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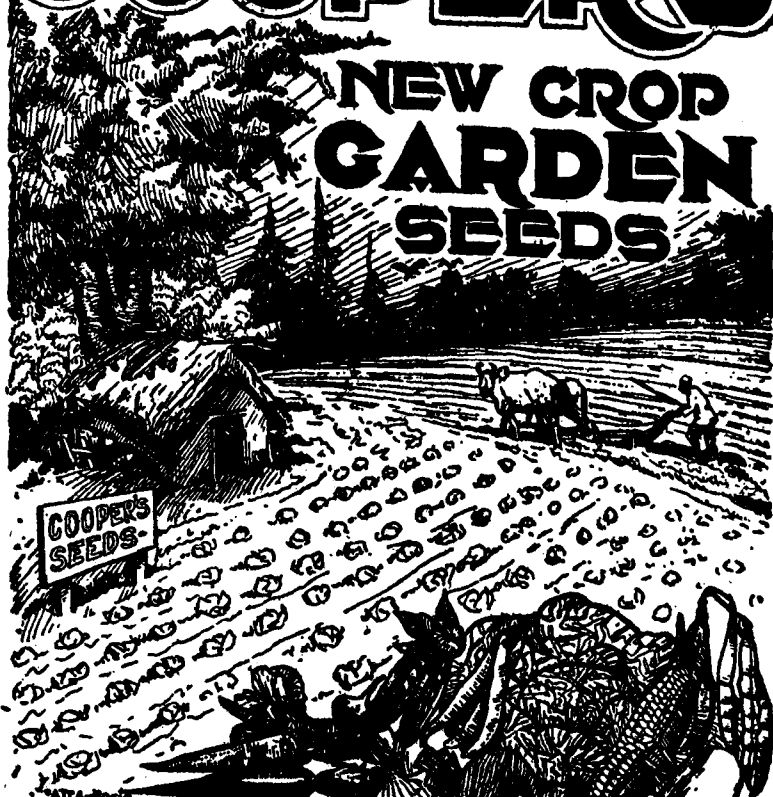
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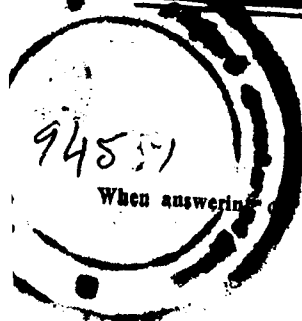
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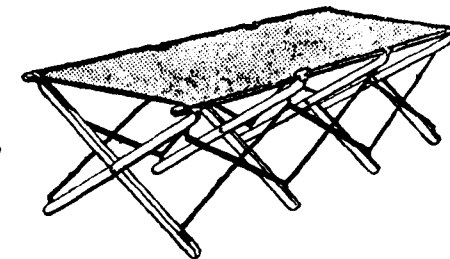
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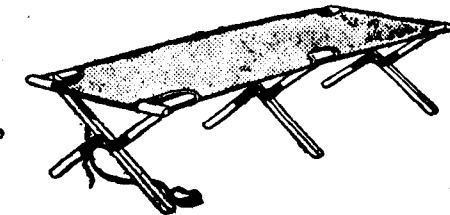
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CONTENTS

ORIGINAL ARTICLES—

- A Statistical Study of Paddy Yield in South Kanara with reference to Rainfall and Weather—By *N. K. Adyanthaya*, B.A. (Hons.), B.Sc. Econ. (London) ... 425

THE M.A.S.U. PARLIAMENT—

- Debate on the prohibition of the export of indigenous manures from the country ... 433

SELECTED ARTICLE—

- The place of Science in the Development of Mysore Agriculture—By *Leslie Coleman*, M.A., Ph.D., C.I.E. ... 450

- BRIEF NOTES ON SOME INDIGENOUS OILS ... 456

- NOTES AND COMMENTS ... 458

- GLEANINGS ... 461

- FARMING CALENDAR ... 462

- COLLEGE NEWS AND NOTES ... 463

- WEATHER REVIEW ... 465

- DEPARTMENTAL NOTIFICATIONS ... 467

- MANAGER'S NOTICE ... 467

- APPENDIX—Additions to the Library ... 468

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Vol. XIX]

OCTOBER 1931

[No. 10

A STATISTICAL STUDY OF PADDY YIELD IN SOUTH KANARA IN RELATION TO WEATHER

By N. K. ADYANTHAYA, B.A. HONS., B.Sc. (LOND.)

Lecturer in Statistics, University of Madras

'We have to contemplate social phenomena as susceptible of prevision, like all other classes within the limits of exactness compatible with their higher complexity.'

—Auguste Comte.

The object of this paper is to point out the possibilities of the application of the modern theory of statistics in the fruitful field of Agricultural Meteorology. As an example, a study of yield in relation to weather will be taken up. In this connection it is worth noticing that in 1927, Mr. J. H. Field, the then Director-General of Observatories, while giving his evidence before the Royal Commission on Agriculture in India, stressed the importance of the service which the Meteorological department can render to Indian agriculture by researches on the correlation between weather and crops. How the computed coefficients of correlation between yield and certain meteorological elements enable us to predict the yield in a certain year or period from a knowledge of the conditions of weather in that year or period, will be clear from the treatment of the topic taken up below.

To secure homogeneity in meteorological conditions which is an important factor in a work of this nature, I have taken up the district of South Kanara on the West Coast, where we have a monsoon lasting for nearly three months and a half from about the beginning of June up to nearly the middle of September, and the crops are mostly unirrigated, thereby ensuring that rainfall, and not irrigation, is the factor entering directly into the determination of yield. In Table I are set out the data of the yield of

paddy in tons, the area under cultivation, the total rainfall, and the average temperature for the month of June for the twenty-three years from 1907-08 up to 1929-30. With the sole exception of the last, these data were taken from the Season and Crop Reports of the Madras Presidency issued every year by the Department of Agriculture.

TABLE I
Study of Paddy Yield in South Kanara for a period of 23 years.

Year	Total estimated yield in tons	Area under cultivation in acres	Total rainfall in inches	Average June temperature
1907-08	277,763	555,279	158.79	80.3
1908-09	277,736	555,225	181.43	80.6
1909-10	278,723	559,208	135.99	79.7
1910-11	307,308	552,908	142.49	77.3
1911-12	309,546	556,935	124.19	79.3
1912-13	319,292	574,470	162.22	80.1
1913-14	314,519	565,881	123.73	80.8
1914-15	318,833	573,643	173.86	80.6
1915-16	329,352	592,569	122.56	82.3
1916-17	390,792	595,493	153.32	78.9
1917-18	387,082	602,096	186.69	78.9
1918-19	317,000	584,508	89.85	79.7
1919-20	399,100	595,919	138.74	80.9
1920-21	414,800	595,596	140.45	79.8
1921-22	401,300	593,356	156.60	80.9
1922-23	407,400	596,398	158.20	79.5
1923-24	373,900	581,689	166.00	81.3
1924-25	373,800	581,430	174.60	79.0
1925-26	373,000	580,245	164.50	80.4
1926-27	384,100	579,362	137.80	80.2
1927-28	389,050	580,983	150.30	81.0
1928-29	381,500	575,429	144.70	79.8
1929-30	386,600	577,308	164.00	78.6

It is not easy to deal with the figures as they stand. So indices for the four factors under consideration were constructed, choosing as base the average for the five years from 1912-13 up to 1916-17, and taking it as 100. The revised table is given hereunder.

TABLE II

Year	Index of yield	Index of area under cultivation	Index of rainfall	Index of temperature
1907-08	83.01	95.67	107.91	99.75
1908-09	83.02	95.66	123.31	100.12
1909-10	83.61	95.74	92.42	99.01
1910-11	91.85	95.26	96.84	96.02
1911-12	92.52	95.96	84.40	98.51
1912-13	95.44	98.98	110.25	99.50
1913-14	94.01	97.50	84.09	100.37
1914-15	95.30	98.83	118.16	100.12
1915-16	98.44	102.09	83.30	102.24
1916-17	116.81	102.60	104.20	98.01

TABLE II—(continued)

Year	Index of yield	Index of area under cultivation	Index of rainfall	Index of temperature
1917-18	115.69	103.74	126.88	98.01
1918-19	94.75	100.71	61.07	99.01
1919-20	119.29	102.67	94.29	100.50
1920-21	123.98	102.62	95.45	99.13
1921-22	119.95	102.23	106.43	100.50
1922-23	121.77	102.75	107.52	98.76
1923-24	111.76	100.22	112.82	100.99
1924-25	111.73	100.18	118.66	98.13
1925-26	111.49	99.97	111.80	99.88
1926-27	114.81	99.82	93.65	100.62
1927-28	116.29	100.10	102.15	99.13
1928-29	114.03	99.14	98.34	99.63
1929-30	115.56	99.47	111.46	97.64

Now, how are we to correlate these indices? Can we correlate them as they stand, and does the resulting coefficient of correlation give a measure of the true relationship between the characteristics correlated? The answer is 'No'. Why? Because the data we are dealing with, which are really time series, are subject to cyclical and secular influences. In order to measure the relationship between yield and the variations of the weather, we must make allowance for these secular and cyclical changes. We can here follow the method adopted by the Bureau of Statistics of the Department of Agriculture of the United States of America for tackling this difficulty.¹ In their forecasts of the probable yield of the crop at the end of the year from the condition of the crop in any month, they have found by experience that it is not profitable to work directly with the absolute values of the condition and yield on account of the violent fluctuations to which a result on this basis is subject at times; they have, on the other hand, found that if they took the ratio of the condition figure in any particular year to the average condition figure for the five or three previous years and equated this to the ratio of probable yield to the average yield for the five or three previous years, or symbolically if they took $\frac{C}{C_5} = \frac{Y}{Y_5}$ where

C_5 and Y_5 are the average condition and yield for the five previous years, this gave a series from which the effects of cyclical and secular changes were very much mitigated. We are going to adopt the same method here, and instead of correlating the indices directly, we shall correlate the ratio of an index for any year to the average index for three previous years with the ratios of other indices similarly treated. Since our data extend only for a period of twenty-three years, we shall be getting twenty items as against eighteen if we had taken a five-year average, and since there is not much to choose between a three-year and a five-year period average, the index ratios to three-year averages are to be preferred. Denoting yield by Y, area under cultivation by A, the total rainfall by R, and average temperature for the month of June by T, and the average yield for the three

¹ Forecasting the yield and price of cotton, by H. L. Moore.

years previous to the year in question by $\bar{Y}_3$, the average area by $\bar{A}_3$ etc., the data in the new form can be set out as follows:—

TABLE III

Year	$\frac{Y}{\bar{Y}_3}$	$\frac{A}{\bar{A}_3}$	$\frac{R}{\bar{R}_3}$	$\frac{T}{\bar{T}_3}$
1907-08	...	...	...	...
1908-09	...	...	...	...
1909-10	...	...	...	...
1910-11	110.4	99.6	89.8	96.4
1911-12	107.4	100.4	81.0	100.1
1912-13	106.8	103.5	120.9	101.7
1913-14	100.8	100.8	86.5	102.4
1914-15	101.4	101.4	127.2	100.7
1915-16	103.7	103.7	80.0	102.2
1916-17	121.8	103.1	109.5	97.1
1917-18	111.8	102.5	124.5	97.9
1918-19	85.9	98.0	58.3	99.6
1919-20	109.4	100.3	96.8	102.2
1920-21	112.8	100.2	101.5	100.0
1921-22	106.5	100.2	127.3	101.0
1922-23	100.6	100.2	108.9	98.7
1923-24	91.7	97.7	109.4	101.5
1924-25	94.8	98.5	108.9	98.0
1925-26	96.9	98.9	98.9	100.6
1926-27	102.8	99.7	81.8	101.0
1927-28	103.2	100.1	94.6	99.6
1928-29	99.8	99.2	95.9	99.8
1929-30	100.4	99.8	113.7	97.8

Calculating the coefficients of correlation between the four indices taken pairs, the coefficients come out as shown below:—

$$r_{\frac{Y}{\bar{Y}_3}, \frac{A}{\bar{A}_3}} = .6688; r_{\frac{Y}{\bar{Y}_3}, \frac{R}{\bar{R}_3}} = .3198; r_{\frac{Y}{\bar{Y}_3}, \frac{T}{\bar{T}_3}} = -.2706$$

$$r_{\frac{A}{\bar{A}_3}, \frac{R}{\bar{R}_3}} = .2901; r_{\frac{A}{\bar{A}_3}, \frac{T}{\bar{T}_3}} = .0944; r_{\frac{R}{\bar{R}_3}, \frac{T}{\bar{T}_3}} = -.1482$$

Here $\frac{Y}{\bar{Y}_3}, \frac{A}{\bar{A}_3}$ denotes correlation between ratios $\frac{Y}{\bar{Y}_3}$ and $\frac{A}{\bar{A}_3}$

$\frac{Y}{\bar{Y}_3}, \frac{R}{\bar{R}_3}$ denotes correlation between $\frac{Y}{\bar{Y}_3}$ and $\frac{R}{\bar{R}_3}$ and so on.

From these values, we see that the correlations between yield and area and yield and rainfall respectively are significant, as we should naturally expect them to be. There is a higher correlation between yield and area than between yield and rainfall, and this is easily explained when we remember that too much of rains may be injurious to crops, while on the

other hand, other things being equal, there is nothing to hinder the yield from progressive increase, so long as the area under cultivation also increases. The coefficient of correlation between area and rainfall is probably a bit significant, and so is the correlation between yield and temperature which is negative, thereby showing that a lower June temperature coupled with rains, is conducive to better yield than a high temperature. The standard error of the correlation between area and rainfall is $\frac{.9147}{\sqrt{20}} = .20453$ and therefore the ratio of the significance of the observed coefficient of correlation from zero will be nearly 1.4, which shows that the observed coefficient is not quite significant. The same may be said about the correlation between yield and temperature. The other two correlations are not significant.

Now, how will these values help us? While too much reliance may not be placed on a small sample of 20 items, still they enable us to answer some important questions. A question like this may be asked: 'How will you predict the yield in a certain year, if you are given the total rainfall for the year?' Since we know the correlation between yield and rainfall, and also their means and standard deviations, the prediction equation is at once written down in the form

$$\frac{Y}{\bar{Y}_3} - 103.45 = .3198 \times .44923 \left(\frac{R}{\bar{R}_3} - 100.76 \right).$$

Here, .44923 is the ratio of the standard deviation of $\frac{Y}{\bar{Y}_3}$ to the standard deviation of $\frac{R}{\bar{R}_3}$. 103.45

and 100.76 are the means of these indices. This equation reduces to $\frac{Y}{\bar{Y}_3}$

$$= .1437 \frac{R}{\bar{R}_3} + 88.97,$$

which is an equation which determines Y from a knowledge of R. We can also make use of the concept of partial correlation, and answer a question like this: 'What effect has the June temperature on the yield, supposing the rainfall to remain constant?' We have simply to find the correlation

between $\frac{Y}{\bar{Y}_3}$ and $\frac{T}{\bar{T}_3}$ for constant $\frac{R}{\bar{R}_3}$ or with the usual notation, we have

to find $r_{\frac{Y}{\bar{Y}_3}, \frac{T}{\bar{T}_3} \cdot \frac{R}{\bar{R}_3}}$. This is equal to

$$\frac{\frac{Y}{\bar{Y}_3}, \frac{T}{\bar{T}_3} \cdot \frac{R}{\bar{R}_3}}{\sqrt{1 - r_{\frac{Y}{\bar{Y}_3}, \frac{R}{\bar{R}_3}}^2} \sqrt{1 - r_{\frac{T}{\bar{T}_3}, \frac{R}{\bar{R}_3}}^2}} = -.2382$$

which is negative, and therefore we conclude that a lower June temperature is conducive to a better yield than a higher one, rainfall remaining constant. The correlation, though negative is not quite significant. So we cannot place too much reliance on this result. There is no doubt that there is a certain normal temperature which gives the best yield, other things being equal. Any temperature in excess or in defect of that may be injurious to crops.

Our object is not so much to study the relationship between yield and the individual factors as to combine the various factors which we have taken as affecting the yield, and arrive at a formula from which we are able to predict the probable yield in a certain year from a knowledge of the three factors which we have considered—the area under cultivation, the total rainfall, and the average June temperature. The theory of multiple correlation developed by Professor Karl Pearson and his co-workers enables us to solve this very important problem. We need not here go into the complex theory of multiple correlation, but we may just state some of the results, which may help an investigator engaged on a work of this nature. If x_0 stand for yield, x_1 for area, x_2 for rainfall and x_3 for temperature, the problem of multiple correlation is to find a linear function in x_1, x_2, x_3 that has the maximum correlation with x_0 . From this function, the prediction equation is readily written down, and it will be

$$\frac{x_0 - \bar{x}_0}{\sigma_0} = - \frac{R_{01}}{R_{00}} \frac{x_1 - \bar{x}_1}{\sigma_1} - \frac{R_{02}}{R_{00}} \frac{x_2 - \bar{x}_2}{\sigma_2} - \frac{R_{03}}{R_{00}} \frac{x_3 - \bar{x}_3}{\sigma_3}$$

where $\sigma_0, \sigma_1, \sigma_2, \sigma_3$, are the standard deviations of x_0, x_1, x_2, x_3 , and R is the symmetrical determinant

$$\begin{vmatrix} 1 & r_{01} & r_{02} & r_{03} \\ r_{10} & 1 & r_{12} & r_{13} \\ r_{20} & r_{21} & 1 & r_{23} \\ r_{30} & r_{31} & r_{32} & 1 \end{vmatrix}$$

and r_{01}, r_{02} , etc., are the correlation between yield and area, yield and rainfall and so on; and R_{00}, R_{01}, R_{02} , etc. are the minors of the determinant R .

The symmetrical determinant to take in this case will be

$$\begin{vmatrix} 1 & .6688 & .3198 & -.2706 \\ .6688 & 1 & .2921 & .0944 \\ .3198 & .2921 & 1 & -.1482 \\ -.2706 & .0944 & -.1482 & 1 \end{vmatrix}$$

and computing the various minors of this determinant, the prediction equation for the yield x_0 will be found to be

$$x_0 = 3.179 x_1 + .033 x_2 - 1.459 x_3 - 73.25$$

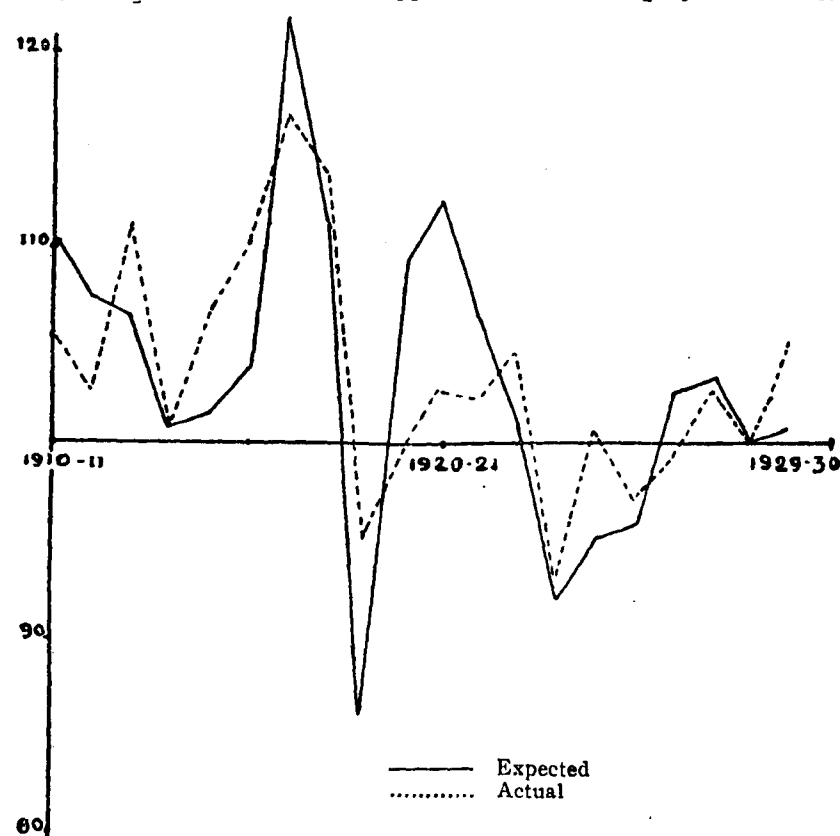
Calculating the values of x_0 , for the various values of x_1, x_2, x_3 , given in Table III, the expected series of values may be set out against the actual as follows:—

Years				Expected	Actual	Difference
1910-11	...	...	...	105.7	110.4	-4.7
1911-12	...	...	...	102.5	107.4	-4.9
1912-13	...	...	...	111.4	106.8	4.6
1913-14	...	...	...	100.7	100.8	-0.1
1914-15	...	...	...	106.4	101.4	5.0
1915-16	...	...	...	109.9	103.7	6.2
1916-17	...	...	...	116.7	121.8	-5.1
1917-18	...	...	...	113.9	111.8	2.1
1918-19	...	...	...	94.9	85.9	9.0
1919-20	...	...	...	99.7	109.4	-9.7
1920-21	...	...	...	102.7	112.8	-10.1
1921-22	...	...	...	102.1	106.5	-4.4
22-23	...	...	...	104.9	100.6	4.3
1923-24	...	...	...	92.9	91.7	1.2
1924-25	...	...	...	100.5	94.8	5.7
1925-26	...	...	...	97.7	96.9	0.8
1926-27	...	...	...	99.0	102.8	-3.8
1927-28	...	...	...	102.8	103.2	-0.4
1928-29	...	...	...	99.7	99.9	-0.2
1929-30	...	...	...	105.1	100.4	4.7

From the above figures we see that the correspondence between theory and observation is pretty close. The standard deviation of an estimate based on this multiple regression method is $\sigma_0 \sqrt{\frac{R}{R_{00}}}$ and this works out

as 5.1527. In no case do we observe a departure of the expected from the observed by three times the S.D. The departure is a bit exceptional in only three cases in the three consecutive years, 1918-19, 1919-20 and 1920-21. The departure here comes to nearly twice the S.D. in each case. But when we remember that these were rather exceptional years in that there was a run of drought beginning with year 1918 and running up to the year 1921, we see how hard it is for any equation to give an adequate fit at these three points. 1918 was an exceptionally bad year, and the index of rainfall for that year is 61.07, the lowest in the whole period, 1915-16 was

also a pretty bad year from the point of view of rainfall and there also the departure is a bit noticeable. The correspondence between the actual and the expected series can be better appreciated from the graph shown below.



Graph showing the 'expected' and the 'actual' indices of Paddy yield in South Kanara, for the twenty years from 1910-11 to 1929-30. The dotted lines, show the expected series.

Before we close, it is fitting that we should make a statement of the limitations of the method which we have employed, and, if possible, suggest a more suitable method of tackling a problem of this kind, if the nature of the data, and the special circumstances of the problem, admit of a better solution. The method we have adopted is not strictly correct, for the correlations we have found between ratios, the ratios having been derived from progressive three-year averages, may be, after all, spurious, and may not be representative of the presence of real causes in the characteristics correlated. Until about the year 1910, statistical science had no means of satisfactorily correlating time series; this problem puzzled mathematicians for a long time, and a method has been gradually elaborated, and we may say that it holds the field now. That method has been termed 'The Variate Difference Method'. Here the correlation between first differences, between second differences, third differences and so on, of the variates are calculated until the calculated coefficients exhibit signs of stability in sign and magnitude. When this is attained, the resulting coefficient is taken as

a measure of the true relationship between the variates. This of course would be the ideal method to use in any practical case, and will no doubt yield very valuable results in a case like the one we considered, where a knowledge of the real underlying causes and the extent of their inter-relationships is essential. But if the series extend only to about twenty years or less, we shall be left with very few items for purposes of correlation, and it would be hazardous to base any arguments or build any theory on the basis of these few items. Moreover, we have to go on taking differences and correlating them until stability in correlation is attained. The series may be nearly exhausted by the time we reach the 6th difference. This was the very consideration which prompted me in the adoption of the alternative method of attack in this particular case. Professor Moore in his paper 'Forecasting the Yield and Price of Cotton' tried the same method, and verified his results by taking the correlation of differences also, and found a very close correspondence between the two. But, if the data available extend for a good number of years, the adoption of 'Variate Difference Correlation Method' would, of course, be ideal.

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THE M.A.S.U. PARLIAMENT

(Proceedings of a Meeting held on 23rd July 1931)

Motion before the House :—'That this House is of opinion that the export of indigenous manures from India is not conducive to the welfare of the country.'

Proposer :—Rao Bahadur B. Viswa Nath Garu, F.I.C., Government Agricultural Chemist, Coimbatore.

Opposer :—C. E. Wootton, Esq., B. Sc., Chemist, Manure Works, Messrs. T. Stanes & Co., Ltd., Coimbatore.

Speaker :—Rao Bahadur M. R. Ramaswami Sivan Ayl., B.A., DIP. AGR., Retired Principal, Agricultural College, Coimbatore.

SPEAKER'S OPENING REMARKS

LADIES AND GENTLEMEN,

It is a very great pleasure for me to be at the scene of my labours again, and I am glad that the M.A.S.U. with whose inception I was intimately connected 25 years ago, has added to its activities by these parliamentary ventures. I heard that the first was extraordinarily successful, and from the kind of people who are taking part to-day I am sure this will be equally so. The subject itself affords much room for discussion; so much has to be said for and against, so much has been discussed in Board of Agriculture meetings, Legislative Council discussions and in conferences. And there is plenty of room for expression of different opinions. It is very convenient for me as

Chairman, for, really in a debate, the speaker has to do very little of speaking and I shall watch the proceedings with very great interest. I now call upon Rao Bahadur B. Viswa Nath to move the proposition that stands in his name.

MR. VISWA NATH'S SPEECH.

MR. SPEAKER, LADIES AND GENTLEMEN,

It is a happy circumstance that this audience consisting of trained scientific workers and economists, should discuss and throw light on this subject of export of manures which has been engaging my attention for some years now. I am also happy to have as speaker to-day a respected ex-colleague of mine, who has pronounced views on manures, and whose quasi-public and quasi-scientific activities after retiring from service, will be of great value to us. I must count it a piece of singular fortune to enlist the co-operation of Mr. Wootton, who happily combines in him science and business, and I am indeed happy that I shall have the honour of crossing swords with an opponent of proved ability and qualifications to speak on the subject with authority. I have, therefore, great pleasure in moving my proposition which runs thus :—

'The export of indigenous manures from India is not conducive to the welfare of the country.'

HISTORICAL INTRODUCTION

The subject of the export of indigenous manures is an old one and has been engaging the attention of scientific bodies, agriculturists, planters, commercial men, economists and the provincial and central legislatures and Governments for nearly forty years, and every time it is brought up for consideration, more and more evidence is forthcoming to show that the export of indigenous manures is not conducive to the interests of the country. The subject was first discussed in 1893 by the United Planters' Association of Southern India at their Annual General Body Meeting and they passed a resolution praying Government to interfere with, or prohibit the export of indigenous manures, especially bones. Since then the subject became almost a hardy annual with that body. Nothing happened, however, till the year 1917 beyond persistent representations made by that Association to the Government. In the year 1917, for the first time, the Board of Agriculture in India interested themselves in the matter and passed a resolution that, in view of the vital importance to Indian agriculture of keeping the supply of phosphates at a price within the reach of the cultivator, the control over all the internal manurial resources should be retained by the Government. In 1919, the Board again considered the subject on the basis of a strong and ably-made-out case by Messrs. R. V. Norris, R. D. Anstead and H. C. Sampson for the total prohibition of export of some manures and for the levy of an export tax on certain others. This case was scrutinised by Professor Gilbert Slater, Professor of Indian Economics, Madras University, and Professor Stanley Jevons, Professor of Economics, Allahabad University, and received their support. The Board after careful consideration accepted the report of their Select Committee and suggested the imposition of an export tax on oil-seeds and oil-cakes, while in regard to bones and fish manure they held that the total prohibition of export was necessary. In 1922, the Board again considered the report of the Select Committee on the subject. Mr. H. A. F. Lindsay, C.B.E., I.C.S., then officiating Secretary to the Government

of India, Commerce Department, submitted an exhaustive note on the subject suggesting caution, but subscribed to the levy of a small export tax. The trend of the discussion in the Board was, however, in the direction whether an export tax or prohibition would cheapen the manures for the cultivator. Mr. C. G. Freke, B.A., I.C.S., then officiating Director-General of Commercial Intelligence in India, placed before the Board his considered views on the subject and in conclusion, suggested that if the real object was the cheapening of manures, then the case should be quite exceptionally strong before the imposition of export taxation was proposed. In the end, the Board was of the opinion that on the evidence before it, it was doubtful whether the method of prohibition or restriction of the export of indigenous manures would achieve the end desired. It was, however, of the opinion that the retention of indigenous manurial resources, especially of phosphates, was of vital importance to the country and that it was essential that a constructive policy should be framed, and the Board requested the Government of India to appoint a small committee of five members for examining the question and to suggest a constructive policy. In 1924, the Board of Agriculture again discussed the subject at its Bangalore meeting and reiterated its request made in 1922 to the Government of India in regard to the appointment of a committee. The Government of India did not, however, appoint the committee in view of an examination of the question by the Royal Commission on Indian Agriculture, which was expected to be appointed. The Royal Commission examined the subject and did not consider that either prohibition or a tax on the export of indigenous manures was necessary as, in their opinion, it would not be to the advantage of Indian agriculturists in general, and might easily have the exact opposite of the effect desired by the supporters of export restrictions. This view was accepted by the Government of India and they did not, therefore, proceed to make any enactment. Subsequently, the problem was debated in 1929, in the Legislative Assembly, and in the Council of State, but no measures were taken to restrict the export of indigenous manures. In 1929, the Imperial Council of Agricultural Research was constituted in accordance with the recommendation of the Royal Commission on Agriculture. This newly-constituted body was responsible for the assembling of the Board of Agriculture. In December 1929, the Governing Body of the Imperial Council of Agricultural Research appointed a Standing Fertilisers Sub-Committee in consonance with the 1924 resolution of the Board of Agriculture, and the instructions of the Government of India to consider the recommendation of the Royal Commission on Agriculture, and to formulate a scheme of investigation of the fertilizer problem in general, with special reference to the more extended use of indigenous manures in particular.

With this brief statement of the historical back ground behind the agitation on the export of manures, I shall proceed to state the case, in support of my proposition, which has become more difficult than before, in view of the weighty pronouncement by the Royal Commission on Agriculture.

THE PROBLEM

The problem for consideration may be put in the form of a brief statement which gives the totals of the exports and imports of the different manures, between the years 1919-20 and 1929-30, and their average prices per ton.

TABLE I

Consolidated statement showing exports from India.

Name of manure	Period	Quantity in tons.	Value in rupees	
			Total	Per ton.
Bone ...	1919-20 to 1929-30 (11 years)	1,010,655	10,42,68,000	...
	<i>Per annum</i>	<i>91,823</i>	<i>94,78,900</i>	
Fish manure and fish guano	1919-20 to 1928-29 (10 years)	130,522	2,16,22,000	...
	<i>Per annum</i>	<i>13,052</i>	<i>21,62,200</i>	
Oil-cakes ...	1919-20 to 1928-29 (10 years)	1,905,370	21,84,70,000	...
	<i>Per annum</i>	<i>190,537</i>	<i>2,18,47,000</i>	
Oil-seeds ...	1919-20 to 1928-29 (10 years)	9,337,643	2,74,23,32,782	...
	<i>Per annum</i>	<i>933,764</i>	<i>27,42,33,278</i>	

(The figures in italics show averages per year)

It is seen from the statement that India exports annually indigenous manures to the value of about thirty-one crores of rupees.

In regard to the imports of artificial fertilizers, it is not possible to prepare a consolidated statement and strike out an annual average as the imports grew steadily, and that too only within the last few years, as will be seen from the statement below :—

TABLE II

Imports of artificial fertilizers into India.

Year	Nitrate of Soda (tons.)	Sulphate of Ammonia (tons.)	Mineral and Super Phosphate (tons.)
1919-20 ...	1,780	10	1,983
1920-21 ...	203	46	3,927
1921-22 ...	130	5	275
1922-23 ...	1,442	306	3,989
1923-24 ...	1,945	76	4,272
1924-25 ...	3,977	203	8,437
1925-26 ...	3,963	4,724	12,991
1926-27 ...	6,070	2,684	12,591
1927-28 ...	7,458	3,915	18,676
1928-29 ...	8,840	17,893	25,743
1929-30 ...	11,722	24,819	30,867

The total value of these imports in 1929-30 was 86 lakhs of rupee. The price levels of the different artificial fertilizers in 1929-30 as obtain

on dividing the import value by the quantity imported, are approximately as below :—

Nitrate of Soda	...	Rs. 140 a ton.
Sulphate of Ammonia	„	145 „
Phosphates	...	„ 111 „

Briefly put, the position appears thus : India gains 31 crores of rupees annually by exporting her indigenous manures and the maximum amount that she paid in any year for her import of fertilizers is far less than a crore of rupees. Further, the export prices reveal that, unit for unit, India is selling her nitrogen and phosphoric acid at a higher rate than what she pays for the imported nitrogen and phosphoric acid. The balance of trade is thus entirely in favour of India and so the export of indigenous manures should be allowed to continue. Are we to accept this position and rest satisfied? That is the problem for consideration.

THE PROBLEM IS NOT SO SIMPLE AS IT LOOKS

Before accepting this position it is necessary that we should view the problem in its entirety and in the light of recent research work and world experience in the use of fertilizers. We should examine the problem from the point of view of crop-production, of national health and vitality, of the farmers' live stock and see if it will really pay India to export bone meal, oil-seeds, and cakes to foreign countries which are willing to pay high prices, and purchase artificials with the money so obtained. A careful consideration will show that it is suicidal to the country to export its indigenous manures, and that the balance of trade in favour of India is only apparent, and not real. To this end I shall place before you evidence based on scientific and general considerations.

VITAL IMPORTANCE OF ORGANIC MANURES AND INADEQUACY OF ARTIFICIALS FOR MAINTAINING SOIL FERTILITY

Our soils are, as a rule, deficient in organic matter, nitrogen and phosphoric acid and our experience and experiments go to show that phosphates are very often the limiting factors. My colleagues, Messrs. S. N. Venkataraman and M. Suryanarayana have, at the instance of the Imperial Council of Agricultural Research, made a careful survey of field experiments with indigenous and artificial manures. The main conclusions of their report which embodies the results of a quarter of a century of manurial experiments in this Presidency, are :—

(1) Organic matter, nitrogen and phosphoric acid are of importance in the order named.

(2) The most successful manures have been green manures in paddy lands, oil-cakes in sugar-cane lands, and cattle manure for all garden and dry crops.

(3) The value of artificials is only secondary as manures to our crops.

(4) The only artificial that has been consistently useful is super-phosphate, but unfortunately it is generally unable to act well alone and requires supplementing with organic or nitrogenous manures.

(5) The behaviour of nitrogenous artificials has not been very encouraging. In many cases there were bad residual effects as with nitrate of soda, and sulphate of ammonia.

(6) It is also doubtful whether we can maintain good yields for a long time with artificials alone. The increases due to nitrate of soda, take a downward course year after year. Even with other nitrogenous artificials, the indications are that the yields will go down by their continued use.

(7) The beneficial value of cakes is very pronounced in cane lands, and sometimes in paddy lands.

ORGANIC MANURES GIVE BETTER QUALITY 'SEED' AND MORE NUTRITIOUS GRAIN AND FODDER

Recent research work at Coimbatore and Coonoor has shown that manuring alters the quality of the seed. The seed material obtained from a plot manured with farmyard manure or oil-cakes gives a much better crop than that from the seed from a plot manured with artificial fertilizers or not manured at all. That is, the seed does not develop its full vital power of producing good plants and a good crop unless it is produced on a soil manured with organic manure. The significance of the finding is enormous. It means that, unless the soils are adequately supplied with organic manure, the seed produced for our future crops will deteriorate year after year and that our ryots raise poorer crops because of the inherent weakness of their seed. It also means that the good work which is being done by Botanists in crop-improvement will be undone by incorrect manuring. It does not end with this. The nutritive value of the crop also varies with manuring. The grain and fodder from a crop manured with cattle manure possessed better nutritive value than grain obtained from a crop manured with artificial fertilizers or not manured at all. There is evidence to show that oil-cakes and fish-manure can take the place of farmyard manure in regard to the reproductive quality of the seed and the nutritive value of the grain. It is thus clear that we cannot replace our indigenous organic manures by artificials. If we do so, we shall be reducing crop yields, we shall be deteriorating the inherent cropping capacity of our seed, with the result that our future crops will get worse and worse, and above all, we shall be producing for our people food lacking in nutrition, and this results in a devitalised population in the present and future generations of the country.

This is neither the time nor the place for submitting to you confirmatory evidence from the other parts of the world. I shall take another opportunity of doing so. For the present, I shall content myself by saying that our findings are confirmed elsewhere in India, in Europe and America. For the benefit of those who want a more detailed information, a list of references is appended to this paper.

It may be argued that if organic manures are so important for our soils we should make better use of our cattle manure and grow more green-manure crops. Assuming that every grain of cattle manure is used for purposes of manuring, the supply of cattle manure is not enough to meet the demand. We have only a twenty-fifth of the demand of the cattle manure for arable area. In regard to green manure it has many limitations and is not always possible to grow green manure.

THE BALANCE OF TRADE IN FAVOUR OF INDIA IS NOT REAL

It will be seen from the statement of exports and imports that, unit for unit, the nitrogen and phosphoric acid in artificial fertilizers are cheaper than those in the indigenous manures. This difference is not real. Anyone who has had experience of agriculture and field experiments, will readily admit that oil-cakes and bone meal possessed better residual values than either ammonium sulphate or superphosphate. This is clearly brought out by a quarter of a century of experimental work on the different experiment stations of the department. On a conservative estimate that the residual effects of oil-cakes and bone meal run only to the second year of their application, ammonium sulphate and superphosphate will have to be applied twice in a given number of years to get the same total effect of a single application of oil-cakes and bone meal. This very liberal estimate in favour of artificials vanishes, and if the export of indigenous manures is allowed to continue, and if artificials equivalent to the nitrogen and phosphoric acid sent out of the country are imported, the ryot who is in effect both the exporter and importer is actually losing money in the transaction in addition to the irreparable loss to his soils and to his cattle by way of exporting the indigenous manures. It is, therefore, clear that the balance of trade in indigenous manures and artificial fertilizers cannot be in favour of India.

THE EXPORT OF INDIGENOUS MANURES IS DETRIMENTAL TO OUR CATTLE

We have so far examined the problem in regard to the requirements of our soils, the quality and quantity of crop-yields. Let us now consider the case of cattle.

According to the report of the Royal Commission on Agriculture, there were 187 million cattle including buffaloes in all India. It is known to every agriculturist that proper feeding of cattle means the inclusion of a small quantity of oil-cake to the straw or fodder. Assuming that, on the average, one pound of oil-cake per animal per day is to be given, we would require roughly 8,500 tons of oil-cake a day or 31 million tons of oil-cake in a year. Cotton, in his hand-book on commercial information, has stated that a ton of groundnuts gives 14 cwts of cake and 6 cwts of oil. On this basis we shall require four and a half million tons of oil-seeds a year to feed our animals. The average annual production of edible and non-edible oil-seeds is 5 million tons. If we exclude from this the non-edible oil-seeds, we have barely enough oil-seeds to produce cake sufficient to meet even the minimum requirements of our cattle.

Oil-cakes are rich in protein and, therefore, constitute an excellent concentrated food for cattle. These are essential for the growth and maintenance of farm animals and we cannot think of substitutes for oil-cakes in this respect. By feeding oil-cakes to animals, not only are the animals improved in condition but also the dung voided by them possesses better manurial value. By retaining oil-seeds and oil-cakes in the country, the condition of the dairy and work animals will be improved, more and better quality manure will be obtained and consequently larger and better crops will be raised. The net result will be more milk and milk products for our children and better quality food for ourselves and our cattle. Are we not now missing all these by exporting away our oil-seeds and cakes?

THE VIEWS OF THE ROYAL COMMISSION ON AGRICULTURE

The Royal Commission on Agriculture in India were not in favour of imposing any restrictions on the export of indigenous manures although such action was acceptable to the Fiscal Commission and the Indian Taxation Enquiry Committee. The Commission did recognise the nitrogen and phosphate deficiency of our soils, the need for organic manures, the importance of oil-cakes, fish manure and bone meal for the agriculture of the country and yet they advocated non-interference with the export of indigenous manures in any form. They were not in favour of the levy of even a very small export tax. The chief arguments advanced by them in the case of bone meal were that

(1) only a very small portion of the bone manure manufactured in India is consumed in the country ;

(2) during War when freight space was difficult to obtain and the price of bone meal was low, not more than 10 per cent of the total production was consumed in India ; and

(3) any restrictions on export would deprive one of the poorest sections of the population of a source of income of which it stood badly in need.

Similar arguments were advanced for fish-manure also.

I venture to submit that these arguments are fallacious. It must be remembered that by the time the Great War broke out in 1914 the Agricultural Departments with their research and demonstration staffs were of recent creation. They were, therefore, in the early stages of experimenting and of educating the ryot in the use of bone meal, the price of which was already steadily increasing. Besides, superphosphate was already in the market and was enjoying in this country also the reputation of being the best of phosphatic manures. At that stage the situation created by the War and the consequent low price of bone meal offered no real advantage to the ryot. It is true that, during War the price of agricultural produce was high but on the other side, the cost of living had so increased that the financial position of the average ryot was no better than what it was before the War, as can be seen from the index numbers of prices in India taken from the *Economic Development of India* by Vera Anstey.

INDEX PRICES

...	1910-14	1915-19.
Commodities exported.	Rs.	Rs.
Food grains	111	136
Cotton	132	195
Commodities sold in local market.		
Grains and pulses	107	152
Raw sugar	107	140
Commodities imported.		
Cotton piece-goods	116	206
Woollen goods	105	243
Java sugar	102	176
Galvanized iron-sheeting	98	281
Group of thirty-nine articles	136	207

It will be seen from the statement that during the War period the ryot had to spend for his normal requirements more than what he obtained by the sale of his produce. The increase in the price of agricultural produce did not benefit him in the least. In addition to this, the fall in the export and price of bone meal was only temporary. Both the quantity of bone meal exported and the price fell till the year 1917 but afterwards the export and price levels of bone meal shot up rapidly. So that, if the consumption of bone meal did not appreciably increase either before or during the War, it was not the fault of the Indian cultivator. Circumstances were and are against him. He has learnt to appreciate the use of bone meal which has now a steady increasing demand. But unfortunately both of them are in a vicious circle. The ryot cannot make a larger use of bone meal unless its price is brought within his reach and the latter cannot be done because there is a large unrestricted export demand at a higher price.

I have not been able to persuade myself to accept the contention of the Royal Commission that any restriction on the export of bones and bone meal is objectionable on the ground that it would hit the poor class of people who collect bones. This is doubtful ; for the total prohibition of the export of bones may, but the levy of a small export tax should not, bring about a sudden paralysis of trade and hit the class of people that collect bones whose wages are almost stationary. Because of a small export duty on bone meal, animals do not stop dying and butchers do not cease slaughter. Under any circumstances the bones are there and will be collected by the class of people who usually collect them. Assuming that the levy of a small export tax would hit the bone collectors, the trouble can be averted by organising them on a co-operative basis and the export tax may be spent in the establishment of small bone-crushing mills in various centres and thus bring genuine bone meal within the reach of the ryot. I am unable to resist the feeling that these considerations should have weighed with the Royal Commission and prompted them to recommend the levy of a small export tax which will not be felt by anybody but which goes a long way in the development and extension of the use of bone meal in the country.

In regard to oil-seeds the Royal Commission recognised the advantages to Indian agriculture from a greatly extended use of oil-cakes but would refrain from imposing even an export duty. The chief arguments advanced were

(1) that India has no monopoly of world's oil-seeds and that an export tax would fall on the producer with the consequent reduction of area under oil-seeds ;

(2) that even if restriction of exports succeeded in reducing the price of oil-cakes, this would mean that a section of the agricultural community would be penalised for the benefit of another and much smaller section, for, the growers of oil-seeds would probably not be those who would make the most use of oil-cakes.

The Royal Commission have admitted that India does not hold a monopoly of the world's supplies of oil-seeds and it is an admitted fact that since the War, other countries such as East and West Africa, Indo-China, Madagascar, Morocco, America, Brazil and West Indies are becoming or are likely to become very serious competitors with the oil-seed trade of India. We may, therefore, visualise a time in the near future when our oil-seeds will not be in great demand. It is for these reasons that we must be on the

look-out and devise ways and means of utilising our oil-seeds to the extent we can. Already the tariffs of other countries are operating against us. Oil-seeds are admitted free to other countries while a tax is levied on oils and oil products. Freight on oil-seeds is lower while freight on oils is disproportionately high. At present we know only how to export oil-seeds. We are incapable of pressing oil-seeds, we do not know the ways and means of exporting oil in bulk, and we are buying back our oils in the form of vegetable ghee, soaps, paints, varnishes, etc. Unless we take steps to develop oil-seed crushing and the utilisation of oils, our oil-seed area will vanish slowly but steadily under stress of competition from outside. It is, therefore, necessary that we should levy a small export tax on oil-seeds and oil-cakes and utilise that money in research and in teaching people in the utilisation of our oils and oil-seed products. As the Royal Commission fear, the producer of oil-seeds will not be appreciably hit. If, as a consequence of the levy of export tax in our honest attempts to improve our oil-seed industry, the foreign buyers refuse to buy our oil-seeds we can insist on those countries, from whom we now buy soaps, candles, margarine, vegetable ghee, paints and varnishes, on buying our oil-seeds or in the alternative, tax these imports and utilise that money in the development of the oil-seed industry.

I am constrained to say that the view of the Royal Commission that, as the result of restriction of exports, the oil-seed growing ryot would be penalised to the benefit of the other, is a narrow one. The oil-seed grower cannot live on oil-seeds alone. He must have other things. If he is directly hit he is benefited indirectly through food grains, cotton goods, sugar and milk products which are produced with the aid of the cake supplied by him.

CONCLUSION

I have shown how the indigenous manures that we are now exporting are of supreme importance to our agriculture from the point of view of yields, from the point of view of plant, human and animal nutrition. I have shown you that the balance of trade in manures in favour of India is not real, and that artificial fertilizers alone are not adequate to maintain the fertility of our soils. I have also discussed the views of the Royal Commission on Agriculture in regard to restrictions on the export of indigenous fertilizers.

In conclusion, I would commend for your consideration the proposition that the export of indigenous manures is not conducive to the interests of the country.

MR. WOOTTON'S SPEECH

MR. PRESIDENT, LADIES AND GENTLEMEN,

First of all, I wish to express my sincere thanks to the Secretary and members of the Madras Agricultural Students' Union for honouring me by inviting me to lead the opposition in this debate. I count it a great honour that I should have to oppose our distinguished Agricultural Chemist, Rao Bahadur Viswanath and I can assure you that I feel very much like the biblical character David, when he opposed the giant Goliath. Nevertheless, although I have not selected stones as my weapons, I have decided to use two very potent weapons namely *Common Sense* and *Facts*.

Now, this evening we are debating as to whether or not it is in the interest of India to export her indigenous fertilizers, and in opposing the resolution, I wish to make a very surprising statement. I wish to affirm that, in Europe and America, bones and oil-seeds are not regarded as potential fertilizers and it is only in the East that these valuable products are utilized as manures which latter, I would impress upon you, is little short of economic sin.

Turning to the *facts* of the case, I must state that the groundnut-seed is considered to be of considerable value, due to its oil and albuminoid contents. I am considering this seed as it is the one which is exported on the greatest scale from India. The oil is a valuable contributor to the soap industry and, in addition, it is used, particularly in America as an article of food under the name 'Pea Nut Butter'. Indeed, the seeds themselves are consumed as food on a considerable scale in America and Europe. After the removal of most of the oil, the residual cake finds a ready demand for the feeding of cattle for which purpose it is eminently suited. The oil-cake may be used for manure if it has turned rancid or if it has been adulterated with the poisonous castor seed.

As you know, Bones consist of tri-calcium-phosphate, calcium carbonate, fat and collagen or 'ossein', of which constituents the last two are of the highest importance. The first treatment to which bones are subjected in industry, is that of degreasing which is either done by the simple process of boiling out with water or by the more expensive and efficient extraction with benzine. When treated by the latter process, bones may yield from 5 per cent to 15 per cent of fat depending upon the quality and type of bone used. The clean fat which is obtained from selected bones by the boiling-out process is used in the manufacture of margarine and the fat obtained by the benzine process is mainly used in the manufacture of soap.

The degreased bones may now be treated in two main operations. They may be converted by the use of high-pressure steam and boiling water into glue and the residual degelatinized bones, or the degreased bones may be treated with hydrochloric acid for the purpose of removing the calcium salts, leaving behind the 'Ossein' and a solution of phosphoric acid. The ossein is next treated with lime and then finally boiled out with water to produce gelatine and the solution of phosphoric acid and hydrochloric acid is treated with lime with the formation of precipitated tri-calcium-phosphate.

The uses of glue are manifold; glue finds application in the match trade, the furniture trade, the linoleum trade, the paper trade as well as in the domestic household. In modern times, a further application has been introduced which depends upon the formation of a condensation product with formaldehyde.

Gelatine is, of course, a well-known article of food in the form of jellies or confectionery and in addition, it is used in the manufacture of photographic plates and films, and also in the printing trade.

Precipitated phosphate is used in the manufacture of tooth-paste and is also used as a fertilizer and feeding stuff.

The residual product from the manufacture of glue, namely degelatinized or steamed bone is ground up into bone flour or bone meal and

although a quantity of bone flour is used for manure, the current tendency is to subject it to a special sterilization process so that it may be used for cattle feeding. The residue from the manufacture of gelatine is used as manure in combination with chemical fertilizers. Furthermore, the treatment of steamed bones with sulphuric acid is occasionally resorted to in the manufacture of vitriolized bones or dissolved bones.

In connection with the products mentioned, it is interesting to note that the main products, namely glue, fat and gelatine, command a very satisfactory price in normal times. I regret that I have no details of the current prices, but I recall that the values during the years 1922-26 were approximately as follows:—

Fat	...	£35	Yield 5-15 per cent.
Glue	...	£30	Yield 25-30 per cent of degreased bone.
Gelatine	...	£60-80	Yield 20-25 per cent of degreased bone.
Feeding bone flour.	£13-14		
Bone meal manure	£ 8		
Precipitated phosphate...	£14		

and I think you will agree that these valuable products should be exploited and put into the service of man.

After drawing your attention to the numerous valuable products available in bones, I think we should consider whether India is justified in prohibiting the export of these materials when it is realized that it is quite impossible to subject bones to the various processes on the plains of India with any degree of success, except perhaps by the use of very elaborate and expensive plant, including refrigerators, dehydrators, etc. The use of such plant would not enable Indian manufacturers to meet competition. If, on the other hand, bones were transported to the mountains for treatment of a similar nature, again the enterprise would be unremunerative owing to freight charges on the raw material and to the atmospheric variations of the hill climates.

As regards the treatment of oil-seeds, the normal method of expressing the oil from seeds is by the use of the country or *chekku* press. Unfortunately this method readily leads to adulteration with sand, to improve the yield of oil and, more important still, the adulteration with castor seed. The castor seed is not, in most cases, wilfully added to the groundnut-seeds but its presence is often due to carelessness in sorting the seeds. The most modern plant in use in India is the 'Expeller Press' which produces a very much higher yield of oil of a high grade quality but as coconut oil is so plentiful, the market value of groundnut oil is often so low as to make its production unremunerative. At present, there is no method available by which the oil can be preserved for shipment to Europe and the result is that the European demand is very small owing to the danger of rancidity. Hence European manufacturers prefer to purchase the seeds in India, and elsewhere, and submit them to the expressing process in Europe. They are therefore in a position to remove any castor seeds which may be present and to produce a pure oil-cake which they can guarantee will be fit for feeding to cattle. This being the case, the market value of oil-seeds is fixed by the exporters so that the indigenous mills are

unable to buy seeds at a price which will allow them a margin of profit, except, of course, on a very small scale.

Turning to the question of indigenous manures, it should be remembered that there are phosphatic deposits in the Trichinopoly district which will go a very long way to meet the present small demand and, in addition fish-manure is available, not to mention the organic nitrogenous *poonac* manufactured from Castor, Rape, *Marotti*, *Mowra* and *Hoongay* seeds. Also there is a large potential supply of green manure and further, an inexhaustible supply of valuable manure in the form of 'ordure' or night-soil, which latter product has not found, as yet, the general application which it deserves and indeed, which it receives in other countries. The use of cattle manure as fuel is still an evil which exists on a large scale and one which deprives the land of its natural plant-food.

I have now mentioned a few facts of the case and therefore I propose to take up the weapon of *common sense* in the hope that the dual combination will remove all doubts from your minds. As I am in the presence of professors, lecturers, scientists and students of agriculture, I know full well that this important factor, common sense, is one which you all possess to a very great degree, otherwise you would not be members of this institution, so that I feel that my appeal will be appreciated to the fullest extent.

Rao Bahadur Viswanath has drawn your attention to the fact that the export of so-called Indigenous Fertilizers has repeatedly received the attention of Government through the action of agricultural bodies but you will recall that on every occasion, Government has definitely concluded that it would be of no advantage to India to levy an export tax.

We know that this important decision was not reached until the matter had been thoroughly thrashed out by making use of the best brains of the country through the scientists, agriculturalists, economists and businessmen so surely this signifies, once and for all that our motion this evening is neither reasonable nor economical.

The whole question revolves round the ancient economic law of supply and demand against which it is futile to act or to legislate. So long as the local demand for an article is poor and the exterior demand is great, that article must be exported to the highest bidder. In normal times, Europe and America have not sufficient bones and oil-cakes to meet their demands; hence they are prepared to bid high prices for these raw materials. India therefore benefits by the higher prices given for her products and is in a position to import those commodities which are not available in this country. The purchasing power of India, both internally and internationally is raised and the result is a higher degree of prosperity than could otherwise be expected. The agriculturist is able to obtain good prices for his oil-seeds and is therefore able to manure his land with those imported manures such as superphosphate, sulphate of ammonia, nitrate of soda etc., together with the necessary organic manure which is available in abundance. The collector of bones looks round for the best market and owing to external demands, the best price is offered by exporting firms. The local manure works have but a limited demand and cannot outbid the foreign consumer. In the case of the local oil mills, the proprietor is unable to find a ready market for his cakes and oil and accordingly he is unable to pay top prices for the seeds, with the result that the exporting firms take the bulk of

the crop. We see therefore that both the bone collector and the ryot are benefited by the external demand for their produce. The additional money thus earned goes into circulation via the bazaar, and in turn, the whole community is benefited by enjoying a higher standard of living and by being in a position to obtain better food and education. It is in this manner that the welfare of a country is built up and what is more, the welfare of the world is encouraged, for, after all, each country in the world plays its important part in the great world machine and this huge machine cannot function smoothly unless all reciprocating parts are in sound working order.

It is important to view this subject from the point of view of the agriculturist. He is the man who raises the crops and farms his cattle. If there is a restricted demand for manure, including bones and oil-cakes, it is only reasonable to expect that manure merchants cannot merchant their fertilizers at prices which will compete, unit for unit and efficacy for efficacy, with imported chemical manures. The ryot therefore buys his manure from imported supplies and augments it with organic matter. By this means he is able to reduce his working costs and to increase his production; so again, we have an increased measure of security and contentment.

Let us consider for one moment what would happen if the export of bones and oil-seeds were to cease. Such a position would be comparable with conditions which exist to-day due to the world slump. The exports of bones and oil-seeds are very small indeed, crops are not paying and the price of bones has fallen to about half the price which was realized twelve months ago. The same remarks apply to oil-seeds, notably groundnut-seeds. Can we say that conditions are better now that we have ample supplies of both commodities upon which we can draw to support our crops? Indeed, no! The position is that bones are falling in value each day and there is practically no demand. The current price is Rs. 40 per ton compared with Rs. 65 per ton last year. Large stocks of bone meal and poonac meal are accumulating and in spite of the greatly reduced prices of these products, the ryots are not buying. Steamed bone meal is now priced at Rs. 80 per ton whereas the price last year was Rs. 105 in Coimbatore. If this restricted export should become a permanency, either due to an export tax or to political action, oil-seeds and bones would become valueless, and no efforts would be made to collect them, resulting in poverty both of individuals and of the land.

In forming our opinion on the subject of this evening's debate, we must not look at the matter entirely from an agricultural point of view but we must take a broad outlook of the whole factors which are involved.

Let us therefore put aside all selfish aims and idealistic sentiments, and let us not allow patriotism to give too great a bias to our opinions. If we do this, I am quite sure that we shall oppose this evening's motion in an effective manner.

You all appreciate that facts are absolutely concrete and that common sense is the most powerful asset with which a man is endowed. It is for these reasons, therefore, that I feel sure you will give me your unanimous support. We all know that figures are very misleading when in the hands of an enthusiast. They can be distorted to such an extent that they are literally untrue, and on an occasion of this nature we seek the truth as much as at any other time in our daily life.

In conclusion I would like to thank you all for the kind attention which you have given to me. I cannot, however, resume my seat without expressing the pleasure which I feel in renewing my friendship with our worthy president, Rao Bahadur Ramaswamy Sivan.

DISCUSSION

Dr. J. S. Patel asked why we should not export oil-seeds when we are not sufficiently advanced in our oil industries to utilize all our produce; and as regards the deficiency of organic matter in our soils he was of opinion that more green manure should be grown so as to meet our requirements.

Mr. S. R. Srinivasa Ayyangar remarked that the relative manurial value of indigenous manures compared with ammonium sulphate as the standard, will mislead one. Because, indigenous manures like oil-cakes have a beneficial effect on the soil and on the succeeding crops which cannot be said of all imported chemical fertilizers. There is also the danger of these fertilizers being leached out, as they are readily soluble in water and serve for a short period only. Secondly, the unit basis of assessing manurial value will also mislead one. For example, cattle manure which contains 0.6 per cent nitrogen and costs Rupees 5 per ton will have on unit basis a value of Rs. 8 for its nitrogen, while on a similar computation, groundnut-cake nitrogen will cost only Rs. 6-8-0. It will appear therefore that the oil-cake is cheaper than cattle manure which you all know is not the case. The same kind of fallacy will appear, when chemical fertilizers are compared with indigenous manures. Fertilizers like ammonium sulphate contain nothing but one kind of plant-food, while oil-cakes contain phosphatic ingredients and organic matter, other essentials for plant growth. If you assess values for all that, one pound of nitrogen in groundnut-cake will cost less than 8 annas, almost the same as that of the ammonium sulphate.

Mr. D. G. Munro referring to the historical agitation for prohibition of export, and to the activities of U.P.A.S.I. in this connection, said that artificial fertilizers were in those days very expensive: besides, their proper use was not known. Recent researches on coffee in Mysore have shown that artificials can be used with advantage and our knowledge about their proper use has also increased.

He also pointed out that the supply of bone meal in this country is very limited, and as regards the other manures, the amount of fish guano was greater in 1920 than it is to-day. This was because the Agricultural Department pushed on sales of this commodity with the result that in five years there was not enough, and a fish guano substitute had to be requisitioned.

As regards oil-seeds, they cannot be looked upon purely as manures. If India can utilize all the oil and start industries, it is all right. But why should we stop export of surplus? There is danger in so doing of cutting the grower and robbing him of his labour's gains.

With reference to the imposition of an export tax, he wanted to remind the audience of a parallel, when by such imposition, the hide industry in this country was paralysed. The point is, that other countries compete for oil, and in this competition India's oil market will suffer and the ultimate result is the poor man will have to be taxed.

If the main difficulty is organic matter deficiency and the insufficiency of supply of farm-yard manure, we must prevent waste by stopping the burning of cowdung as fuel, and increase our organic manure by composts.

(At this stage the speaker Rao Bahadur M. R. Ramaswami Sivan had to leave the meeting on unavoidable, urgent business and his place was taken by Mr. R. C. Broadfoot, President of the Union. Before he left the speaker made the following remarks:—

From the interesting speeches and discussions, you will see that the problem is capable of being looked at from a number of aspects. Mr. Visvanath's speech showed that the balance of trade in these manures, in favour of India, was only apparent, while Mr. Wootton argued why we should not export our oilseeds and fish products at a higher price, and by cheaper manures for our requirements at our door. There is evidently something valuable about our fish, otherwise, why should Japan, an island surrounded on all sides by a vast ocean, leave us in the field, without being a serious rival.

I am sorry to leave at an interesting stage of the debate, but shall eagerly await the report and the results of voting to-day).

Mr. S. N. Venkataraman observed that apart from and beyond common sense, the question should be thrashed out from the point of view of political economy as well. Oil-cakes should be regarded not merely as feeding stuffs. They are potential fertilizers as well. Experimental data have furnished conclusive evidence about the supreme importance of organic matter and its superiority over artificials. In fact, this superiority has been of increasing value with successive years of application, and this point should guide us chiefly in judging this question. We are arguing in a vicious circle by insisting on common sense and export of surplus, because there is no oil industry at home. Only if you stop this export there will be stimulus for starting industry, and that is good for the future of the country.

Mr. T. V. Rajagopalachariar was of opinion that there was no disagreement about the necessity for conserving all our organic matter resources. According to him, the burning of cow-dung for fuel was a myth grossly exaggerated, and, as a practice, was not prevalent very much in Madras. The point was that we are not wasting but that our supply is not enough. Twenty million cattle in the presidency will give enough manure to make a seven-to-eight cart load dose per acre. The deficit has to be made up. It is not sound argument to say 'grow green manures, to make up this deficit' for, the raising of green manure crops is beset with difficulties and limitations and is not possible everywhere. Mr. Wootton raised the point that we are considering the question only from the agriculturist's point of view and not from any other. What other view can we take when 87 per cent of our population are agriculturists or dependent on agriculture. There is need, therefore, to conserve all organic matter possible and need for opening up industrial avenues and we must adopt means to stop export.

Rao Bahadur T. S. Venkatraman stated that common sense very often depends on the angle of vision. Facts also can be manipulated, and as an instance, he cited the fact that after an earthquake, timber is cheap. But is this fact a curse or blessing? History and evidence show that organic matter is essential, and we must use all the organic material in the country. The Imperial Council of Agricultural Research has paid attention to this problem by instituting an enquiry into the effect of manures and if the findings of that enquiry tell us anything, we must have prohibition to develop our agriculture and industries. In Japan and Madagascar a great deal of attention is paid to the conservation of organic matter. Life in Japan is indeed costly but that does not matter, for all the money is within the country.

MOVER'S REPLY

I agree with Mr. Wootton that bone meal etc., are not to be called essentially as fertilizers, but I used the common term, under which these go by and are understood by all. Mr. T. V. Rajagopalachariar has already answered Mr. C. E. Wootton's point that we have to treat the subject mainly as agriculturists for in a country with 80 per cent of population engaged in Agriculture no other view point is possible.

As regards burning of cow-dung, I can only say that it is also a matter of common sense and ryots are forced to this custom as a matter of necessity. The Deltaic and the Ceded districts are absolutely treeless tracts and the only fuel available is cow-dung.

With reference to the difficulties of starting oil manufacture in our country mentioned by Mr. C. E. Wootton, we must view this aspect on wider and more economic considerations. Other countries are taking interest in the production of oil-seeds and we must give an answer, only by accumulating our resources and placing them on a sounder basis. That is why I suggested a small tax with a view to collect enough revenue. Dr. J. S. Patel mentioned that we need not worry about organic manure as long as we are able to apply green manure and that therefore other produce like oil-seeds can be exported with profits. But we have not enough green manure and the growing of suitable green manure, for incorporation into soil is attended with great difficulties.

Mr. D. G. Munro said that the prices of artificials have gone down of late and that I am arguing on previous years' figures. But this will not alter the situation, as I am taking into account not the mere cost but the analysis, the experience, and also the residual effects. He also cited the failure of the hide industry on account of the imposition of an export tax. Mine is not a parallel, for my tax is very small and as he said the poor oil-seed producer will not be affected, for my tax will accumulate funds which will be spent on oil-seeds' research and thus benefit him. In the proceedings of the Board of Agriculture of 1922, Mr. Wood quoted the instance that Japan some years ago prohibited the export of rock phosphates.

The cattle manure available in our country is only 1/25th of the demand; organic composts are not yet evolved fully. We have, therefore, to conserve every bit of indigenous manure in our country. Considering the residual effect, therefore, I hold that export should be done only after meeting our demands. Consider also our irrigation projects, and the effect of applying fertilizers to these areas and take a long-range view of the results before you give your opinion.

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THE PLACE OF SCIENCE IN THE DEVELOPMENT OF MYSORE AGRICULTURE¹

By LESLIE C. COLEMAN, C.I.E., M.A., Ph.D.

Director of Agriculture in Mysore

I need hardly point out to you that Mysore is essentially an agricultural country and that, as far as we can now see, it is likely to remain so. I need perhaps also hardly remind you that nearly one-half of the State's revenue is derived directly from the agriculturist and that of the rest a very considerable proportion is derived either from the owners or tenants of land or from the labourers on it. If, therefore, this State is to take that place in the future Commonwealth of India which we believe she should occupy, it must be very largely through the development of this great industry. The steady progress of Mysore must be based on the increasing prosperity of her ryot population. To hope for a prosperous and enlightened Mysore, with, at the same time, a poverty-stricken ryot population would be absurd.

The Problems of Mysore.—While there are other parts of India which may be destined, in the future, to remain as essentially agricultural as Mysore, there are, I believe, few if any, other parts where the problems facing the agricultural investigator are so varied and where, through the

¹ Summary of the Sri Krishnarajendra Silver Jubilee Lecture 1931.

compactness of the area and the natural intelligence of the agricultural population, the conditions are so favourable for testing and introducing improvements resulting from scientific investigation. Let us consider the variety and complexity of the problems. These are conditioned primarily by the great variety of climate and soil. It is true we have not that marked variation in temperature which gives the agriculture of North India two marked crop-seasons in which tropical crops regularly alternate with those of the temperate zone. We have, however, a variation in rainfall both as regards amount and distribution which would be hard to duplicate in an area of similar size anywhere outside Mysore. We have in the western part of the State a rainfall going up to three hundred inches per annum while in certain of our eastern taluks it sinks below 20 inches per annum. There are areas of the State where the main sowing season for dry crops is the month of May, while in others less than twenty miles away, it is July or August. In fact there are areas such as those in Chitaldrug District where a range of hills in places less than five miles wide almost entirely changes the character of crops and the time of sowing on its two sides. The character of our soil varies not only over wide areas but also within short distances almost as greatly as does our climate.

All of this has brought about a very striking complexity of crop species and varieties and also of agricultural methods to suit more or less exactly these variations. This can be illustrated by the striking variations in our main food crop—*ragi*¹—which covers an area of approximately 2½ million acres in this State. In the *malnad* to the extreme west *ragi* is a crop of insignificant importance but evidence is not lacking that in the past it has occupied a much more important area than it has occupied, for there are many signs of former cultivation in the higher land above the area gardens and paddy fields which are the characteristic feature of our northern *malnad*, and undoubtedly a very much larger amount of food grains must have been grown in that area in those days to feed the much greater population that inhabited the *malnad*. There is also experimental evidence that as good crops of *ragi* can be grown in this region as in many other parts of Mysore.

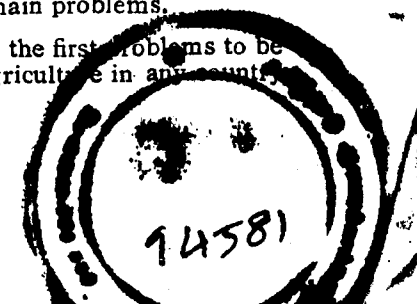
What applies to *ragi* applies to many other dry crops in the State. It applies to a lesser extent to our main irrigated crop, paddy, but here irrigation comes and naturally disturbs the play of climatic conditions.

To indicate the extent of soil variation in Mysore I need only point out to you that Dr. Narasimha Iyengar in his soil survey of the Irwin Canal area which he is now bringing to completion, has found it necessary to take soil borings on an average for every 15 to 20 acres of the 120,000 acres surveyed, in order to get a reliable picture of the soil conditions in the area. I doubt if such an intensive soil survey has ever before been made of any corresponding area.

I have used these illustrations to enable you to gain some small conception of the complexity of the problems which face the scientific workers of the future in this State. I shall now turn for a few minutes to a very general and imperfect survey of some of our main problems.

Improvement of crops and supply of seed.—One of the first problems to be tackled in connection with the improvement of agriculture in any country

¹ *Eleusine coracana*



must be the supply of seed of the best and highest yielding strains of the important economic plants grown. This is especially important in Mysore for there is no other agricultural improvement which can be introduced at so little cost to the cultivator. The seed required for one acre of *ragi* costs at present prices about 8 annas which is a very small part of the total cost of cultivation. I shall not go into the question of the technique used in the production of new varieties but shall simply point out that in a field of *ragi* as ordinarily grown by a ryot there are a large number of strains differing greatly in vigour, in yielding capacity, in the time required for coming to maturity, and in such other important points as freedom from grain shedding, amount and strength of straw, and resistance to disease. It is the work of the Botanist to select from this rather bewildering mass not in one field only, but in fields covering large areas those plants which he considers will combine the greatest number of desirable qualities placing yield at the front. It must be obvious that even this work can hardly have finality, for the selection of the very best plants from two million odd acres is a task upon which work can well continue almost indefinitely. Even were we confident that the very best strains now available had been found, we should have to have different strains suited to our different climatic and soil areas, which means the final selection not of one strain but of possibly a dozen. More than this we should almost certainly find that no one strain approached the ideal in all respects and that it would be only through the combination of the qualities of several different strains that the ideal could be approximated. This introduces the fascinating but complicated work of hybridization.

In this connection it is of great importance to have a very comprehensive collection of all the different varieties at present existing, to use as possible foundation stock, for these old varieties which have been grown probably for thousands of years have frequently qualities of hardiness and resistance to disease, which are in great danger of being lost in the process of increasing yield or quality. This has been only too frequently the result of breeding work in western countries and there is now a marked insistence on the necessity of retaining the old varieties on experiment stations so that they can at any time be used as foundation stock for future breeding. It may interest you to know that we have in the Hebbal farm a collection of no less than 300 varieties and strains of *ragi* representing not only the different climatic areas of Mysore but also regions in British India where *ragi* is being grown.

But *ragi* is only one crop. As a matter of fact there are listed in the Mysore *Season and Crop Report* no less than 36 important crops grown in Mysore State and these represent only a small part of the total. Of these we have been able to deal even in a preliminary manner, with less than ten crops and in the case of only five have we reached the stage of being able to give out seed for general growth or for preliminary testing by ryots of Mysore. I may point out that the results so far obtained have come almost entirely from the labours of two men, Dr. V. K. Badami and Mr. V. N. Ranganatha Rao. When I tell you that from five to seven years is looked upon as the shortest time required to bring a new selection of an annual crop to the stage for distribution and in the case of a perennial crop such as coffee this period must be multiplied by three or four, you will be able to understand something of the immense amount of careful scientific labour involved.

Other means of improving yields.—The production of new high yielding strains of economic plants while immensely important, cannot lead us very far in agricultural development if we stop here. As a matter of fact it has been estimated in Europe that this method of crop improvement has been responsible on an average for an increase in yield of about 10 per cent; although of course increases in individual cases have been much higher than this. The increases that have been registered in ryots' fields from our work in Mysore have varied between 10 and 25 per cent.

It must be obvious in a country such as Mysore, standing as it does on one of the oldest geological formations in the world and where conditions do not now allow and have not in the past probably for many centuries, allowed for enrichment through the deposit of silt except in restricted areas under canals and tanks, the soil must have reached an equilibrium such that about the same amount of plant-food material can be taken away in the crop as is added to the land in the form of manure. If therefore we introduce new strains which can feed more efficiently on the soil than those we are replacing, it stands to reason that there must be a gradual, if perhaps at first imperceptible, lowering of soil fertility unless we increase the amount of manure applied to the soil. The tendency of high yielding strains to exhaust the soil has already become apparent to the ryots in the Cauvery Channel area where a high yielding strain of paddy developed by the Madras Department of Agriculture has largely replaced local varieties. It is the general view of growers that this new variety, although it gives higher yields, also demands more manure.

Need for Co-operation.—From this it will be seen that work on the manurial requirements of Mysore soils must go hand in hand with work on the improvement of our crops through breeding. In other words the chemist and the trained agriculturist must work in close co-operation with the botanist. I have already pointed out the very marked diversity of Mysore soils and so the work required in connection with them and their manurial requirements is enormous. Then we have the special manurial requirements of the different economic plants grown in various parts not only as to quality but also as to quantity. Up to the present these investigations have been confined to only seven of our important crops.

The use of Fertilizers.—In regard to the manuring of even these comparatively few crops our knowledge is far from complete. It is true we do know to which particular plant-foods they react by increased yield and we are even able to advise in a general way on amounts and proportions of plant-foods which will under average conditions give a profitable return on the money invested. In most cases, however, we cannot say definitely what is the maximum amount of plant-food in the form of manure which can be profitably applied. An immense amount of experimental work in this direction is still required even on the few crops we have under experiment.

It seems certain that if we are to increase our production to anything like the standard of western countries we shall have to take much more largely to the use of artificial fertilizers and more especially nitrogenous and phosphatic ones. Our soils are in general very poor in the two important plant-foods, nitrogen and phosphates. Our local supplies are entirely inadequate and even then are decidedly more expensive, per unit of available plant-food, than the artificial fertilizers now available. No one, I think, seriously looks upon the so-called chemical fertilizers as more than

supplementary to the supplies of manures available to the ryots but there seems no doubt whatever that in this regard they can and should play a role of immense importance. There is evidence that as far as food-grains are concerned, samples from fields manured by the so-called natural fertilizers such as cattle manure do contain more of the essential vitamins than those from fields manured solely with artificials. Even if we accept the work already done by Mr. Viswanath of the Madras Agricultural Department in co-operation with Col. McCarrison as conclusive on this point, it may be pointed out that there are a very large number of our commercial crops in which vitamin content cannot come into the picture at all. This is the case with sugarcane, one of the crops on which fertilizers can be used with the greatest profit. I believe I am safe in saying that the final product from sugarcane whether it be jaggery or sugarcandy, hardly contain any vitamins. The same applies to such valuable crops as coffee, arecanut, and tobacco where the produce after preparation for consumption or in the form in which they are consumed, cannot provide to man any of the vitamins we now recognize as so necessary for growth and health. I could name many other important agricultural products which come under the same category but those I have mentioned should, I think, suffice. It seems to me necessary to emphasize the importance of realizing that in any consideration of the use of fertilizers in this country in the future, the needs of Indian agriculture should be considered as of paramount importance, and that merely political considerations should be carefully excluded.

If, as I anticipate, artificial fertilizers should increase greatly in importance in Mysore during the next quarter century the necessity for most careful scientific investigation in connection with their use must, I think, be obvious. Whereas in the case of such natural manures as cattle manure and green manures, the manure is obtained at small cost to the ryot and it is practically impossible to injure the crop or the soil by any application that is at all generally possible under existing conditions; in the case of artificial manures very much more care must be exercised. We must know which of a number of different manures will give the best results and what particular amount of application will give the highest economic return. As many of these artificial fertilizers are made available to the plant almost immediately after application, the stage of the plant's growth at which they can most profitably be applied is another question of great importance. In all these directions, our present knowledge is extremely meagre.

Soil moisture.—As far as our dry crops are concerned, the plant-foods in the soil are frequently not the limiting factor in crop production. Production is limited very largely by soil moisture which again depends upon the rainfall. Obviously drought resistance must be a most important character in our improved varieties. Recent work in the United States and Canada goes to show that the chemist can assist the plant-breeder greatly in connection with the elucidation of the characteristics upon which drought resistance depends. This question which has hardly been touched upon in India is a fascinating and important one for future study. The effect of manurial treatment on the moisture-holding capacity of soils and on the ability of plants to increase their root systems so as to utilize the soil moisture more efficiently, is another important question where the Chemist, the Physicist and the Physiological Botanist must join hands.

Problems of Cultivation.—We cannot turn from a consideration of soil problems without reference to the very important problems of cultivation. As you may be aware, our most important cultivating implement is the plough. The wooden plough which has been used in this country for many centuries has, it is true, the virtue of cheapness but it is anything but an efficient implement. Dozens of different types of plough have been imported into India but only a comparatively few have proved at all suitable for Indian conditions. Even among these there is, I venture to state, not a single one which is much more than an approximation to what is required. Probably the soils of Mysore place as large and as varied a demand on a plough as any in India, and we have, I believe, in this State, a larger number of improved ploughs *per capita* than in any other part of this great country. The question of materials to be used for efficiency and wear is as important as the question of design and in both directions there is an immense amount of scientific work to be done. It may interest you to learn that the Department of Industries and Commerce and the Department of Agriculture are working in close co-operation on this problem at present. I may say however, that young engineers and metallurgical chemists, if there are any of the latter in the University, need not fear that we shall have exhausted all the possibilities of improvement in this direction by the time they are ready to start their life's work. In any case I may point out to them that the plough is only one of many agricultural implements and I believe agricultural development will, in the future, demand changes both in design and materials in many, if not most, of these implements.

Insect Pests.—If we turn to the question of insect pests we have an equally large field. As in the case of plant diseases our ordinary field crops usually allow for only the cheapest methods of control. This, in turn, demands a most thorough investigation of the insects concerned from the biological and physiological standpoint, otherwise it will be impossible to decide upon the effective method and the effective time of application. The name of Dr. K. Kunhi Kannan whose recent death has been a very serious loss to the agriculture of this State will, I believe, find enduring association with entomological investigations in this State more especially with reference to the devising of methods of insect-control adapted to our conditions. Dr. Kunhi Kannan displayed a real genius and his is a shining example for the entomologist of the future. One of the last problems on which Dr. Kunhi Kannan was engaged was the utilisation of some of the many local fish poisons derived from wild plants in the control of injurious insects. Although we already know that some of these fish poisons furnish very efficient insecticides and that they are present in great abundance in our forests, a very great deal of work remains to be done on such important questions as the particular part or parts of these plants which will yield the effective poison in the greatest quantity, and the most efficient as well as the cheapest method of extraction. I may point out in this connection that an immense amount of work in this direction is at present being carried out by scientists in America.

The future of Agricultural Research.—I have touched upon only a very few of the multitude of scientific problems, that lie before us in connection with the development of agriculture through scientific investigation. If I have not failed utterly in my task, this short review must have impressed you with the fact that a very large number of scientific workers could be

engaged on these problems to the profit of Mysore agriculture. I am not a prophet and am not able to predict what will happen during the next ten years in this State. I think, however, it is safe to say that we shall not have workers at all comparable in numbers and ability to the importance of the problems which face us. This is a rather depressing thought but life has always seemed to me a struggle with almost impossible odds and still we keep struggling. There seems to be one ray of sunshine in the gloom and that is the possibility of mobilizing larger forces than are at present available. These forces need not be confined to the pitifully meagre army of men in the Agricultural Department. 'I can see no reason why the University should not play a noble part in this work. It may interest some of you to know that a beginning in this direction has already been made and that I hope we shall soon see the Scientific departments of the University through the staff and, also I hope, through graduate students, in steadily increasing numbers actively co-operating in the investigation of important scientific problems connected with agriculture. To the young men of this audience let me say that if you have not yet tasted the joys of adding to the world's sum of scientific knowledge, if you have not yet been thrilled by the thought that you have wrung from the heart of Nature some small secret which no one has heretofore known, you have something of great value to anticipate. To me a small contribution to knowledge upon which can be based a definite advance in the development of agriculture would be a more satisfying monument than any of gold or bronze or stone that has ever been erected.—*The Hindu*.

BRIEF NOTES ON SOME INDIGENOUS OILS

The following brief notes kindly supplied by the Superintendent, Kerala Soap Institute, Calicut, to the Principal, Agricultural College, who forwarded same to us for publication will be read with great interest. (Ed. M.A.J.)

No.	Name of Oil	Botanical Name	Percentage of oil contents	Uses	Tracts where found
1	Cloves oil.	<i>Eugenia carophyllata</i>	14 to 21% of the dried buds.	Medicine and Perfumery.	In the foothills of the Western Ghats.
2	Mowrah oil.	<i>Bassia longifolia</i> <i>B. latifolia</i> , <i>B. butyracca</i> .	50-55% of seeds.	In soap, candle and chocolate industries.	<i>B. longifolia</i> in Madras and Hyderabad; <i>B. latifolia</i> in Central Provinces, Bengal and Western India; and <i>B. butyracca</i> in Northern India.
3	Pongam oil.	<i>Pongamia glabra</i>	27% of seeds.	For medicinal and illuminating purposes.	Malabar and Mysore.
4	Margosa oil. (Neem oil)	<i>Melia azadirachta</i>	23-30% seeds.	In medicine (anthelmintic and anti-septic) and soap-making.	Malabar, certain parts of Deccan, Bengal and Burma.

No.	Name of Oil	Botanical Name	Percentage of oil contents	Uses	Tracts where found
5	Mustard oil.	<i>Sinapis nigra</i>	31-33% of seeds.	As an edible oil and in soap-making.	Bengal, Assam, United Provinces, the Punjab and Sind.
6	Castor oil.	<i>Ricinus communis</i>	46-53% of seeds.	In medicine, soap-making, as a lubricant and for burning purposes.	Madras Presidency (particularly the Ceded Districts), Hyderabad, Bombay and Central Provinces.
7	Maroti oil.	<i>Hydnocarpus wightiana</i>	22 to 30% of seeds.	Soap-making and medicinal (for skin diseases).	Western Ghats.
8	Cashew rind oil.	<i>Anacardium occidentale</i>	35-40% of rind.	For preserving carved wood-work books, etc., against insects and white ants.	In the coastal districts of India.
9	Kojum Butter.	<i>Garcinia indica</i>	...	Edible, soap-making and medicinal purposes.	Southern districts of Bombay Presidency, and in the forests of Konkan, Kanara and Coorg.
10	Coconut oil.	<i>Cocos nucifera</i>	63-65% of dried kernel (copra)	An edible oil, illuminant and for soap-making.	Ceylon, the Malabar and Coromandel coasts, Bengal and Burma.
11	Groundnut oil.	<i>Arachis hypogaea</i>	42-44% of the decorticated seeds.	For edible purposes, illumination and soap-making.	Bombay Presidency and the Central districts of Madras Presidency.
12	Sesame oil.	<i>Sesamum indicum</i>	44-50% of seeds.	Do.	Grown generally throughout India, but chiefly in Bombay, Madras, Central Provinces and Burma.
13	Punna oil (Alexandrian Laurel).	<i>Calophyllum inophyllum</i>	50-53% of kernel	In medicine (for rheumatism) for illumination and soap-making.	Western Ghats. Orissa, Ceylon and Burma.
14	Macassar oil (Kusum or Poovath).	<i>Schleichera trijuga</i>	42% of seeds.	As an illuminant and in medicinal and toilet preparations.	In dry and deciduous forests of India, Burma and in Chota Nagpur.
15	Ganja seed oil.	<i>Cannabis sativa</i>	15 to 25% of seeds.	For paints, varnish and soap-making and as a lamp oil.	N.-W. Himalayas, Nepal, Simla, Kashmir and Sind.
16	Linseed oil.	<i>Linum usitatissimum</i>	37 to 43% of seeds.	For paints, varnishes and soft soaps and as an edible oil.	Behar, United Provinces, Bengal and Central Provinces.
17	Cottonseed oil.	<i>Gossypium spp.</i>	16 to 24% of seeds.	For edible purposes and for manufacture of soaps and margarine.	Various parts of India, chiefly, Bombay, Central districts of Madras, Bengal and Assam.

Notes and Comments

Japanese Ammonium Sulphate.—The production of Ammonium Sulphate by Japan during the year 1931 is estimated at 100,000 tons. The important works are the Showa Fertiliser Company in Kanose and Turumi, the Sumitomo Company's Works at Niihama and the Mitsui Miiki Works. The Japanese Ammonium Sulphate has a characteristic appearance different from that we usually come across in the South Indian market. The crystals are rather small and of an unusual colour. The Japanese product is making slow but steady entry into the Java market which was entirely in the hands of the British and German producers. The quotations for 1931 and 1932 are, according to a note in *Chemistry and Industry*, ten per cent below those of the European product.

The Origin of Agriculture.—Professor Varilov, President of the Lenin Academy of Agricultural Sciences, contributed a paper embodying the results of his enquiries as to the origin of Agriculture, to the International Congress of the History of Agriculture and Technology, held in London this year. As the result of enquiries carried out from the primary centres in the Old and New Worlds, great stress is laid on Abyssinia, and the Professor concludes that the primary centres are generally in tropical and sub-tropical mountain regions.

Protected Markets.—We learn from a short note in *Nature*, that Sir Eric Geddes, in a pamphlet entitled *Mass Production*, says that a protected home market is essential to enable British manufacturers to compete with foreign mass production. When such is the feeling in England, our economists here are nervous of a small export duty on bones and oil-seeds, so vitally connected with the agriculture and live stock of the country.

A Temporary Deletion.—Owing to very great pressure on our space, we are reluctantly compelled to hold up our 'Correspondence' columns just for this month. We have a number of interesting queries and we request our correspondents to excuse us for the disappointment we are causing them.

A Plea for Popular Education.—We learn from a note in the *Mysore Economic Journal*, that 548 *bona fide* British male workers in full employment, have written essays embodying their views on 'How to restore Britain's Industrial prosperity' and will be adjudicated by Ernest Benn, Sir Francis Goodenough, and Mr. Archibald Crawford, K.C. The essayists made a number of notable suggestions, one of which applies with as much force as and even greater force than, to the agriculture of India as to the industry of Britain. It is the opinion of the writers of the essays, that popular education is lacking in technical and other matters that befit the scholar for an industrial career. If, in an industrially advanced country like Britain, the lack of popular education is felt, how much more should it be in India! The lack of popular agricultural education is one of the causes for the distaste of agriculture to the modern youth.

His Excellency's visit.—Elsewhere, under 'College news and notes' will be found an account of the visit to the College, by His Excellency

October 1931]

Notes and Comments

459

Lt.-Colonel the Right Honourable Sir George Frederick Stanley, P.C., G.C.I.E., G.M.G., the Governor of Madras and Her Excellency Lady Beatrix Stanley. This is the first visit of Their Excellencies to the Agricultural College and Research Institute, and we believe there will be a number of occasions arising in future, when we will have the honour and proud privilege to welcome Their Excellencies when he finds it possible to make a longer stay with us.

The Sri Krishna Rajendra Silver Jubilee Lecture, Mysore.—The Silver Jubilee Lecture, on 'Science and Agriculture' delivered this year by Dr. Leslie Coleman, M.A., Ph.D., C.I.E., Director of Agriculture in Mysore, is pregnant with observations of practical wisdom. The lecture is a masterly survey of the rôle of the several sciences in their application to agriculture, and many of the remarks that Dr. Coleman makes with reference to Mysore, apply with equal force to agriculture in the Madras Presidency. We believe that his lecture, which we have extracted from the *Hindu* elsewhere in this issue, will be read with great interest.

The Suspension of the Gold Standard.—The immediate causes for the break-down of the gold standard in England are said to be that a great deal of the capital invested in London by foreigners had been withdrawn, and this was aggravated by the budget deficits. This made the gold holding of the Bank of England so slender that Government had to take immediate steps to counteract the outflow. But the real and ultimate cause of the break-down is that England had lost her dominant position in the international money market which she enjoyed before the War. Britain's share of the World's trade particularly in coal and cotton textiles gradually began to diminish after the War, other countries which have raw materials nearer home capturing the market. The War and the consequent unsettlement of Europe, and the growth of economic nationalism, trade union activities and the diminishing purchasing power of the agricultural countries, and her slowness of adaptation in a rapidly changing world, have all played a part in bringing about a change in Britain's industrial and commercial supremacy. She had been able to capture only a small share of the prosperous and growing post-War industries like artificial silk, wireless apparatus, motor vehicles, electric requisites and so forth.

The suspension of the gold standard has in many ways relieved the strain on Britain, and British industries will now receive a slight advantage over foreign competitors. But the extent of the advantage will depend on the degree of depreciation of the sterling and on bridging the gap between British and foreign prices. The financial position of Britain is substantially sound and the depreciation of sterling may not last long, and with her vast resources she could still mobilise without much difficulty.

So far as India is concerned, the rupee is now tied to the sterling and not to gold as previously. If the rupee had continued on the gold basis, Indian exchange would have stood in terms of sterling at 21d. or above, which would have further depressed our export trade with England on account of the depreciated sterling. The rupee is now equivalent to less than 16d. and Indian-business is bound to receive an impetus by this. The prices of our export staples jute, cotton, tea, ground-nut, and copra, might rise slightly. The agriculturists would receive a little more for their produce, a thing long overdue. Imports from foreign countries are likely to become slightly dearer and this is likely to help our textile, steel, jute and other industries. By the linking of the rupee to the sterling, British

exports may not become dearer and this is tantamount to a preference to British goods. This principle is being objected to by our business men and politicians alike, who have all been agitating to fix the exchange at 16*d.* to the rupee. It is contended by them that in trying to maintain the 18*d.* ratio for the last four years, India had lost a considerable portion of her gold reserves. According to them if the sterling appreciates again, as it is bound to, the temporary advantage which India has got now might again disappear. But it must be said that India being a debtor country unlike England, the risk of unlinking the rupee from either gold or sterling and allowing it to find its own level would be much greater, moreover India's trade with England represented no inconsiderable portion and it was better to have a stable business for that at least.

The Banking Enquiry Committee Report.—The Banking Enquiry Committee which was appointed at the instance of the European and Indian commercial bodies in India, with Sir Bhupendranath Mitra as Chairman and Sir Purushottamdas Thakurdas as Vice-chairman with twenty-one other members, published their almost unanimous report on the 14th September at Simla. The recommendations are comprehensive and are of a far-reaching nature. Those that are concerned with agriculture are briefly these. They draw the attention of the Provincial Governments to the recommendations of the Royal Commission on Agriculture and of the Provincial Banking Enquiry Committees to examine and to suggest to cultivators the possibilities of agricultural improvement and make the following suggestions.

1. In backward tracts where cultivators are not fitted to exercise the rights of transfer of land and where co-operative credit societies cannot be successful, and also in areas which frequently suffer from defective distribution of rainfall and water-supply, the free availability of facilities under the Agriculturists Loans Act is strongly recommended.
2. The operation of the Agriculturists Loans Act should be generally restricted to the relief of distress.
3. The attention of Government is drawn to the weighty observations made by the Indian Famine Commission, 1901, regarding the policy to be followed by Government in the matter of granting loans under the Agriculturists Loans Act and the Land Improvement Loans Act.
4. The grant of advances under the two Acts should not replace the assistance for famine relief.
5. It is inadvisable to use the co-operative agency to advance loans to non-members on the responsibility of the society for their recovery, and their proper application. There is, however no objection to Government using the co-operative societies as agents for distribution.
6. An extension of the system of advances by Joint-stock banks against precious metals including ornaments is supported.
7. The recommendations of the Bengal Provincial Banking Enquiry Committee in regard to loan offices are generally approved with certain modifications.
8. The appointment of a special officer by the Bengal Government for the first few years at least of the working of the proposed Loan Offices Act in order to supervise and give sympathetic guidance to the loan offices is recommended.

Gleanings

Rice: Cultivation and Treatment.—At this point, a word about manure is appropriate. Heavy cropping occurs, year after year, in British Guiana, without using manure of any description. In Egypt, apart from experimental plot work, the only manurial effect is obtained by sowing *berseem* or clover, among the rice as it comes to maturity. After the rice is harvested, cattle are turned on to the field to graze, and ultimately, the *berseem* roots together with the old rice stubble are ploughed in.

In some of the important rice areas in the United States of America *soya* bean is planted as a green manure: all such leguminous crops are of great value to rice.

Farmyard manure is excellent, but difficult to collect and distribute in countries where millions of acres are under rice; for the same reason, as well as on the score of expense, the application of chemical manures is strictly limited. In any case, the application of artificial manures should only be done in consultation with a soil chemist.

In Japan—as in China—a dressing compounded of green and farmyard manures and village sewage, is almost universally employed, with highly satisfactory results. (By C. E. Douglas in the *Journal of the Imperial College of Agriculture*, Vol. VII, No. 7 Extract. The *Journal of the Mysore Agricultural and Experimental Union*.)

The Necessity of Organic Matter for the Maintenance of an Available supply of Phosphorus in the Soil.—Laboratory and field tests of the Louisiana Experiment station indicate that the greatest problem of the upland soils of the South is of keeping the soil phosphates sufficiently available for the growing of cotton, even with the application of soluble phosphate fertilizers to the soil. It has been found that organic matter is more important from the point of keeping soil phosphates sufficiently soluble for plant growth than from any other point or points. With the depletion of organic matter, the soil phosphates as well as those added, become less and less effective. The benefits ascribed to organic matter in the literature are indeed very important, but the rôle of the organic matter in keeping the soil phosphates sufficiently soluble for plant growth overshadows them all.

The problem of keeping the soils of the South in a high state of fertility is one that requires a programme of farming that embodies the practice of green-manuring in combination with the applications of the required plant-foods. In soils depleted of organic matter, even heavy applications of soluble phosphates do not have the desired effect. It is only with very heavy applications that a sufficiently high level of available phosphorus is maintained. In soils low in organic matter and high in the sesqui-oxides, the solubility of the phosphates is too low for the maximum growth of plants. It has been suggested that the soluble phosphates be applied in narrow bands to avoid immediate complete reversion, and this practice has given promising results. However, there are still some undesirable

features to be worked out in such a practice. The less soluble phosphates, as precipitated tricalcium phosphates, have been suggested, owing to their slower rate of reversion. From a theoretical consideration they should give some promise.

It appears that the full fertilizer value of mineral nitrogen and potassium fertilizers can be obtained in the absence of organic matter, more nearly so than with phosphorus.

In this connection it is of interest that the successful production of bananas is closely associated with available supply of phosphorus. Bennet's suggestion of pH is only correct in as far as the desirable pH is incidental to a high available supply of phosphorus.

The problem of the South and the Tropics of maintaining the fertility of their soils is one of maintaining a high amount of available phosphorus. The incorporation of organic matter is highly important with a judicious application of mineral plant-foods. In other words, the partial and sometimes complete failure of fertilizer, particularly superphosphate, is usually due to lack of organic matter in the soil.—(*Science, August 1931.*)

FARMING CALENDAR, COIMBATORE DISTRICT

November–December. (Karthigai)

The full moon day of the month of Karthigai is a day of rejoicing. South Indian homes are lit up with beautiful rows of lights; the full moon shines in all her splendour. This day falls on or about the 15th of Karthigai, that is, towards the end of November, after which the North-East monsoon current practically stops. Hence the proverb,

‘கார்த்திகைக்கப்பால் மழையுமில்லை
கண்ணனக்கப்பால் கொடையுமில்லை’

‘There is no rain after Karthigai and no donor after Karna’

(The word ‘Karthigai’ here refers to the lunar mansion ‘Karthigai’ which the full moon occupies in this month.)

The rains of this month are usually heavy as the proverb ‘கார்த்திகை கனமழை’ (Heavy rains in Karthigai) explains. These rains are very helpful in hastening the appearance of the earheads of the different cereal crops which practically finish their vegetative growth during this period.

‘Even the grass amongst the rocks will bear grains in the rains of Karthigai’

One is tempted to ask here whether the practice of having the frontage of houses lit up not only on the full moon day mentioned above but also on all evenings of this month has not an agricultural significance. At the earing time of crops all around the villages, the lights may serve as light-traps to attract the various insects that attack the crops.

The rainfall for the month is 5 to 6 inches,

A few late sowings of Bengal gram and wheat may take place. Small plots in gardens here and there are sown to Panivaragu (*Panicum Miliaceum*).

Field operations consist of intercultivations of growing crops during intervals of dry spell. Dry cotton is weeded and hoed. Early-planted tobacco receives good cultivation, and advanced plants are topped and suckered to encourage leaf development.

All the dry cereals are up in ears and young boys howl about beating trumpets to scare away birds in cholam fields.

Betel vines are planted in this month. Sugarcane planted in *Adi* (July–August) receive final earthing up; drains and trenches are dug for this crop.

Plantain fields are trenched and manured. Round about Coimbatore, tannery refuse is preferred as a good manure for plantain.

Paddy continues to grow well and in general will be in shot blade and in ears. Some of the early varieties are fast ripening.

Cattle get abundant grazing from this month onwards and improve in condition and appearance; young stock are specially prepared for the various cattle markets in the coming dry-weather months.

The grain stock with the ryots becomes almost depleted. Generally the prices of food grains rule rather high, to be immediately followed by a drop at harvest time.

College News and Notes

Students' Corner.—Athletic activities were at an ebb during September which marked the end of the Cricket season, on account of the closing of the College for the Michaelmas vacation. Most of the students went home, but a few especially of the third year, and from the Telugu districts stayed on at the Hostel. The College reopened on 1st October, after Michaelmas, but the third year students left immediately on tour to the West coast, in charge of Mr. V. Muthusami Iyer, DIP. AGRI., AG. Lecturer in Agriculture and Mr. E. Kunhappa Nambiar, L. AG., Assistant Lecturer in Agriculture. After visiting Pattambi, Taliparamba and Kasargod, the party returned on the 10th, after a busy and instructive trip. Now that the College is again in full swing, vigorous hockey practice is going on, in view of the tournament coming on very soon.

His Excellency's Visit.—On the afternoon of the 13th October, His Excellency Sir George Frederick Stanley, P.C., G.C.I.R., C.M.G., the Governor of Madras, accompanied by Lady Beatrix Stanley, Miss Barbara Stanley and Personal Staff visited the College and the Research Institute. His Excellency was given a ‘posse of welcome’ at the College entrance by the Estate Boy Scouts. Rao Bahadur D. Ananda Rao, Headquarters Deputy Director of Agriculture in charge, and Mr. C. Tadulinga Mudaliar, the Principal of the College, received the distinguished guests and conducted them to the main hall where gazetted officers attached to the Institute were introduced

to Their Excellencies. After signing the visitors' book, they went round the various sections spending about ten minutes at each place, and were deeply interested in all that they saw. They then crossed over to the Freeman Building where after an introduction to the lecturers, they were met by Mr. C. Tadulinga Mudaliar, at tea to which officers at the College and from Coimbatore, as well as important non-officials of Coimbatore, had been invited. After tea, His Excellency motored over to visit the Hostel, the Dairy and the Dairy-herd, and a very busy day ended with an inspection of the Central Farm and of the Students of the Class I at work on the Farmyard. After three hearty cheers lustily responded to by the students, Their Excellencies left late in the evening.

Mr. S. H. Slater, Collector of Coimbatore, and Mr. J. Elliott, District Superintendent of Police, accompanied His Excellency.

Boy Scouts.—The Estate Boy Scouts went on a whole-day excursion to Vedapatti on Sunday, the 27th September. They attended a Scout rally at the Coronation Parks, Coimbatore, on 12th September, when the Scouts of Coimbatore gave a 'posse of welcome' to His Excellency the Governor of Madras, on the occasion of the S.P.C.A. Show.

Visitors.—We had quite a number of visitors during the month September-October. Mr. M. Rathnaswamy and Khan Bahadur Bazlullah Sahib, Members of the Public Services Commission, were here from 10th to 12th September in connection with the selection of Sub-Inspectors of Police, Western Range. Mr. K. J. V. Naidu, the Rajah of Kangundi, Honorary Visitor to the College, visited us on the 21st, Dr. B. Sundara Raj, Director of Fisheries, on the 22nd, Rao Bahadur A. Pillai, Senior Assistant Auditor, M. S. M. Railway, on the 24th. Mr. T. Murari, Superintendent-in-charge, Live-stock Research Station, Hosur, was here on an official inspection during the third week of September. Mr. C. K. Krishnaswami Pillai, Professor of Geology, Presidency College, was here to provisionally select students for a later selection, at Madras, of the cricket team to represent the Madras University against the Aligarh University. Coimbatore was one of the centres of selection, and students from Mangalore College, the Coimbatore College, and the Salem College were here, and with the students of the Agriculture College, took part in a trial game arranged on the 22nd. We understand that W. Patnaik, student, III year B. Sc., is one of those provisionally selected at Coimbatore, and we shall be watching his performances at Madras and elsewhere with interest.

Mr. P. V. Isaac, Imperial Dipterist, Pusa, camped here for a fortnight from 24th September.

The Officers' Club Day.—The Club Day was celebrated with great *clat* on the 24th October accompanied, as usual, by sports, dinner, entertainments and speeches.

Weather Review

SEPTEMBER 1931

RAINFALL DATA

Division	Station	Total for month	Departure from normal	Total since January 1st	Division	Station	Total for month	Departure from normal	Total since January 1st
Circars ...	Gopalpore ...	5.6	- 1.7	14.6	South ...	Negapatam..	1.3	- 2.4	16.7
	Vizagapatam..	5.4	- 1.4	17.5		Madura ...	2.2	- 2.5	9.7
	Cocanada ...	9.8	+ 3.8	31.5		Pamban ...	0.3	- 1.4	2.7
	Masulipatam	7.2	+ 0.9	23.7		Palamcottah.	nil	- 1.2	1.4
Ceded Districts.	Karnool ...	5.5	- 0.6	18.1	West Coast	Trivandrum.	4.2	+ 0.1	47.8
	Bellary ...	4.3	- 0.6	8.7		Cochin ...	5.9	- 3.3	120.2
	Anantapur ...	5.9	...	11.1		Calicut ...	8.1	- 0.3	120.7
	Cuddapah ...	4.2	- 2.5	14.2		Mangalore ...	11.1	- 0.1	142.8
Carnatic...	Nellore ...	4.6	+ 0.3	14.8	Mysore and Coorg ...	Bangalore ...	9.6	+ 2.7	20.1
	Madras ...	8.5	+ 3.7	24.8		Mercara ...	15.2	+ 4.2	126.3
	Cuddalore ...	1.4	- 4.2	19.1					
Central ...	Vellore ...	8.8	+ 1.8	28.7	Hills ...	Kodaikanal..	6.7	- 0.1	37.1
	Salem ...	4.6	- 2.0	21.1		Coonoor ...	4.6	- 0.2	21.4
	Coimbatore Town ...	1.5	...	12.2					
	Coimbatore Res. Inst. ...	1.0	- 1.0	7.9					
	Trichinopoly.	10.8	5.9	25.9					

Summary of general weather conditions:—

Weather was unsettled almost throughout the month over the presidency, and conditions during the first half of the month were of the transitional type. The depression at the end of last month crossed the Orissa coast on the 1st and thereafter failed to affect weather over the reporting area. From about the 6th, thunderstorms appeared in the south and widespread rainfall occurred over the area stretching westward from the Coromandel coast. These unsettled conditions failed to concentrate into a depression but after concentrating rainfall on the North Madras coast passed inland as a wave of low pressure on the 20th and caused extensive rainfall in north Deccan and finally disappeared over the Central Provinces on the 24th. Conditions again became unsettled in the centre of the Bay on the 21st and a depression formed at 18° N. and 88° E. on the 22nd and drifting slowly westwards crossed in a very feeble state near Vizagapatam on the 26th and on the 28th lay as a diffuse 'Low' over west Central Provinces. The

depression was feeble in character throughout its passage and gave rise to widespread but light rainfall in the vicinity of its track.

Rainfall was general and moderate in quantity over practically the whole of the area. It was above normal on the Coromandel coast, Mysore, and locally in the Central districts and in slight defect elsewhere. The notable falls of rain were Cocanada 3.7" (19th), Calicut 4.1" (11th), and Madras 3.4" (17th).

Weather was generally cloudy and cool over the greater part of the presidency. At the beginning of the month, day temperatures were high and Nellore and Cuddalore recorded maxima of 100°. During the period of widespread rain in the Deccan, temperatures were markedly below normal.

Weather Report for the Research Institute Observatory:—

Absolute Maximum in shade	...	...	93.0
Absolute minimum in shade	...	...	66.5
Mean maximum in shade	...	...	90.2
Mean minimum in shade	...	...	70.7
Total rainfall	...	...	0.96 inches
Heaviest fall in 24 hrs.	...	...	0.28 "
Number of rainy days	...	...	2
Mean rainfall for September	...	...	1.97 "
Departure from normal	...	...	- 1.01 "
Mean daily wind velocity	...	...	3.9 M.P.H.
Mean 8 hours wind velocity	...	...	2.2 "
Mean humidity	...	...	73.9 %
Total hours of bright sunshine	...	...	259.5
Mean daily hours of sunshine	...	...	8.65

Summary of weather conditions:—

Weather was fine for the first week with clear skies. Thunderstorms appeared during the second week and though rainfall was light it was widespread and heavy in the vicinity. Weather continued unsettled till about the 15th when south winds began to blow and continued till the end of the month, weather was thereafter dry with warm days and cool nights.

Rainfall totalled 0.96 inch and was 1.01 inch below the mean, this rain fell during the second week of the month associated with thunderstorms.

P. V. R.
B. S. N.

Departmental Notifications

I Circle.—K. Suryanarayana, A.A.D., Anakapalle, l.a.p. for 15 days from 10-10-31. Mr. Ramamurthi, Farm Manager, l.a.p. for one month from 7-9-31. *III Circle.*—K. T. Bhandary has been posted to Hospet on return from leave. P. V. Subba Rao, A.A.D., Nandyal, l.a.p. for 15 days from 6-9-31. N. Annasami, A.D., Kadiri, extension of leave on average pay for two months on medical certificate in continuation of the leave already granted to him. *IV Circle.*—Mr. Narayana Iyer, A.D., extension of leave on average pay on medical certificate for two months from 2-10-31. *VI Circle.*—A. M. Muthiah Nattar, extension of l.a.p. for 16 days from 15-9-31. *VIII Circle.*—V. Satagopan, A.D., Coimbatore, l.a.p. for two months from 28-9-31. *G.M.'s Section.*—D. Marudarajan, Assistant, extension of leave l.a.p. for one month from 17-9-31. *O.S.S. Section.*—A. P. Balakrishnan Nair, Farm Manager, Pillicode, joined duty on 16-9-31. *Livestock Section.*—K. H. Subramanya Iyer, Farm Manager, l.a.p. for 13 days from 1-9-31. N. K. Thomas, Upper Subordinate, Temporary, services terminated from 1-10-31 for not having passed the Accounts test.

LATEST NOTIFICATION

Mr. D. Balakrishna Murti, Deputy Director of Agriculture, II Circle, is granted leave for 2 months and 5 days preparatory to retirement with effect from 11-10-31. *III Circle.*—Mr. K. T. Bhandary, Upper Subordinate, extension of l.a.p. for 15 days. *VII Circle.*—S. Krishna Naik, A.D., Moodbidri, l.a.p. for 1 month from 15-10-31. *I Circle.*—V. Thirumal Rao, Ent. Assistant, Berhampur, l.a.p. for 1 month from date of relief. *VIII Circle.*—K. Sivasankara Menon, A.D., Dharmapuri, l.a.p. for 1 month from 20-10-31. *G.E.'s Section.*—C. Ranganatha Mudaliar, Artist, extension of l.a.p. for 1 month. *G.A.C.'s Section.*—T. Varahalu, Assistant, l.a.p. for 6 days from 21-9-31.

D.A.'s Office orders.—D. Panakala Rao, A.D., Ramachandrapur, transferred to the II Circle, to report himself for duty to the D.D. II Circle. G. Sitarama Sastry, F.M., A.R.S., Guntur, to I Circle, to report himself for duty to D.A.O., Rajahmundry.

Rao Sahib Y. Ramachandra Rao, Deputy Locust Entomologist, under the Imperial Council of Agricultural Research, on reversion, to be Government Entomologist, Coimbatore. Dr. T. V. Ramakrishna Ayyar, Ag. Government Entomologist, to be Lecturer in Entomology, Agricultural College. Mr. M. C. Cherian, Ag. Lecturer in Entomology, to be Assistant Government Entomologist.

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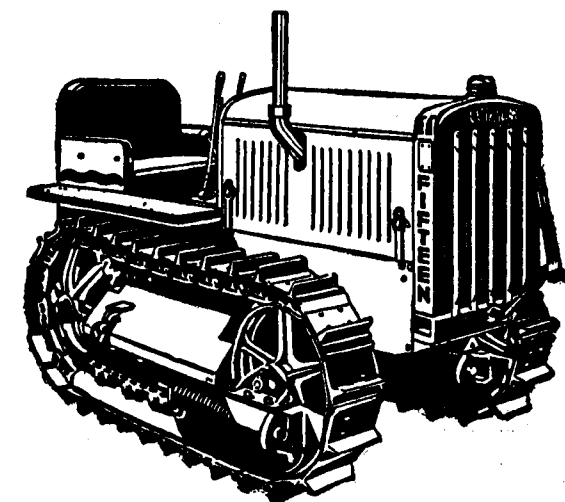
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4. Estimates of Area and Yield of Principal Crops in India. 1929-30
5. Livestock Statistics—India ...
6. British India Agricultural Statistics ... 1928-29 *I.T.J. Supplement.*
7. Do. do. ... 1929-30
8. Review of Sugar trade in India during ...
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10. Report of the Nagpur Agricultural College (C.P. and Berar). 1929-30
11. Annual Report of the National Institute of Agricultural Botany (England). 1927-28
12. Do. do. ... 1928-29
13. Do. do. ... 1929-30
14. Report of the 2nd Agricultural Conference (S.S. and F.M.S.). 1930
15. Report: Livestock Diseases—New South Wales Agricultural Department. 1929-30

C. BULLETINS, MEMOIRS, Etc.

16. Grass Farming in Coimbatore (Madras Agricultural Department). *Bulletin No. 23*
17. Agricultural Research and Demonstration in the Dutch East Indies. *Mysore Agricultural Department Bulletin No. 14*
18. The Improvement of Coffee in the Dutch East Indies. ... 15
19. Report on the Coffee Berry Borer in Java ... 16
20. Dynamometer tests and the efficiency of some improved ploughs. *U.P. Agricultural Bulletin No. 54*
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24. Two Citrus fruit borers and the Green scale of coffee ... 7

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 26. Cotton trials at the Irrigation Experimental Orchard, Berri, 1921-22. ... 169
 27. Fertilizers and Soil Amendments ... 182
 28. Smyrna fig culture ... 186
 29. Notes on manuring fruit trees and vines in irrigated areas. ... 216
 30. Fruit growing ... 219
 31. The Almond in South Australia ... 220
 32. Cement concrete posts for fencing ... 225
 33. The control of drifting sand... ... 229
 34. The Agricultural Bureau of South Australia ... 230
 35. Citrus culture in South Australia ... 233
 36. Common pests and diseases of fruit trees and vines with methods of prevention. ... 234
 37. Potatoes ... 235
 38. Fallowing and Cultivation methods for sandy soils. ... 236
 39. Pasture work and management ... 242
 40. Some popular farming fallacies ... 244
 41. Fruit production in the Union ... *Union of South Africa Bulletin No. 100*
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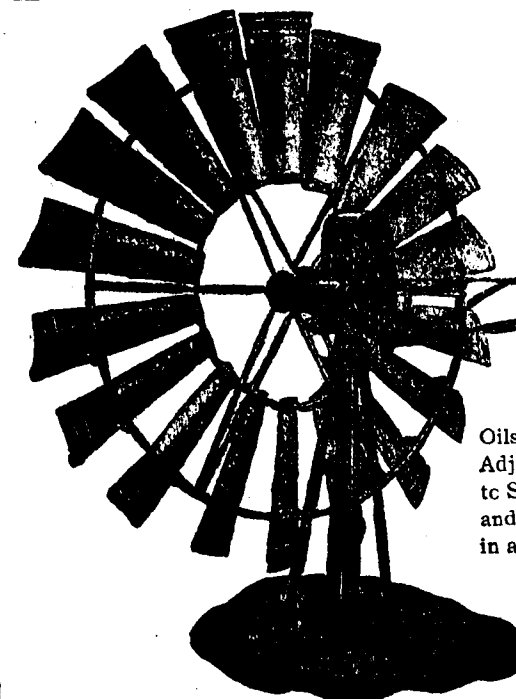
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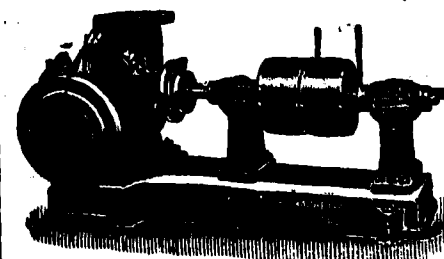
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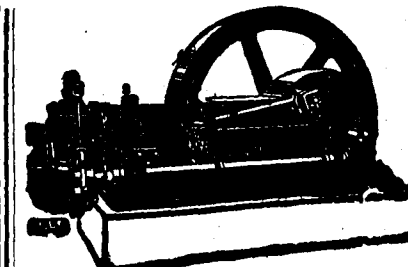


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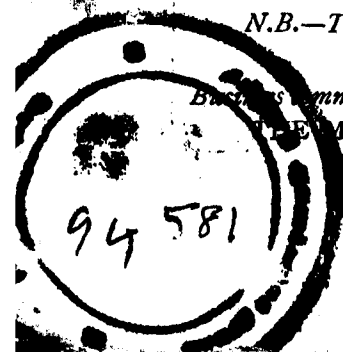
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