are phosphate deposits in India at two centres the phosphatic nodules in Trichy, and the phosphatic rock in Singbhum, Behar. The standard practice is to convert the insoluble phosphate by treatment with sulphuric acid to form super-phosphate. The large production cost of sulphuric acid in India from imported sulphur has stood in the way of the development of the industry. It has been found, however, that such phosphate rocks can be solubilized by fusion. with silica, feldspar, magnesium carbonate, etc. The process is practically the same that takes place in a rotary cement kiln. In the Chemical Department of the Indian Institute of Science, Bangalore a process has been worked out using Trichy phosphate as the starting material. The one which contains about 52% calcium phosphate is treated first for removal of the incrustation of calcium carbonate, and a material containing 72% calcium phosphate is obtained thereby. This is then crushed to fine powder mixed with suitable fluxing agents and fed into a rotary kiln fired with an oil burner and maintained at a temperature of 1350°C. The fused mass slowly flows down the rotary converter and on sudden cooling gives a feasable material which contains but 16 to 18% citric acid soluble phosphate. It has been estimated that such phosphatic fertilizer can be sold in India at Rs. 50 per ton which is much cheaper than super-phosphate manufactured with the aid of sulphuric acid Extensive field trials are now being made with this material at the pilot plant of the Indian Institute of Science, Bangalore, and in the Madras Government Agricultural Farm at Coimbatore.

It is hoped that large scale production of this fertilizer will also begin at an early date. The importance of technological studies on problems of synthetic fertilizers industry in India cannot be over emphasised, and in any future plan of economic reconstruction of India, this industry will be considered as a No. 1 key industry. (*Extract from Science and Culture, December 1944, page 227.*)

A New British Insecticide.

The Gamma Isomer of Benzene Hexachloride.

By Dr. ROLAND SLADE, M. C.

Since pyrethrum and derris are expensive to produce, and the supply is limited, investigators have for some years been looking for chemicals easily synthesised which would be as effective for insecticidal purposes as the pyrethrins and rotenone.

From 1934 over a period of five years we, in I. C. I. investigated several thousand organic and other chemicals prepared in our various laboratories. These were tested by Dr. O. B. Lean and his staff at the I. C. I. Hawthorndale Laboratory at Jealott's Hill. The general method was to determine the concentration necessary to obtain a 50 p. c kill on a series of standard insects, including grain weevils, flies and locusts, mosquitoes and certain aphids.

During this period we found many substances poisonous to insects, but none was so effective and or so harmless to plants and animals as the pyrethrins or rotenone.

The first trials with "666". Five or six years ago we changed the method of attack in our entomological laboratory. Instead of testing large numbers of chemicals we selected certain insect pests and sought for the chemicals and methods best suited to fight them. Early in 1942, when we were looking for a substance to kill the turnip flea beetle, a sample of 1, 2, 3, 4 5, 6 hexachlorocyclohexane (benzene hexachloride, the chemical formula of which is $C_6H_6Cl_6$ or 666 for short) was tested, and this was found by F. J. D. Thomas to be promising. The results of trials against a number of insect pests both in the laboratory and on the small field scale in the summer of 1942 were most encouraging, but the results were not as consistent as expected.

We did, however, decide to use 666 in place of derris in flea beetle powder for use in the spring and summer of 1943. The powder was standardised by biological tests. Some hundreds of tons were sold and the powder was at least as effective as powders made up with derris had been.

Meanwhile, we investigated the toxicity of the various isomeric forms in which 666 was known to exist. Nearly a hundred years ago Meunier showed that 666 contained two isomers the alpha isomer having a melting point of 157°C, and the beta isomer which had a much higher melting point. In 1912, Van der Linden ("Berichte," 45, 236 (1912) established the existence of four isomers having the following melting points: alpha, 158°C, beta, over 200°C, gamma 108°C, delta, 139°C.

Late in 1942 pure specimens of the alpha and beta isomers of 666 were prepared by J. C. Smart, and their toxicity to insects was investigated by F. J. D. Thomas. It was found that both isomers were relatively inactive to weevils, the beta isomer being practically non-toxic. Early in 1943 the gamma isomer was isolated and found to be more toxic to weevils than any substance which we had even tested. It was thus established that the insecticidal action of 666 was due almost entirely to the presence of *gamma, 1. 2, 3, 4, 5, 6, hexachlorocyclohexane*, which I shall call gammexane. This, the active principle of 666, is present to the extent of 10–12 p. c. in the crude material.

Separation of the isomers The method was worked out by J. C. Smart The crude material is treated with a limited amount of methanol, in which the alpha and beta isomers are relatively insoluble. Separation of the solid product (1) leaves a solution containing the gamma and delta isomers and other highly-soluble chlorinated bodies, very little alpha and some beta. On evaporating the solution a small crop of practically pure gamma (11) is thrown down. As evaporation is continued the next crop of crystals contains gamma and some beta. A later crop contains gamma, a trace of beta and some delta (111). Pure alpha and pure beta may be readily isolated from (1) by taking advantage of the low solubility of beta in practically all solvents. Pure gamma may be readily prepared from (11) by recrystallisation from Chloroform. Pure delta may be prepared with more difficulty from (111) by selective precipitation of a methanol solution with petrol ether, followed by recrystallisation from chloroform.

Stability of the hexachlorocyclohexanes. The hexachlorocyclohexanes possess considerable chemical stability. In the process of manufacture they are exposed to the action of hot water and light for a considerable period. They can be crystallised from hot, concentrated nitric acid. Hence, these materials will be unaffected by continued exposure to the atmosphere.

In the presence of alkalis such as limewater at 60°C or even at ordinary temperatures, hydrogen chloride is removed from the benzene hexachloride molecule giving a mixture of the isomers of trichlorobenzene. This effect may also be brought about by mixing 666 with dry lime. Dehydrochlorination does not take place with ground limestone or chalk at room temperature or at 60°C either dry or in the presence of water. So 666 is stable in natural waters.

In the pure state isomers of benzene hexachloride are well defined colourless crystals, practically insoluble in water, soluble in organic solvents, practically inodorous and possessing bitter tastes.

Pharmacological investigations. Their toxicity to animals has been investigated by Dr. H. Taylor, who found that the following quantities per kilog. of body weight were necessary to obtain a 50 p c kill (in 7 days) of rats when introduced into the stomach. Alpha isomer, 1·7 grammes; beta isomer, no animals were killed. gamma isomer, 0·19 grammes; delta isomer, 1·00 grammes the mixture of isomers, 1·25 grammes.

Experiments on the chronic toxicity showed that rats could be fed 10, 20 or 30 milligrammes of gammexane per day for 5 weeks without effects of any kind being produced, and 100 mgs. of the mixture of isomers was fed daily with the food for 2 months to rats without producing any effect. These experiments are still going on.

The effect on the skin is being tested by painting the tails and ears of rats with an emulsion containing 5 p. c. of the mixed isomers, but so far no effects have been produced.

The subcutaneous injection of 100 mgs. of gammexane per kilog. body-weight killed 25 p. c. of the rats. The rest were severely affected but recovered

in three days. 600 mgs. of the mixed isomers per kilog. body-weight were injected without producing any effect.

Experiments on the toxicity to goldfish showed that the alpha and beta isomers at saturated concentration did not affect the fish, but that gammexane was distinctly toxic at a concentration of one part per million.

There appears to be little or no danger to animals or men by the use of 666, but with all new chemical materials we have to watch carefully the effect upon the skin. It is difficult to deduce the effect upon man from experiments on other animals.

Application of gammexane. The original demand for an insecticide as a substitute for ground derris was satisfied by producing a finely divided powder containing 20 p. c. of crude 666 and 80 p. c. of gypsum, which was further diluted with selected materials to give insecticidal powders for use on crops.

(*From Chemical Trades Journal.*)

The Madras Agricultural Students' Union, Coimbatore.

Annual General Body Meeting.

The Annual General Body Meeting of the Madras Agricultural Students' Union was held in the Agriculture Lecture Hall in the Freemen Building at 5–30 P. M. on Monday, the 5th November 1945 with the Vice-President Mr. C. M. John in the chair.

Fiftysix members including 39 students were present.

After the minutes of the previous General Body Meeting were read and adopted, the Annual Report for the year 1944–45 was presented by Mr. V. Gomathinayagam Pillai who was acting as Secretary. Mr. M. R. Balakrishnan pointed out that mention should be made in the report of the services rendered by Sri C. Balasubramania Mudaliar as Secretary of the Union during the year under report after Sri N. Muthuswami Naidu was transferred from Coimbatore. The suggestion was accepted with pleasure by the General Body and the valuable work of Mr. Mudaliar rendered to the Union was placed on record.

The auditor's report of the accounts for 1944–45 and the committee's budget estimate for 1945–46 were then taken up for consideration. After a discussion over the several items of receipts and expenditure they were passed without any division. In the course of the discussions several members requested the executive to take steps to conduct the College Day and Conference at least in 1946.

The election of office bearers were then proceeded with. The following were elected as office bearers for 1945–46.

I. Council (16 members).

1. President ... Principal Ex-officio.
2. Vice-President ... Sri M. Anandan.
3. Editor ... Sri P. D. Karunakar.
4. Secretary ... Sri T. S. Lakshmanan.

Moffussil Vice-Presidents:

5. Sri C. R. Srinivasa Ayyangar.
6. Sri Rao Bahadur V. Ramanatha Ayyar.
7. Sri M. B. Venkatanarasinga Rao.

Moffussil members:

8. Sri A. Gopalakrishnaya Naidu.
9. Sri A. Gopalan Nair.
10. Sri A. Chidambaram Pillai.
11. Sri A. Ramaswami Ayyar.

Resident members:

12. Mr. C. M. John.
13. Sri S. Jobitharaj (co-opted vice Sri K. M. Thomas).
14. Sri H. Shiva Rao.
15. Sri S. Krishnayya (Student).
16. Sri P. Sankara Rao, Secretary, Students' Club (Ex-officio).

II. Managing Committee (10 members).

1. Resident Vice-President. 2. Editor. 3. Secretary.
4. Manager ... Sri S, V. Parthasarathi.
5. Treasurer ... Sri I. Sambasiva Rao (co-opted).

Members:

6. Sri V. Gomathinayagam. 7. Sri K. Ramasamy.
8. Sri K. B. Viswanathan. 9. Sri M. S. Swaminathan (Student).
10. Sri P. Sankara Rao, Secretary, Students' Club (Ex-officio).

III. Editorial Board (8 members).

1. Editor. 2. Secretary. 3. Manager. 4. Sri M. R. Balakrishnan.
5. Sri T R. Narayanan. 6. Sri S. Varadarajan. 7. Mr. M. A. Wahid (Student).
8. Sri P. Sankara Rao, Secretary, Students' Club (Ex-officio).

In winding up the proceedings the chairman congratulated the members of the newly elected committees and expressed his hopes that they will carry on the work of the Union with success and keep up its reputation. He remarked that there was a decline in the spirit and enthusiasm on the part of many members towards the affairs of the Union and that it was high time that such tendencies were dropped in the interest of this old institution zealously built up by our elders. He thanked the members present for their kind co-operation in the successful conduct of the meeting.

Messrs. Anandan and Lakshmanan were then installed as the Vice-President and Secretary respectively. Mr. Anandan, on behalf of the newly elected committee thanked the members for the honour done to him and to his collegues and assured the house of his earnest efforts to do his best for the Union.

Report of the Managing Committee of the Madras Agricultural Students' Union for the year 1944—'45.

The Managing Committee of the Madras Agricultural Students' Union beg to present the following report of the activities of the Union for the period 1st June 1944 to 31st May 1945.

Membership. The number of members on the roll on 31st May 1945 was 501 as against 520 in 1944 and 515 in 1943. The low decline in membership is much to be regretted, especially when we note the substantial increase in the number of students in the Agricultural College and staff in the Agricultural Department. It is hoped that more members would join the Union and thereby strengthen its activities and cause.

Office bearers. The office bearers of 1943-44 continued till September 1944. Sri N. Muthuswami Naidu, the Secretary, had to relinquish his office due to his transfer from Coimbatore and his place was taken up by Mr. C. Balasubramania Mudaliar. The office bearers for 1944-45 were elected at the General Body Meeting held on 9th September 1944. The following gentlemen were elected to the Managing Committee:—

Vice-President	...	Sri C. M. John.
Editor	...	Sri C. Vijayaraghavan.
Secretary	...	Sri S. Krishnamurthi.
Manager	...	Sri M. A. Sankara Ayyar.
Treasurer	...	Sri B. Suryanarayanamurthi.
Members	...	Sri V. Gomathinayagam Pillai.
		,, M. M. Krishna Marar.
		,, C. S. Krishnaswami.
		,, C. V. Anjanayalu.
		,, H. S. Habibullah.

In the place of Mr. M. A. Sankara who declined Mr. K. Kunhikrishnan Nambiar was elected by the Managing Committee as Manager. Mr. Narasimalu displaced Mr. H. S. Habibullah in January 1945 as the Secretary of the Students' Club. The Principal, Rao Bahadur P. V. Ramiah continued to be the ex-officio President till 20th October 1944 when he went on six months' leave. Sri C. R. Srinivasan, officiating Principal was ex-officio President during the absence of Sri Rao Bahadur P. V. Ramiah.

College Day and Conference. The Managing Committee have once again to report that it has not been possible to hold the annual College Day and Agricultural Conference this year also due to causes entirely beyond their control. Members will be sorry to note that this is the fourth year in succession that we are missing this eventful and important function of the Union in which the old boys from various parts of the Presidency met at their *Alma Mater* and discussed on matters of agricultural interest. Now that the strain of the war is over and increased transport facilities are available it is hoped that the Director of Agriculture will persuade Government to permit the next Committee to hold the College Day and Conference in the near future and depute the district officers to attend the Conference. As in previous years the Committee arranged for the College Day Sports which was held on 10th February 1945. All the sports items were keenly contested and new records were set up in five events The function terminated with the presentation of prizes to the winners by Mrs. M. C. Cherian to whom our thanks are due. We have also to thank Mr. C. Ramaswami Naidu and other members of the Sports Committee for the excellent field arrangements on the sports day which very much contributed to the success of the function.

Managing Committee Meetings. Ten meetings of the Committee were held during the year.

Editorial Board Meetings. There were eight meetings of the Board during the year. We are thankful to Sri C. Vijayaraghavan, Editor and the other members of the Board for efficiently carrying on the publication of the Journal during these difficult times.

The Madras Agricultural Journal. The previous Managing Committee had in the last annual report stated that due to the difficulty in obtaining the required quantity of paper the publication of the Journal as a quarterly or even temporary suspension may be necessary. We are extremely thankful to the Director of Agriculture, Madras for the timely help in getting our cause represented at the appropriate quarters and in obtaining exemption from the Paper Control Order. We are glad that the Journal which had to restrict its publication has again emerged as a monthly issue from May 1945. We have, however, to admit that it has not been possible for us to publish the issue as regularly as before. This is mostly due to the shortage of hands at The Scholar Press, Palghat, who have been our Printers for a fairly long period. We hope that with the return of normal conditions, the Press will be able to execute our work with more promptness and enable us to bring out the issue more regularly. Our thanks are due to the Department of Information, New Delhi for the supply of numerous blocks concerning war subjects for printing in our journal. Our grateful thanks are also due to the Government of Madras for the annual subsidy of Rs 400 granted to the Journal. We hope that the amount will be increased substantially in the near future.

Subscribers. The number of subscribers to the Journal, who are not members of the Union was 318 at the end of the year as against 313 last year and 230 in 1943. It is evident from enquiries received from all over India that the Journal is attracting the attention of the public in other Provinces indicating the need for the expansion of the scope and utility of the Journal

Exchange and free list. We are glad to report that despatch of copies to foreign institutions in United States of America. England. Australia, Russia etc., which are on our exchange list has been resumed. Issues which had accumulated for the last six years have been sent.

Ramasastrulu Munagala Prize 1945. The prize was announced to be awarded this year for an original economic enquiry on any agricultural subject. There was only one entry and the judges who adjudged the paper considered it not up to the mark. The prize was not therefore awarded this year.

Acknowledgement. The Committee record their grateful thanks to all members of the Union for their valuable co-operation and Sri Rao Bahadur P. V. Ramiah and Sri C. R. Srinivasa Ayyangar who as ex-officio Presidents evinced keen interest in the affairs of the Union.

College & Estate News.

Students' Club. There were three meetings held under the auspices of the Club, main items for the lectures being (1) the food situation in S. India by Sri K. G. Sivaswami Iyer of Servants of India Society, (2) "the rambling thoughts of forest exploration" by Sri S. V. Parthasarathy and (3) debate on the proposition "March of Science has been responsible for killing human values" with Mr. R. N. K. Sundaram in the chair.

Tours. The students' tour to Nilgiris by II years and to West Coast by III years were of highly educative nature.

Students' Corner. *Cricket.* In connection with the Rhondy shield tournament the Agricultural College team won over the Royal Navy by 17 runs on the 1st innings score of 65 against 48 respectively. The home team beat the local Arts College in the 'Vijayakumar' cup tournament conducted by the Arts College by 89 runs. The scores were 102 and 227 against 111 and 129 respectively for first and second innings. In the inter collegiate tournament played at Salem against Salem Mnnicipal College, our team defeated the Salem team by 125 runs, the respective scores in first and second innings being 130 and 182 against 86 and 101. The miraculous bowlings of K. S. Alwa in 1st innings taking 8 wickets for 34 runs, and 4 wickets each by Alwa and D P. Rangaswami in 2nd innings scored one more trophy to the credit of the College.

Among other friendly matches the important ones were those played with Veterinary College which defeated the home team by 40 runs, the Mangalore team in which even after scoring 167 for 9 wickets the match ended in a draw, the Coimbatore Cricket Club wherein the College won by 6 runs and 5 wickets and with the Officers ending in a draw. The college on the whole exhibited a fair enthusiasm and excellent results in cricket in these months.

Hockey. The season seemed to be a bit dull. In the three tournaments viz. Y. M. C. A., the Inter Collegiate and the Arts College tournaments, the College was successful in the last one, losing the 1st two by narrow margin due to the absence of some veteran final year players and serious injuries to other players. Arrangements are made for a new hockey field, (hard), to give practice to the students to get accustomed on a fast ground.

Foot-ball. This is another of the vigorous outdoor games. In about a dozen matches played during the period the college has won in all except two. The college won this year the Uberoi tournament against the City Municipal High School, Coimbatore, scoring four goals to two.

Departmental Notifications.

Gazetted Service—Postings and Transfers.

Names.	From	To
Sri S. Dharmalinga Mudaliar	D. A. O. (on leave)	D. A. O., Salem.
,, M. Gopala Chettiar	D. A. O., Saidapet	D. A. O., Nellore.
,, M. Ramamurthi	P. A. to D. A. O., Bezwada	Gazetted Asst. to D. A. O., Bezwada.
,, K. Veerabhadra Rao	P.A. to D.A.O., Nellore	To act as D.A.O., Nellore.
Janab A. Muhammad Ali Sahib Bahadur	Gazetted Asst. to D. A. O., Bezwada	Gazetted Asst. to H-Q. D. A , Madras.
Sri R. N. K. Sundaram	Gazetted Asst. in Agri. Vocational Training for Soldiers, Coimbatore	S.L.A. and Supdt., Central Farm, Coimbatore.
,, K. Venkatarama Iyer	Gazetted Asst. to Dy. D. A., Madras	Gazetted Asst. in Agri. Vocational Training of soldiers, Coimbatore.
Janab Mirsa Ansari Baig	Gazetted Asst. to D. A. O., Guntur,	Gazetted Asst. to the D. D. II Division, Rajamundry for Loans.
Sri M. Kanti Raj	—	Dy. D. A., 1st Dn., Vizagapatam.
,, R. Vasudeva Rao Naidu	Suptd., A.R.S., Anakapalli	,, 2nd Dn., Ellore.
,, A. Gopalakrishnaiah Naidu	Dy. D. A., Chittoor	,, 3rd Dn., Guntur
,, V. T. Subbaiah Mudaliar	J. L. A. & Asst. Supdt., Central Farm, Coimbatore	,, 4th Dn., Cuddapah.
Saadat ul lah Khan Sahib Bahadur	Dy. D. A. (on leave)	,, 5th Dn., Vellore
Sri A. Ramaswami Iyer	D. A. O., Cuddapah	,, 6th Dn., Tanjore.
,, A. Gopalan Nair	D. A. O., Calicut	,, 7th Dn., Madura.
,, M. Anandan	—	,, 8th Dn., Coimbatore.
,, D. Viswanatha Reddy	Asst. Marketing Officer, Madras	J. L. A. & Asst. Supdt., C. F., Coimbatore.
A. Gulam Ahmed Sahib Bahadur	D. A. O. (on leave)	D. A. O., Kurnool.
Sri M. Veeraraghava Rao Naidu	D, A. O., Kurnool	D. A. O., Chicacole.
Muhammad Khasim Adeni Sahib Bahadur	D. A. O., Chicacole	Gazetted Asst. to D. A O , Cocanada (Loans work).
Sri A. M. Muthiah Nattar	Gazetted Asst. to D. A. O., Cocanada	Asst. Marketing Officer, Madras
,, P. Abisekhanathan Pillai	Curator & D A. O., Nilgiris	Dy. Director of Agri. and Curator, Nilgiris.
,, Rao Bahadur P. V. Ramiah	Principal, Agricultural College, Coimbatore	Principal, Agrl. College and Res. Institute.
,, M. Sanyasi Raju	Asst. to Agrl. Chemist, Coimbatore	Asst. Agrl. Chemist for Cyclone work, Anakapalle.
,, K. C. Ramakrishna Iyer	Lecturer in Agrl. Economics, Coimbatore	(On other duty).

Sri P. S. H. Narayana-swamy Naidu	F. M., Gudiyattam	Supdt., Agrl. Research Station, Anakapalle.
„ C. Ramaswami Naidu	S. L. A. & Supdt. Central Farm Coimbatore	On other duty (Study abroad).

Subordinate Service.

Sri J. Gopal Rao	A. D., Rayachoti	A. D , Ongole.
„ K. Ranga Rao	A. D., Ongole	A. D., Bapatla.
„ G. Kameswara Rao	A. D., Beemavaram	A. D., Pithapuram.
„ M. Jeevan Rao	P. A. to D. A. O., Bellary	Marketing Asst., Kurnool.
„ Devasikamani	—	A. D., Proddatur.
„ R. Satagopan	A. D., Perambalur	Food Inspector, Trichy
„ R. Guruswami Naidu	A. D., Rural Reconstruction Scheme Army Centre, Bangalore	A. D., Rural Reconstruction Scheme Army Centre, Jalagatta.
„ S. Rama Rao	A. D., Land Colonization Scheme (on leave)	A. D., Raipur.
„ T. Venkataraipai	A. D., H. I Cotton Scheme, Guntakal	A D., H. I Cotton Scheme, Adoni.
„ P. Lakshminarayana	(On leave)	A. D., H. I Cotton Scheme, Guntakal.
Janab Muhammad Baig	A. D., Loan Work	A. D., Nandyal.
Sri K. Dinkar Rao	A. D., Kondapur	A. D., Kasaragode.
„ V. Ramalingam	Asst. in Mycology, Coimbatore,	A. D., Omalur.
„ J. Vaidyanathan	A. D., Sriperumpudur	A. D., Papanasam.
„ G. Ramalingam	A. D. under training, Pithapuram	A. D., Anantapur.
„ D. Srinivasa Rao	A.D., Loan work, Guntur	A. D., Dhone.
„ K. V. Natesan	A. D., Tirupur	A.D., Rural Reconstruction Army Centre, Bangalore
„ K. C. Thomas	A. D., Vocational training for soldiers C.F., Coimbatore	A. D., Tirupur.
„ M. J. David	A.D., Land Colonization Scheme, Tanjore	A.D., Vocational training for soldiers C.F., Coimbatore.
„ T. S. Francis	Probationary D. A. O., under training, Trichy	A. D., Ariyalur.
„ T. V. Ayyaswami Iyer	A. D., Ariyalur	A. D., Perambalur.
„ M. Venkoba Rao	Asst. in Cotton, Guntur	Asst. in Cotton, Nandyal.
„ R. Narasimha Reddy	A. D., Dhone	Asst, Cotton, Guntur.
„ S. Venkataramanappa	A. D., Proddatur	Marketing Asst., Nagpur.
„ K. Venkataswami	Marketing Asst., Nagpur	Food Department, Govt. of India.
„ K. S. Subba Rao		A. D., Pulivendla.
„ K. Padmanabha Rao	Asst. in Paddy, Maruteru	Food Inspector Tadepalligudam.
„ S. Sithapathi Rao	F. M., A. R. S., Guntur	A. D., Cyclone work, E. G.
„ S. Lakshminarayana,	F.M., A.R.S., Samalkota	F. M., Nandyal.
„ K. Govindan Nambiar	(on leave) A.D., Pattambi	A.D., Pattambi for Fieldmen.
„ A. Kannan Nambiar	A. D., Pattambi	A. D., Ponnani.
„ R. Krishnamurthi,	A. D., Giddalore	A. D., Madanapalle.
„ G. V. Venkatarama Reddy,	A. D., Madanapalle	A. D., Kalahasthi.
„ I. Lakshmipathi Rao	Food Inspector, Tadepalligudam	A. D., W. Godavari.
„ G. H. Sankara Reddy	A. D., Proddatur	Asst. in Chemistry, Coimbatore.

Sri V. S. Rangacharlu	A. R. S. Hagari	Fruit Asst., Badamata.
„ M. Vaidyanathan	P.A. to D.A.O., Tinnevelly,	F.M., A.R S., Koilpatti.
„ P. Somayajulu	F.M., Arukuvali Scheme	A.D., Cyclone work, Rajamundry.
„ K. Krishnamurthi	„	A. D., Chicacole.
„ R. Ratnavelu	on leave	A. D., Land Colonization Co-operative, Tanjore.
„ N. Balasubramaniam	Special A. D , Pulses	A. D., Tanjore.
„ P. K. Sivasubramaniam	A. D., Tanjore	A. D., Cheyar.
„ M. Subba Reddy	A. D., Indian Vegetable, Buchireddipalam	P. A. to D. A. O., Nellore
„ V. V. Rajagopalan	A. D., Vegetable Scheme, Coimbatore	F. M., Central Farm, Coimbatore
„ M. Kelukutty Menon	F. M., C. F., Coimbatore	A. D., Palghat
„ T. Veeriah	A. D , Narasipatam	A. R. S., Samalkota
„ T. Gopalan Nair	A. D., Palghat	A. D., Alathur
„ T. Paramanandam	F. M., Nandyal	F.M., Samalkota for training
„ B. Ramakrishna Reddi	A. D., Atmakur	Asst. in Cotton, A. R. S., Bellary
„ C. Ekambaram	A. D., Conjeevaram	F.M , A. R. S., Gudiyattam
„ D. Narasimhamoorthi	A. D., Podili	A. D., Gudur
„ K. Narayana Rao	A. D., Gudur	Marketing Asst., Kurnool
„ S. V. Ramachandra Iyer	P.A. to D.A.O., Tinnevelly	F. M., A. R. S., Palur
„ K. Sitharama Iyer	F. M., A R. S., Palur	A. D., Tirukoilur
„ T. N. Balasubramanian	P. A. to Special Agrl. Officer, Pattukottai	P. A. to D. A. O., Tinnevelly
„ A. Ramadoss		P. A. to Special Agrl. Offices, Pattukottai
„ E. K. Nambiar	F. M., A. R. S., Koilpatti	F. M., A. R. S., Nileshwar
„ P. Ramakrishna Rao	Food Inspector under Dt. Supply Officer, Nellore	A. D., H1 Cotton Scheme, Bellary
Janab P. Muhammad Ibrahim	A. D., Adirampatnam	A. R. S., Pattukottai
Sri P. S. Krishnamoorthi	Asst. in Entomology, Nellore	Asst. in Entomology, Coimbatore
„ S. V. Kuppuswami and J. Dorai Raju	Asst. in Chemistry, Coimbatore	Asst. to the Agrl. Chemist, Rajamundry
„ A. Azimuddin	A. D., Melur	F, M., Central Farm, Coimbatore
„ N. S. Vaidyanathan	Food Inspector under grain purchase officer, Tanjore	F. M., Wynad Colonization Scheme
„ K. Janardhana Rao	„ Tenali	F. M., A. R. S., Anakapalle
„ P. L. N. Somayajulu	„ „	„ „ Samalkota
„ S. Ramanathan	„ „	Asst. Millets, A.R.S., Guntur
„ A. Thomas Reddy	„ „	F. M., A. R. S., Guntur
„ G. Adinarayana Reddy	„ „	A. D., Kudligi, Bellary Dt.
„ D. Bappayya	„ „	F.M., Kalahasti Farm, Chittoor
„ K. Padmanabha Rao	„ Tadipalligudam,	A. D., Giddalore
„ B. Seshawatharam	„ „	Marketing Asst., Bellary
Gulam Muhammad Shariff	„ „	Asst. in Chemistry, Coimbatore
Sri Y. Venkataswamy,	„ „	A. D., Royachoti
„ A. Ramamohan Rao	„ „	A. D., Anantapur
„ P. Nageswara Rao	„ „	A. D., Atmakur

Sri Y Jagannadha Rao	Food Inspector under grain purchase officer, Tadipalligudam	Asst. in Mycology, Coimbatore
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„ M. Ramanathan	„ „	Asst. in Paddy, A. R. S., Maruteru
„ M. Kasiviswanadan	Food Inspector under grain purchase officer, Trichinopoly	F. M. under special office, Vegetable Scheme, Coimbatore
„ K. Moorthi Raju	Food Inspector under Dt. supply officer, Nellore	A. D., Nellore
„ D. Ranga Rao	„ „	F. M., A. R. S., Hagari
„ P. Ramakrishnan	„ „	A. D., H1 Cotton Scheme, Bellary
„ K. Bhaskara Rao	Food Inspector under grain purchase officer, Bezwada	A. D., Vegetable Scheme, Anakapalle
„ T. V. Krishnaswami Rao	„ „	A. D., Ichapur, N. Vizagapatam
„ K. V. Narayana Reddy	„ „	Asst. in Chemistry, Coimbatore
„ G. V. Raghavulu	„ „	A. D. S., Vizagapatam Dt.
Janab Syed Ahmaddullah	„ „	A. D., Vinukonda
Sri Y. R. Sundara Row	„ „	A. D., Nuzwid, Kistna Dt.
„ K. Ramanatha Iyer	Agricultural Demonstrator (retired)	Re-employed for a period of one year from 11-10-'45 as Farm Manager, Kalahasthi